Sharing the Pain? Credit Supply and Real Effects of Bank Bail-ins*

Thorsten Beck
Cass Business School
CEPR, and CESifo

Samuel Da-Rocha-Lopes
European Banking Authority
and Nova SBE

André F. Silva
Federal Reserve
Board

September 2019

Abstract. We analyze the credit supply and real effects of bank bail-ins by exploiting the unexpected failure and subsequent resolution of a major Portuguese bank. Using matched firm-bank data on credit exposures and interest rates, we show that banks more exposed to the bail-in significantly reduced credit supply and tightened credit conditions at the intensive margin. While affected firms were on average able to compensate the reduction in overall credit, SMEs experienced a binding contraction of funds available through credit lines. Those with lower ex-ante internal liquidity responded to this shock by increasing precautionary cash holdings and reducing investment and employment. (JEL G01, G21, G28, G38)

*We thank our discussants Marco Bonomo, Charles Calomiris, Duckki Cho, Matteo Crosignani, Ralph De Haas, Hans Degryse, Yuliya Demyanyk, José Maria Liberti, Cathérine Koch, Fergal McCann, Judson Murchie, Diane Pierret, Alberto Pozzolo, Lev Ratnovski, João Santos, Klaus Schaeck, Daniel Streitz, and Wensi Xie for their extremely helpful comments. We are also grateful to Tobias Berg, Allen Berger, Diana Bonfim, Max Bruche, João Cocco, Francesca Cornelli, Giovanni Dell'Ariccia, Mathias Dewatripont, Daniel Dias, Mariassunta Giannetti, Piers Haben, Daniel McCarthy, Ralf Meisenzahl, Camelia Minoiu, Steven Ongena, Sole Martinez Peria, Marco Pagano, Andrea Presbitero, Enrico Sette, Paolo Volpin, Spyridon Zarkos, as well as conference and seminar participants at the 2018 Sapienza/BAFFI CAREFIN/RFS Conference (Italy), 45th EFA Annual Meeting (Poland), 2018 FIRS Conference (Spain), 2019 Federal Reserve Day-Ahead Conference (US), Columbia University/BPI 2019 Bank Research Conference (US), Basel Committee on Banking Supervision/CEPR Workshop (Switzerland), 2018 AFA PhD Poster Session (US), 11th Swiss Winter Conference on Financial Intermediation (Switzerland), ABFER/CEPR/CUHK First Annual Symposium in Financial Economics (Hong Kong), 2nd CEPR Annual Spring Symposium in Financial Economics (UK), De Nederlandsche Bank/EBC/CEPR Conference (Netherlands), 5th Emerging Scholars in Banking and Finance Conference (UK), Columbia Business School (US), IMF (US), 32nd EEA Conference (Portugal), 4th Bank of Canada/Bank of Spain Workshop (Canada), Single Resolution Board (Belgium), 9th European Banking Center Network Conference (UK), Deutsche Bundesbank/IWH/CEPR Conference (Germany), BI Norwegian (Norway), Bank of Italy (Italy), 4th EFI Research Network Workshop (Belgium), Sydney Banking and Financial Stability Conference 2017 (Australia), Universidad Carlos III de Madrid (Spain), 2018 Fixed Income and Financial Institutions Conference (US), Bank of England (UK), University of Bonn (Germany), 2018 Luso-Brazilian Finance Meeting (Brazil), and 17th CREDIT Conference (Italy) for the valuable suggestions. We also thank Adelaide Cavaleiro, Graça Damião, Olga Monteiro, Paulo Jesus, Paulo Taborda, Sandra Pinheiro, and the Department of Statistics of the Bank of Portugal for providing excellent research support. To the memory of Samuel's beloved mother, Filomena Da-Rocha. The views expressed in this paper are solely those of the authors and do not necessarily represent the opinions of the European Banking Authority or the Eurosystem, or those of the Board of Governors of the Federal Reserve System or other members of its staff. Send correspondence to André F. Silva, 20th Street and Constitution Avenue N.W., Washington, D.C., 20551. Email: andre.f.silva@frb.gov

1 Introduction

The recent financial crisis highlighted the pressing need for a robust mechanism to resolve distressed banks. In the absence of a viable alternative to insolvency which could lead to contagion and a credit crunch, policymakers around the world opted to bail-out financial institutions using public funds. In Europe, for instance, taxpayers have covered more than two-thirds of the cost of recapitalizing and resolving banks (Philippon and Salord, 2017). These interventions were often accompanied by significant government losses and austerity programs associated with political frictions and distributional problems. To counter this pervasive issue, most developed economies recently introduced formal resolution mechanisms featuring bank bail-ins that involve the participation of shareholders and creditors in bearing the costs of restoring distressed banks and include severe restrictions on taxpayer support.

An effective bank resolution framework should balance the benefits of imposing market discipline with the potential costs that an intervention might have for credit supply and the real economy (Beck, 2011).[1] Lambrecht and Tse (2019), for instance, show theoretically that while bank bail-ins reduce managerial risk-taking and improve loan quality and banks' capital ratios relative to bail-outs, they also lead to lower levels of credit provision and value created net of recapitalization costs.[2] This trade-off is explained by government guarantees that subsidize the cost of borrowing and artificially boost loan issuance and overall growth in a bail-out regime. However, despite these theoretical predictions, there is little to no empirical evidence on the effects this new bank resolution mechanism might have on credit supply and economic activity. Our study contributes to filling this gap in the literature by analyzing the effects of the bail-in of a major bank in Portugal using a unique dataset combining firm-bank matched data on credit exposures and interest rates from the Portuguese credit register with balance-sheet information for firms and their lenders.

[1]Previous literature has shown the detrimental impact of public guarantees on bank risk-taking (e.g., Gropp, Hakenes, and Schnabel, 2011; Dam and Koetter, 2012; Silva, 2019) as well as the negative effects of bank failures on real outcomes (e.g., Bernanke, 1983; Calomiris and Mason, 2003; Ashcraft, 2005).

[2]Berger, Himmelberg, Roman, and Tsyplakov (2019) also show that bail-ins provide superior capital incentives for banks relative to bail-outs, while Schäfer, Schnabel, and Weder (2017) find evidence consistent with bail-in events reducing bail-out expectations and thus increasing banks' risk premia.

Specifically, we exploit the unexpected collapse of Banco Espírito Santo (BES) in August 2014 that was coined "one of Europe's biggest financial failures" (FT, 2014). The bank was resolved through a bail-in and split into a duly capitalized "good bank" and a "bad bank", protecting taxpayers and depositors but leaving shareholders and junior bondholders holding the toxic assets. The costs of this intervention were borne not only by the bank's creditors, but also indirectly by other resident banks that had to provide ad-hoc funding to the Portuguese Resolution Fund. Importantly, the bank's collapse was unrelated to fundamental risks in the banking sector or a generalized group of its borrowers. Instead, it was caused by large risky exposures to a limited number of foreign non-financial firms part of the Espírito Santo Group owned by the same family (Economist, 2014). In fact, the Portuguese Central Bank indicated that the losses that led to the bank's failure reflected a "fraudulent funding scheme between the companies belonging to the Group" not subject to its direct supervision, and the "practice of management acts seriously detrimental to the interests of the bank and non-compliance with determinations prohibiting an increase of the exposure to other entities of the Group" (Banco de Portugal, 2014a,b). Thus, from an identification perspective, this shock can be seen as exogenous from the perspective of any given Portuguese firm.

We start the analysis by examining over 115,000 bank-firm lending relationships and using a within-firm difference-in-differences specification comparing changes in credit supply to the same borrower across banks exposed differently to the bail-in i.e., the bailed-in bank itself, other banks that provided ad-hoc financing to the Portuguese Resolution Fund, and banks that were exempt from making additional contributions. By exploiting the widespread presence of Portuguese firms with multiple bank relationships, this approach allows us to control for changes in observable and unobservable firm characteristics such as credit demand, quality, and risk (Khwaja and Mian, 2008).

Comparing lending to the same firm by banks one standard deviation apart in terms of exposure to the bail-in, we find that more exposed banks reduced total committed credit and granted credit lines by 3.0 and 5.7 percent more than banks exposed less, respectively.[3] This credit supply contraction at the intensive margin was more pronounced among large firms and is concentrated on firms whose main lender prior to the shock was the bailed-in bank.[4] Similarly, we find an economically large tightening of credit conditions by banks more exposed to the shock following the resolution, with a one standard deviation increase in bank exposure to the bail-in leading to a 0.40 and 1.54 percentage point increase in interest rates on all new credit operations and granted credit lines for the average firm, respectively, a decrease in loan maturity of 7.51 percent relative to the pre-shock mean and an increase in the share of collateralized credit by 25.8 percentage points.

A fundamental follow-up question is whether more exposed firms could compensate the credit supply tightening and worse credit conditions by accessing funds from other banks less affected by the shock.[5] Importantly, following Abowd, Kramarz, and Margolis (1999) and Cingano, Manaresi, and Sette (2016), we are still able to control for credit demand in the cross-section of firms by including in the regressions the vector of estimated firm-level fixed effects from the Khwaja and Mian (2008) within-firm specification.

We find at the cross-sectional level that firms more exposed to the bail-in did not suffer a reduction of overall credit after the intervention when compared to less exposed firms. In fact, the average firm was able to compensate the reduction of total committed credit at the intensive margin with borrowing from other less exposed financial institutions with which it already had a relationship. However, when isolating granted credit lines from total credit and focusing on firms with credit lines at multiple banks, we show that SMEs more exposed to the resolution experienced a binding contraction in the quantity of funds available through lines

[3]Total committed credit between a bank and a firm refers to all types of drawn and undrawn credit, while granted credit lines includes only the amount committed on revolving credit lines. In line with the existing literature, we consider granted instead of drawn credit throughout since the latter is likely driven by firm demand for credit e.g., firms actively choose to draw down credit lines, particularly in stress periods.

[4]We confirm our findings when using the complete sample of borrowing firms in Portugal in a model that replaces firm fixed-effects with industry-location-size fixed-effects for single-bank-relationship firms following Degryse, De Jonghe, Jakovljević, Mulier, and Schepens (2019).

[5]This issue is particularly important in the context of SMEs which usually find it difficult to substitute credit from other sources because they are more opaque and thus mainly rely on existing banking relationships. This is still a source of great concern among academics, regulators, and policy-makers, particularly in Europe.

of credit—an essential component for corporate liquidity management due to their unique role as insurance against future liquidity needs (Sufi, 2009; Jiménez, Lopez, and Saurina, 2009; Berg, Saunders, Steffen, and Streitz, 2017). Specifically, a one standard deviation increase in firm exposure to the bail-in is associated with a 2.2 percent binding decrease in granted credit lines to SMEs. Our cross-sectional results also show that the resolution came at the cost of modestly worse credit conditions for more exposed firms.

Finally, we also find evidence of a negative adjustment of investment and employment policies at SMEs borrowing from more exposed banks. This effect is again economically significant, with a one standard deviation increase in firm exposure to the shock leading to a relative drop in investment and employment at SMEs of up to 2.0 and 1.5 percent, respectively. These adverse effects of the bank resolution on real sector outcomes are driven by a response to increased liquidity risk by firms with lower ex-ante internal liquidity. Consistent with the argument that firms' option to access credit lines should be more valuable when internal liquidity is scarce (e.g., Campello, Giambona, Graham, and Harvey, 2011), we find that the negative real effects are concentrated among less liquid SMEs more exposed to the resolution that responded to the shock by increasing cash holdings while decreasing investment and employment.[6] Instead, in line with precautionary cash savings being important in times of dislocation in markets for external finance (e.g., Duchin, Ozbas, and Sensoy, 2010), more exposed SMEs with high liquidity before the bail-in were able to use their available internal cash holdings to compensate for the binding contraction in granted credit lines and thus maintain steady levels of employment and investment.[7]

The contribution of this paper is twofold. First, we contribute to the literature on financial intermediation examining how distressed banks should be resolved. Kahn and

[6] This result is consistent with the evidence in Berg (2018) and is not explained by differences in anticipated growth opportunities across SMEs with low and high levels of internal liquidity prior to the bank resolution.

[7] In a separate but related exercise, we gauge whether the bail-out of four Portuguese banks in 2012 resulted in similar negative effects. We find no significant differences between borrowers of bailed-out and non-bailed-out banks in terms of credit supply, investment, or employment. This points to rather sharp differences between the two bank resolution policies, although we caution that unlike the exogenous nature of the bail-in event, the bail-outs of 2012 were arguably endogenous to previous lending decisions and borrowers' performance. In addition, the macroeconomic situation was considerably different during these two episodes and the public intervention in 2012 was more systemic in nature.

Winton (2004) suggest that a "good-bank-bad-bank" split may be beneficial as it reduces risk-shifting incentives in the healthy bank and increases its incentive to screen and monitor the performing loans. More recent work, however, has mostly focused on describing the potential benefits and costs of the different bank resolution mechanisms (e.g., Dewatripont, 2014; Conlon and Cotter, 2014; Avgouleas and Goodhart, 2015; Philippon and Salord, 2017) and examining the interaction between bail-ins and bail-outs from a theoretical perspective (e.g., Klimek, Poledna, Farmer, and Thurner, 2015; Keister and Mitkov, 2018; Colliard and Gromb, 2018; Bernard, Capponi, and Stiglitz, 2018; Walther and White, 2019; Segura and Vicente, 2019; Berger, Himmelberg, Roman, and Tsyplakov, 2019; Lambrecht and Tse, 2019).[8] Our paper contributes to this literature by assessing the effects of a bank bail-in on credit supply and real sector outcomes using detailed bank-, firm- and loan-level data. To the best of our knowledge, this is the first empirical study examining this issue.

Second, our paper contributes to the corporate finance literature on firms' liquidity management, highlighting the "dark side" of precautionary savings in the context of supply driven credit line reduction as well as the importance of firms' internal liquidity for the transmission of credit supply shocks to the real economy. Under the precautionary demand for cash theory firms hold cash as a buffer against adverse cash flow shocks. This can be particularly valuable for firms that are financially constrained (Almeida, Campello, and Weisbach, 2004) and following a credit crunch (Duchin, Ozbas, and Sensoy, 2010). However, Berg (2018) finds that while liquid SMEs are indeed able to absorb credit supply shocks by using existing cash buffers, their illiquid counterparts increase cash holdings when a loan application is rejected, cutting non-cash assets by more than the requested loan amount, and thus investment and employment. While Berg (2018) uses discontinuities in credit scores comparing accepted and rejected loan applicants at a single German bank, we contribute to generalize his findings by using an exogenous bank shock for identification and analyzing the entire banking sector of an economy.

[8]Similarly, Bolton and Oehmke (2019) examine theoretically the impact of the two main resolution models (single and multiple point of entry) on the organization form of global banks.

2 Background

Bank failure and subsequent resolution. Banco Espírito Santo (BES) collapsed and was put into resolution by the Portuguese Central Bank on August 3, 2014. This decision was the result of a rapid series of events including the disclosure of hefty losses of €3.6 billion in the first half of 2014 arising from exposures to Espírito Santo Financial Group (ESFG)—the parent holding company set up outside Portugal to hold investments of the Espírito Santo family, including a 20 percent stake at the bank at the time of the resolution.[9] The bank was at the time of the resolution the third largest financial institution in Portugal, with a market share of 19 percent of credit granted to non-financial corporations and 12 percent of total deposits (Banco de Portugal, 2014b).[10] It was also one of only four financial intermediaries in Portugal classified as a significant credit institution by the European Central Bank (ECB).[11]

The scale of the losses came as a surprise to the Portuguese central bank, which indicated that these reflected a "fraudulent funding scheme between the companies belonging to the Group" not subject to its direct supervision, and the "practice of management acts seriously detrimental to the interests of the bank and non-compliance with determinations prohibiting an increase of the exposure to other entities of the Group" (Banco de Portugal, 2014a,b).

The resolution included the immediate creation and duly capitalization of a bridge bank named Novo Banco that received the sound assets and liabilities of BES such as cash, retail deposits, performing loans, and central bank funding. In contrast, shareholders and junior bondholders were bailed-in and thus left with the toxic assets that led to the mounting losses which remained in a "bad bank" that was liquidated.

[9]While the stake of the family at the bank was held by Luxembourg-based ESFG, this company was in turn owned by Espírito Santo International (ESI)—the Espírito Santo family's ultimate holding entity, also headquartered in Luxembourg. Intertwined into this corporate structure was ES Bank Panama, a subsidiary of ESFG that extended hidden credit lines to ESI-connected companies (FT, 2014).

[10]As an universal bank, both before and after the resolution, the institution provides a diversified range of financial services such as domestic commercial banking to retail, corporate, and institutional clients as well as private banking, international commercial banking, asset management, and insurance.

[11]As a result, the major objectives of the Portuguese authorities when designing this intervention were to (i) safeguard the interests of taxpayers and ensure accountability of the bank's shareholders; (ii) protect depositors—for which, unlike in Cyprus (e.g., Brown, Evangelou, and Stix, 2018), potential losses were completely ruled out; and (iii) preserve financial stability (Banco de Portugal, 2014b).

Importantly, the newly-created bank became fully owned by the Portuguese Resolution Fund that provided the entirety of the €4.9 billion of capital. The financial resources of the Fund do not include public money as it is financed by the initial and periodic contributions of all the country's lenders and the proceeds from a levy over the banking sector (Banco de Portugal, 2014a). However, since the Fund was only established in 2012, it did not yet have enough resources to fully finance such a large operation and, as a result, obtained a loan from a syndicate of eight member banks (€0.7 billion) and another from the Portuguese Government (€3.9 billion). The Portuguese officials ensured that, in contrast with other resolutions adopted in the past in Portugal and the rest of the world, the deal would have no direct or indirect costs for taxpayers. In fact, the loan by the Government was made to the Portuguese Resolution Fund and not to the bank itself, with the country's lenders who bear the risks of the operation having several years to recoup the shortfall with their contributions (Banco de Portugal, 2014a; World Bank, 2016).[12]

Unexpected and idiosyncratic nature of the bank failure. Figure 1 shows that the CDS spreads of the bailed-in bank moved in line with the rest of the banking sector until late June 2014 when the degree of exposures to the holding company owned by the same family started to be revealed. Within a month, the spreads moved from less than 2 percent to almost 7 percent. The event came after a long period of increasing stability in the banking sector, with CDS spreads for Portuguese banks having declined from its crisis peak of around 16 percent in late 2011.[13]

The figure also shows the limited contagion effects of the resolution to the remainder of the banking system, with the average CDS spread of the other local banks considered

[12]The Portuguese Central Bank decided to move even further towards a bail-in type of intervention with a re-resolution in the last days of 2015—16 months after the original intervention. Specifically, a limited number of bonds were transferred to the "bad bank", imposing losses on almost €2 billion of senior bondholders (Banco de Portugal, 2015; FT, 2016). In October 2017, Lone Star Funds (a US private-equity fund) acquired 75 percent of the "good bank" in return for a capital injection of €1 billion, with the remaining 25 percent held by the Portuguese Resolution Fund (Banco de Portugal, 2017). Given that we only have loan and firm-level data available until 2015, our analysis does not consider these two shocks and is instead solely focused on the effects of the original resolution in August 2014.

[13]At the country-level, by the end of EC/ECB/IMF Economic Adjustment Program in June 2014, Portugal was growing 0.3 percent faster than the EU, excluding Germany (Reis, 2015).

significant credit institutions by the ECB increasing only slightly in the weeks leading up to the intervention and remaining below 3.5 percent until the end of 2015. This is consistent with Hüser, Hałaj, Kok, Perales, and van der Kraaij (2018) who, using granular data on the securities cross-holdings among the largest euro area banking groups, show that bail-ins lead to limited spillovers due to low levels of securities cross-holdings in the interbank network and no direct contagion to creditor banks. Similarly, Havemann (2018) shows that the bail-in of a small South African lender financed almost exclusively with wholesale funding had a limited impact on the financial system in terms of contagion. Nevertheless, to be conservative in our analysis, we take into account the exposure of other banks to the bail-in—even if small—through the institution-specific amount of financing to the ad-hoc loan granted to the Portuguese Resolution Fund.

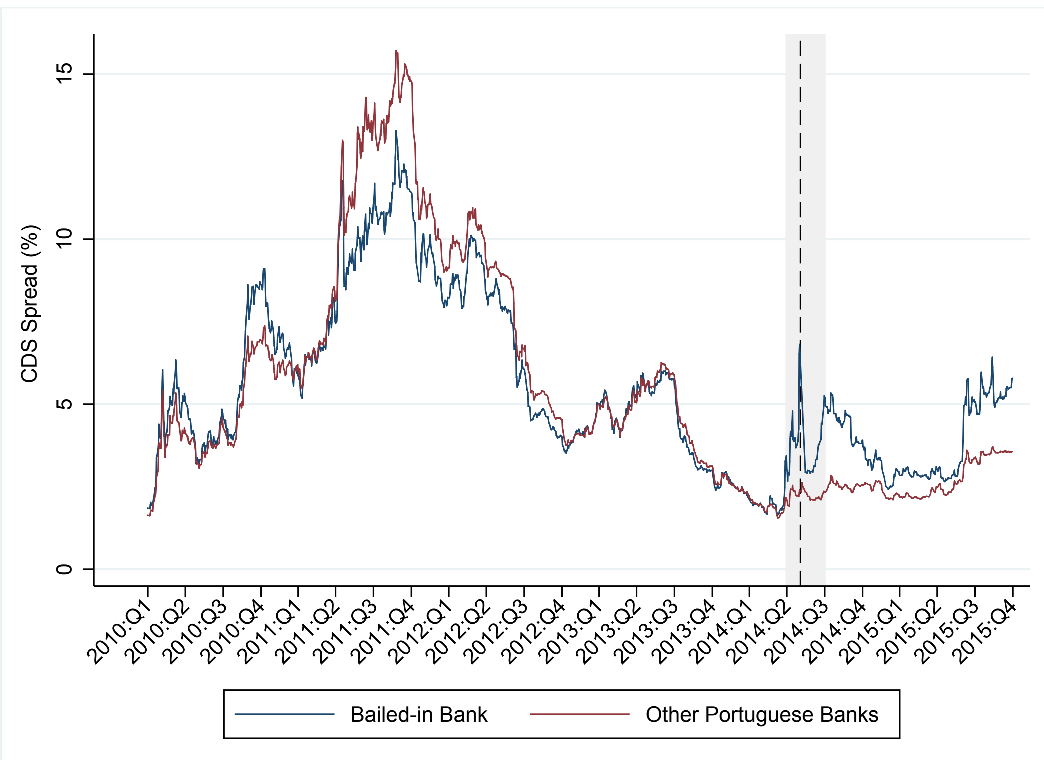

Figure 1: Evolution of bank CDS spreads over time. This figure plots daily 5-year CDS spreads on senior unsecured debt between 2010:Q1 and 2015:Q4. "Bailed-in Bank" refers to BES until August 3, 2014 (i.e., the day of the resolution—vertical dashed line), and the "good bank" (Novo Banco) thereafter. CDS spreads for "Other Portuguese Banks" are computed as the equal-weighted average across banks in Portugal with available information (Caixa Geral de Depósitos, Banco BPI, Banco Millennium BCP). The banks in this figure correspond to the four significant credit institutions operating in Portugal as defined by the ECB. Source: IHS Markit.

Bail-in vs. losses prior to the resolution. A key concern is whether our estimates are driven by the bail-in per se or, instead, by the losses that occurred prior to the resolution. In fact, there is a large literature in different settings showing that banks cut lending after a shock to their net worth that then leads to negative real effects (e.g., Peek and Rosengren, 2000; Puri, Rocholl, and Steffen, 2011; Chodorow-Reich, 2014; Huber, 2018). In our case, however, the bail-in should indeed be the driver of the results because of the division of assets into a "good bank" and "bad bank" that took place at the time of the resolution. Specifically, the shock we study is rather unique since the €3.6 billion of losses and related bad assets associated with risky lending to few non-financial foreign entities of the Espírito Santo Group were fully absorbed by the "bad bank" that was liquidated. In other words, the toxic exposures and respective losses were not passed to the balance sheet of the "good bank" that started operating after the resolution. Thus, we should not expect our results to be driven by the bailed-in bank changing its lending policies after the resolution directly as a result of the losses disclosed a few weeks prior to the intervention.[14]

Similarly, the "good bank" was duly recapitalized during the resolution and had a Tier 1 Capital Ratio of 10.3 percent when it started operating—above the regulatory minimum and in line with capital ratios of other major banks in Portugal and in Europe at the time. In addition, the "good bank" was also not capitalized worse than its pre-shock counterpart, with BES having a Tier 1 Capital Ratio of 10.5 and 10.6 percent in 2012:Q4 and 2013:Q4, respectively. Unlike in the literature exploiting shocks to bank capital requirements (e.g.,

[14]Empirically, the exposures to non-financial entities part of the Espírito Santo Group that generated the hefty losses and drove the collapse of the bank are not part of our estimations since (i) these firms were based abroad and our dataset only captures credit granted to firms headquartered in Portugal, and (ii) given that their credit claims were fully transferred to the "bad bank" that was liquidated, these would not appear in the post-shock period of our difference-in-differences specification even if a firm was based in Portugal. It is also important to note that the other major shareholders and junior bondholders of the bank wiped out during the resolution were also foreign institutions. Besides ESFG—the family-controlled holding company based in Luxembourg and the largest stockholder with a 20 percent stake—the other main shareholders of the bank included Credit Agricole (France) with 15 percent, Silchester International Investors (UK) and BlackRock (US) with 5 percent each, and Capital Research and Management Company (US) and Bradport (fully owned by Banco Bradesco based in Brazil) with 4 percent each (BES, 2014). Similarly, the main holders of junior debt passed to the "bad bank" included Goldman Sachs (US), BES Finance (Cayman Islands), BTG Pactual (Brazil), GoldenTree Asset Management (US), New Zealand Superannuation Fund (New Zealand), and Silver Point (Mauritius) (Expresso, 2019).

Aiyar, Calomiris, Hooley, Korniyenko, and Wieladek, 2014a; Aiyar, Calomiris, and Wieladek, 2014b; Jiménez, Ongena, Peydró, and Saurina, 2017; Gropp, Mosk, Ongena, and Wix, 2019), there were also no changes in the regulatory framework that affected the bail-in bank differently than other banks in Portugal during the period we analyse. Thus, given the evidence on the effects of different bank interventions (e.g., Giannetti and Simonov, 2013; Augusto and Félix, 2014) and that the capital injection was large enough to re-establish bank capital requirements, we should also not expect our results to be driven by the bailed-in bank changing its lending policies after the resolution due to a lack of sufficient capital.

Bail-in vs. bail-out. The bank bail-in we analyze differs markedly from the taxpayer-funded bail-outs of distressed banks around the world, including in Portugal, following the 2007–2009 financial crisis. Given that the resolution imposed the losses on shareholders and creditors, this holds even when being overly conservative and considering this intervention a potential hybrid of bail-in and bail-out (Economist, 2014).

Compared to a bail-out, a bail-in is also part of a stricter and broader restructuring process that not just wipes out shareholders and creditors—thus changing a bank's ownership structure—but that also replaces managers and thus alters the bank's governance structure. The fact that the resolution authority in a bail-in has the legal power to replace the failing bank's management team is key since it changes substantially the risk-taking incentives of the bank following the resolution. In addition, the new resolution framework also requires the newly-appointed managers to engage in an extensive reorganization plan to address the bank's structural weaknesses and restore its long-term viability. The basis for the reorganization strategy should be the factors that caused the entry of the bank into resolution, and include withdrawal from loss-making activities and stronger risk management framework, capital, and liquidity planning. Together, we should expect a distressed bank to be considerably more prudent moving forward if it is resolved through a bail-in rather than a government bail-out.

In fact, free of the riskiest exposures and associated losses which were passed to the "bad bank" and following these statutory powers in the new resolution regime, the "good bank" broke with the former legacy by implementing a more sustainable lending policy.[15] This included the reduction and non-renewal of credit lines as well as a decrease in its credit exposure to large firms, with any new large loan requiring extensive review and risk committee board approval (Novo Banco, 2014). The latter is particularly important since, as Berg (2015) shows, the involvement of risk managers in the loan origination process can reduce default rates by more than 50%. The bailed-in bank's strategy to manage its capital and liquidity positions prudently by deleveraging non-core assets from the loan portfolio and optimizing risk-weighted assets led to an 18 percent reduction of its balance sheet from the day of the resolution until the end of 2015 (Novo Banco, 2015).

Importantly, while this intervention occurred before transposition of the Bank Recovery and Resolution Directive (BRRD) into national legislation, the Portuguese resolution regime then in force was already, in substance, very similar to the final European regulation (World Bank, 2016). Unlike in a bail-out, this included the automatic suspension of the members of the bank's Board of Directors and the Board of Auditors, with the new members of the management bodies appointed by the Portuguese Central Bank, which also approved the statutes, strategy, and risk profile of the newly-created institution.[16]

Overall, this shock, widely considered as one of the most prominent cases of a bank bail-in to date worldwide (World Bank, 2016; Philippon and Salord, 2017; IMF, 2018), arguably provides a unique laboratory to shed light on the potential effects of future similar resolutions.

[15] The detailed list of assets, liabilities, and off-balance-sheet items transferred to the "bad bank" beyond the exposures to the family-controlled parent Group is available in Annex 2 of Banco de Portugal (2014b).

[16] The EU and the US strengthened their bank resolution regimes and introduced bail-in powers via the BRRD and the Dodd-Frank Act, respectively. Despite many similarities between the EU and US resolution schemes (e.g., removal of the management team of the failing financial institution), there are still some differences such the lack of a restructuring option in the US (Philippon and Salord, 2017).

3 Identification Strategy

We investigate the credit supply and real effects of a bank bail-in in two steps. First, we assess whether the resolution induced significant changes in the supply of credit to firms from banks that were differently exposed to the shock (within-firm analysis). Second, we investigate whether more affected firms were able to substitute funding from other (less exposed) banks, if they were able to obtain similar credit conditions—i.e., interest rates, maturity, and collateral—as well as the consequences of the resolution for investment and employment (cross-sectional analysis). The first part of the analysis uses firm-bank matched data to exploit variation within firms that have more than one lending relationship, while the second makes use of variation across firms with different pre-shock exposures to the bail-in.

Within-Firm Analysis. The main challenge of our empirical analysis is to identify the causal impact of bail-ins on credit supply, price conditions, and real outcomes. In fact, this shock may be correlated with underlying changes in the overall economic situation that may affect both credit provision and firms' demand for credit. To address this identification issue, we exploit an exogenous shock in August 2014 corresponding to an unexpected bank failure and subsequent resolution, and use a difference-in-differences approach to compare lending before and after the shock across banks more and less exposed to the shock.

Specifically, following the novel approach of Khwaja and Mian (2008), we exploit our panel of matched bank-firm data and account for unobserved heterogeneity in firms' credit demand, quality, and risk by saturating our model with firm fixed-effects. As a result, our identification comes entirely from firms that were borrowing from at least two different banks before and after the resolution. This strategy isolates the causal impact of the bail-in shock on the change in credit supply by comparing the within-firm variation in the change in lending from banks differently exposed by the intervention. The baseline specification is defined as:

$$\Delta log(Y)_{bi} = \beta(BankExposure_b) + \delta' X_b + \alpha_i + \varepsilon_{bi} \tag{1}$$

where the main dependent variable $\Delta log(Y)_{bi}$ is the log change in total committed credit or in granted credit lines from bank b to firm i from the pre to the post-period. In the latter case, our identification comes from the sub-set of firms (35 percent) with credit lines granted by at least two different banks before and after the resolution. Since we want to ensure that changes in credit are not driven by demand driven draw-downs of credit lines by certain firms, we consider granted instead of drawn credit throughout the paper i.e., the amount of credit that is available to a borrower, not only the portion that was taken up. We also use the change in interest rates, maturity, and share of collateralized credit from the pre to the post period as alternative outcome variables. We therefore investigate whether the same firm borrowing from multiple banks experienced a larger increase in interest rates and collateral required, or a larger decrease in loan maturity by relatively more exposed banks. As in Khwaja and Mian (2008), the data is collapsed (time-averaged) into a single pre (2013:Q4–2014:Q2) and post-shock (2014:Q3–2015:Q3) period to ensure our standard errors are robust to auto-correlation (Bertrand, Duflo, and Mullainathan, 2004).

The main independent variable, $BankExposure_b$, is the percentage of assets of each bank exposed to the bail-in i.e., the percentage of assets that was effectively bailed-in for the resolved bank, the specific contribution to the ad-hoc €0.7 billion loan to the Portuguese Resolution Fund granted as part of the resolution for the 8 participating banks (as a percentage of assets), and 0 otherwise. This indicator is computed using the publicly available financial statements of the banks operating in Portugal. The percentage of assets that was effectively bailed-in for the resolved bank amounts to 6.79 percent, while the specific contribution to the ad-hoc loan to the Fund granted as part of the resolution for the 8 participating banks ranges from 0.04 to 0.37 percent of assets—see Table OA1 in the Online Appendix for the explicit value for the each bank where this indicator exceeds zero. We do not include in this measure the ordinary contributions to the Fund that each bank made in 2013 as these were already priced in before the resolution. As in Silva (2019), for instance, we scale all coefficients throughout the paper by the corresponding variable's standard deviation to ease the interpretation of the magnitudes and ensure comparability across the different samples.

X_b refers to a set of bank-level controls measured in the pre-period, including bank size (log of total assets), bank ROA (return-on-assets), bank capital ratio (equity to total assets), bank liquidity ratio (liquid to total assets), and bank NPLs (non-performing loans to total gross loans). These controls are particularly relevant in our setting since bank-specific exposures to the bail-in are not randomly assigned but a function of bank characteristics (e.g., the contribution to the Fund is determined by each bank's amount of liabilities), which may be correlated with changes in their willingness to lend.[17] α_i are firm fixed effects that capture firm-specific determinants of credit flows and can be interpreted as a measure of credit demand (e.g., Cingano, Manaresi, and Sette, 2016). Finally, since the shock is bank-specific, changes in the credit granted from the same bank may be correlated. As a result, we use standard errors clustered at the bank level in the within-firm regressions.

Cross-Sectional Analysis. Although the above specification allows us to examine whether there was indeed a credit contraction and which type of firms were more likely to be affected by the shock, it is not appropriate to assess the overall effect of the shock. This is because the within-firm analysis is not able to capture credit flows from new lending relationships and also ignores all terminated lending relationships between the pre and post-shock period. Given the importance of the extensive margin for credit adjustment, we also estimate the related between-firm (cross-sectional) effect of firm exposure to the shock as:

$$\Delta log(Y)_i = \beta(FirmExposure_i) + \tau' F_i + \delta' \bar{X}_i + \hat{\alpha}_i + \varepsilon_i \tag{2}$$

where $\Delta log(Y)_i$ is the log change in total committed credit or in granted credit lines between 2013:Q4 and 2015:Q4 from all banks to firm i. We use the same model to examine the effects on other credit conditions and analyze potential real effects.

$FirmExposure_i$ is the exposure of each firm to the bail-in computed as the weighted average of $BankExposure_b$ across all banks lending to a firm, using as weights the pre-period

[17] It is important to note, however, that while the largest banks generally provided more funds to the Portuguese Resolution Fund in absolute terms, there is little correlation with size when scaling the individual contributions with each bank's total assets—see Table OA1 in the Online Appendix.

share of total credit of each bank. F_i are firm characteristics including firm size (log of total assets), firm age (ln(1+age)), firm ROA (net income to total assets), firm capital (equity to total assets), and firm liquidity (current assets to current liabilities)—all measured as of 2013:Q4. We also include industry and district fixed effects in the model. Bank controls $\bar{X}_i$ include the same variables as in specification (1) but are averaged at the firm-level according to the share of total credit granted to the firm by each bank prior to the shock.

Finally, given that in the cross-sectional model (2) the firm-specific demand shock α_i cannot be absorbed, an OLS estimate of β would be biased if $FirmExposure_i$ is correlated with credit demand (Jiménez, Mian, Peydró, and Saurina, 2014; Cingano, Manaresi, and Sette, 2016). Thus, to control for demand for credit when looking at the cross-section of firms, we follow the method developed by Abowd, Kramarz, and Margolis (1999) and recently applied by Bonaccorsi di Patti and Sette (2016) and Cingano, Manaresi, and Sette (2016). Specifically, we include in the between-firm specification (2) the vector of firm-level fixed effects $\hat{\alpha}_i$ estimated from the within-firm model (1).[18] As in Khwaja and Mian (2008), standard errors are clustered at the main bank level i.e., the institution that a certain firm has the highest percentage of borrowing with before the shock.

4 Data and Descriptive Statistics

The dataset we use throughout the paper merges four unique databases held and managed by the Portuguese Central Bank: the (i) Central Credit Register (Central de Responsabilidades de Crédito); (ii) Individual Information on Interest Rates (Informação Individual de Taxas de Juro); (iii) Central Balance Sheet Database (Central de Balanços); and the (iv) Bank Supervisory Database.

[18] Jiménez, Mian, Peydró, and Saurina (2014) propose an alternative method to correct for the bias that arises if the firm exposure to the shock is correlated with credit demand in the firm-level regressions. They use a numerical correction exploiting the difference between OLS and FE estimates of β in the Khwaja and Mian (2008) within-firm regression. Cingano, Manaresi, and Sette (2016) show that the approach of Jiménez, Mian, Peydró, and Saurina (2014) and the one we use in this paper are equivalent.

The Central Credit Register provides confidential information on all credit exposures above 50 euros in Portugal.[19] It covers loans granted to non-financial companies by all banks operating in the country as reporting to the central bank is mandatory. Besides recording the outstanding debt of every firm with each bank at the end of every quarter, each claim also specifies the amount that each borrower owes the bank in the short and long-term, and the amount that is past due. The database also provides information on other credit characteristics e.g., the undrawn amount of a credit line or credit card.

The database on Individual Information on Interest Rates reports matched firm-bank interest rate information on new loans. While only banks with an annual volume of new corporate loans of more than €50 million were required to report between June 2012 and December 2014, this requirement was extended to all resident banks in January 2015. For consistency, we restrict the analysis to banks that reported interest rate information before and after this reporting change. Besides interest rates, we have loan-level information on the amount, maturity, date of origination, whether the loan is collateralized, and loan type.

The Central Balance Sheet Database provides detailed financial information with an annual frequency for virtually all Portuguese firms e.g., total assets, year of incorporation, equity, net income, number of employees, total debt, cash holdings. Finally, we also match the above datasets with bank balance-sheet data from the Bank Supervisory Database e.g., bank size, profits, capital, liquidity and non-performing loans. Given the very low threshold to capture credit exposures in the credit register, the zero minimum loan size of the interest rate database, and the compulsory reporting of balance sheet information by all firms and banks operating in Portugal, the combined dataset we use is arguably one of the most comprehensive loan-bank-firm matched databases available worldwide.

Table 1 presents firm-level descriptive statistics computed using the bank-firm matched sample. Specifically, we present the mean, median, and standard deviation of the dependent

[19] This threshold alleviates any concerns on unobserved changes in bank credit to SMEs. In addition, it has significant advantages when studying credit supply restrictions of smaller firms when compared to other widely-used datasets e.g., US Survey of Small Business Finances or the LPC Dealscan which have incomplete coverage of entrepreneurial firms.

variables as well as firm and bank characteristics across the 40,927 firms and 98 banks in our sample. On average, firms' total credit and granted credit lines increased by 1.1 and 0.3 percent from the pre-shock (2013:Q4–2014:Q2) to the post-shock period (2014:Q3–2015:Q3), respectively. Over the same period, firm investment shrank between 1.6 and 2.6 percent, employment increased by 2.5–3.2 percent, while cash holdings increased by 10.8 percent. Finally, there was an average decrease in interest rates from the pre- to the post-resolution period of 94 and 83 basis points on total credit and credit lines, respectively, an increase in loan maturity of 1.8 months, and a decrease in the share of collateralized credit of 4.2 percentage points.

Turning to firm characteristics, the average pre-failure firm exposure to the bail-in was 0.008, with a standard deviation of 0.013—the average bank exposure to the bail-in across the 116,245 firm-bank relationships is instead 0.009, with a standard deviation of 0.020. Firms in our sample have on average 4 lending relationships and 32 percent started a new lending relationship within a year after the resolution. SMEs constitute 98 percent of all firms. Before the shock, the average firm had €0.75 million in assets, was operating for 13.6 years, had a capital ratio of 26 percent, suffered losses of 0.6 percent of total assets and had a current ratio of 2.2. Finally, we also present bank characteristics, which are averaged at the firm-level according to the pre-period share of total credit granted to the firm by each bank. These are also measured in 2013:Q4 and include bank size (log of total assets), bank ROA (return-on-assets), bank capital ratio (equity to total assets), bank liquidity ratio (liquid to total assets), and bank NPLs (non-performing loans to total gross loans).

5 Results

In this section, we first examine the effect of the bank failure and subsequent resolution through a bail-in on credit supply and firms' borrowing conditions—both at the intensive and extensive margin. We then trace these effects to real sector outcomes and examine the role of firms' internal liquidity position in explaining our findings.

Table 1: Summary statistics

	N	Mean	Median	SD
Dependent Variables:				
Δ *log* Total Credit	40,927	0.011	-0.031	0.485
Δ *log* Credit Lines	14,320	0.003	0.008	0.570
Δ *log* Tangible Assets	40,927	-0.026	-0.054	0.978
Δ *log* Fixed Assets	40,927	-0.016	-0.049	0.959
Δ *log* Employees	40,927	0.032	0.000	0.433
Δ *log* Worked Hours	40,927	0.025	0.009	0.646
Δ *log* Cash Holdings	40,927	0.108	0.117	1.526
Δ Interest Rate on Total Credit	17,632	-0.942	-1.006	3.108
Δ Interest Rate on Credit Lines	6,397	-0.831	-0.815	2.513
Δ Maturity	17,632	1.830	0.000	22.95
Δ Collateral	17,632	-0.042	-0.014	0.280
Firm Characteristics:				
Firm Exposure	40,927	0.008	0.002	0.013
No. Bank Relationships	40,927	4.106	3.000	2.280
New Lending Relationship	40,927	0.323	0.000	0.467
SME	40,927	0.983	1.000	0.129
Firm Size	40,927	13.53	13.40	1.516
Firm Age	40,927	2.679	2.773	0.752
Firm ROA	40,927	-0.006	0.008	0.143
Firm Capital Ratio	40,927	0.261	0.286	0.424
Firm Current Ratio	40,927	2.191	1.414	3.555
Bank Characteristics:				
Bank Size	40,927	23.90	24.36	1.349
Bank ROA	40,927	-0.010	-0.009	0.008
Bank Capital Ratio	40,927	0.054	0.053	0.021
Bank Liquidity Ratio	40,927	0.012	0.011	0.005
Bank NPLs	40,927	0.064	0.065	0.020

The table presents firm-level summary statistics computed using the bank-firm matched sample. The firm-specific change in the log level of total committed credit and the change in the log level of granted credit lines are constructed by collapsing (time-averaging) the quarterly data for each credit exposure into a single pre (2013:Q4-2014:Q2) and post-shock (2014:Q3-2015:Q3) period. Log change in investment (tangible or fixed assets), employment (no. employees or total no. worked hours), and cash holdings are the firm-specific changes in the log level of the each variable between 2013:Q4 and 2015:Q4. Change in interest rates on total credit and credit lines (in percentage points), maturity (in months), and share of collateralized credit (in percentage points) refer to the firm-level change in the loan-amount-weighted value of the respective variable. Since the interest rate dataset only captures new credit operations rather than outstanding amounts, we consider all new credit operations for each firm between 2013:M12 and 2014:M7 (pre-period) and 2014:M9 and 2015:M9 (post period). Firm Exposure captures the average exposure of each firm to the bail-in and is computed as the weighted average of Bank Exposure across all banks lending to a firm, using as weights the pre-period share of total credit from each bank. Bank Exposure is the percentage of assets of each bank exposed to the bail-in i.e., the percentage of assets that was effectively bailed-in for the resolved bank, the specific contribution to the ad-hoc loan to the Resolution Fund granted as part of the resolution for the 8 participating banks (as a percentage of assets), and 0 otherwise. New lending relationship is a dummy variable taking the value of 1 if the firm has a new loan after the shock (2014:Q3-2015:Q3) with a bank that it had no loan before, and 0 otherwise. Firm size categories are defined according to the EU Recommendation 2003/361. Firm characteristics include size (log of total assets), age (ln(1+age)), ROA (net income to total assets), capital ratio (equity to total assets), and current ratio (current assets to current liabilities)—all measured as of 2013:Q4. Bank controls, averaged at the firm-level according to the pre-period share of total credit granted to the firm by each bank, are also measured as at 2013:Q4 and include bank size (log of total assets), bank ROA (return-on-assets), bank capital ratio (equity to total assets), bank liquidity ratio (liquid to total assets), and bank NPLs (non-performing loans to total gross loans).

5.1 Within-Firm Analysis

Bank Resolution and Credit Supply. The results in Table 2 show a significant reduction in credit supply, including granted credit lines, from banks more exposed to the bail-in. Columns (1) and (2) present the results without and with bank-level controls measured as of 2013:Q4—bank size, ROA, capital ratio, liquidity ratio, and NPLs. Column (3) differentiates the main effect of interest across SMEs and large firms. The unit of observation is the change in the log level of total committed credit between each of the 116,245 firm-bank pairs, corresponding to 40,927 firms and 98 banks. As in Khwaja and Mian (2008), the quarterly data for each credit exposure is collapsed (time-averaged) into a single pre (2013:Q4–2014:Q2) and post-shock (2014:Q3–2015:Q3) period. *Bank Exposure*, the main explanatory variable, is the percentage of assets of each bank exposed to the bail-in i.e., the percentage of assets that was effectively bailed-in for the resolved bank, the specific contribution to the ad-hoc loan granted to the Portuguese Resolution Fund for the 8 participating banks (as a percentage of assets), and 0 otherwise. The coefficients are scaled by the corresponding variable's standard deviation to ease the interpretation of magnitudes and ensure comparability across different samples. All specifications focus on borrowers with multiple bank relationships and include firm fixed-effects. This ensures any observed changes in lending are supply driven and not the result of idiosyncratic firm-level shocks such as changes in credit demand or in the risk profile of a borrower.

The relative credit contraction from banks more exposed to the shock is both statistically and economically significant. Specifically, the coefficient of interest in column (2) indicates that a one standard deviation increase in bank exposure to the bail-in (0.020) is associated with a supply-driven decrease in total credit for the average firm of 3.0 percent. While the effect is significant across the different firm size groups, the results in column (3) show that it is more than twice as strong for large firms than for small and mid-sized firms—6.3 vs. 2.9 percent, respectively.

Table 2: **Bank exposure to the bail-in and credit supply – baseline results**

	Δlog $TotalCredit_{bi}$			Δlog $TotalCredit_{bi}$	Δlog $CreditLines_{bi}$	
	(1)	(2)	(3)	(4)	(5)	(6)
Bank Exposure	-0.023***	-0.030*		-0.030***	-0.057***	
	(-3.570)	(-1.844)		(-4.751)	(-3.156)	
Bank Exposure × SMEs			-0.029*			-0.055***
			(-1.739)			(-3.017)
Bank Exposure × Large Firms			-0.063***			-0.084***
			(-3.746)			(-4.676)
No. Observations	116,245	116,245	116,245	39,573	39,573	39,573
No. Firms	40,927	40,927	40,927	14,320	14,320	14,320
No. Banks	98	98	98	95	95	95
Adj. R^2	0.047	0.049	0.050	0.065	0.103	0.103
Bank Controls	N	Y	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y	Y	Y
No. Bank Relationships > 1	Y	Y	Y	Y	Y	Y
Credit Lines with ≠ Banks	N	N	N	Y	Y	Y

The table presents estimation results of the within-firm specification (1), where the dependent variables are the change in the log level of total committed credit or granted credit lines between each firm-bank pair. The quarterly data for each credit exposure is collapsed (time-averaged) into a single pre (2013:Q4–2014:Q2) and post-shock (2014:Q3–2015:Q3) period. Bank Exposure is the percentage of assets of each bank exposed to the bail-in i.e., the percentage of assets that was effectively bailed-in for the resolved bank, the specific contribution to the ad-hoc loan to the Resolution Fund granted as part of the resolution for the 8 participating banks (as a percentage of assets), and 0 otherwise. Bank Controls are measured as at 2013:Q4 and include bank size (log of total assets), bank ROA (return-on-assets), bank capital ratio (equity to total assets), bank liquidity ratio (liquid to total assets), and bank NPLs (non-performing loans to total gross loans). Firm size categories are defined according to the EU Recommendation 2003/361. All coefficients are scaled by the corresponding variable's standard deviation and t-statistics (in parentheses) are robust to heteroskedasticity and within bank dependence. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

In columns (4) to (6) of Table 2 we focus on firms with credit lines granted by multiple banks. This corresponds to 14,320 out of 40,927 firms, for a total of 39,573 firm-bank relationships. In line with Ippolito, Peydró, Polo, and Sette (2016) who find that following the 2007 freeze of the European interbank market Italian banks managed liquidity risks by extending fewer and smaller credit lines, the coefficient estimates show that granted credit lines were the main channel through which banks more exposed to the bail-in reduced credit supply—a decrease of 5.7 percent to the average firm for a one standard deviation increase in bank exposure to the shock. It is important to note that the differential effects between total committed credit and granted credit lines are not driven by sample differences. Comparing the results in columns (2) and (4) corresponding to the full and restricted sample using the change in the log level of total committed credit as outcome variable, we observe that the coefficient estimates are not only both negative and statistically significant but also have the same magnitude.

Identifying Assumptions. The validity of our identification strategy relies on two main assumptions. First, our quasi-experimental research design requires that in the absence of treatment (i.e., the bank failure and subsequent resolution), banks more exposed to the shock would have displayed a similar trend in terms of credit supply to that of less exposed banks. While the parallel trends assumption cannot be tested explicitly due to the absence of a counterfactual, Figure 2 shows it is likely to be satisfied in our setting. In detail, we use a modified version of the within-firm specification (1), regressing for each quarter the change in the log level of total committed credit between each firm-bank pair in that quarter relative to 2014:Q2 (the last period before the shock) on *Bank Exposure* and firm fixed-effects. The dashed lines indicate the 5%–95% confidence interval using standard errors clustered at the bank level. Before the shock, there is no significant variation in credit provision across banks more or less exposed to the resolution. Starting from 2014:Q3, however, credit supply from banks more exposed to the bail-in decreased significantly and deteriorated over time.

Second, the implicit assumption behind using firm fixed-effects to control for idiosyncratic demand shocks in the Khwaja and Mian (2008) within-firm specification is that loan demand changes proportionally across all banks lending to the firm i.e., individual firms take their multiple banks as providers of a perfectly substitutable good. In our setting, this assumption could be violated if firms reduced credit demand from more exposed banks after the shock while increasing it from other (healthier) banks.[20] However, some factors suggest the effects

[20]Although we argue here against this demand-side explanation, it is important to note that even such borrower behavior would be a direct reaction to a supply-side shock and, therefore, would not constitute a demand-side shift per se. In other words, even if part of a possible credit reduction was driven by customers rather than the bank, we would argue that this is still a supply-side shock caused by the bank resolution rather than by changes in firms' credit demand.

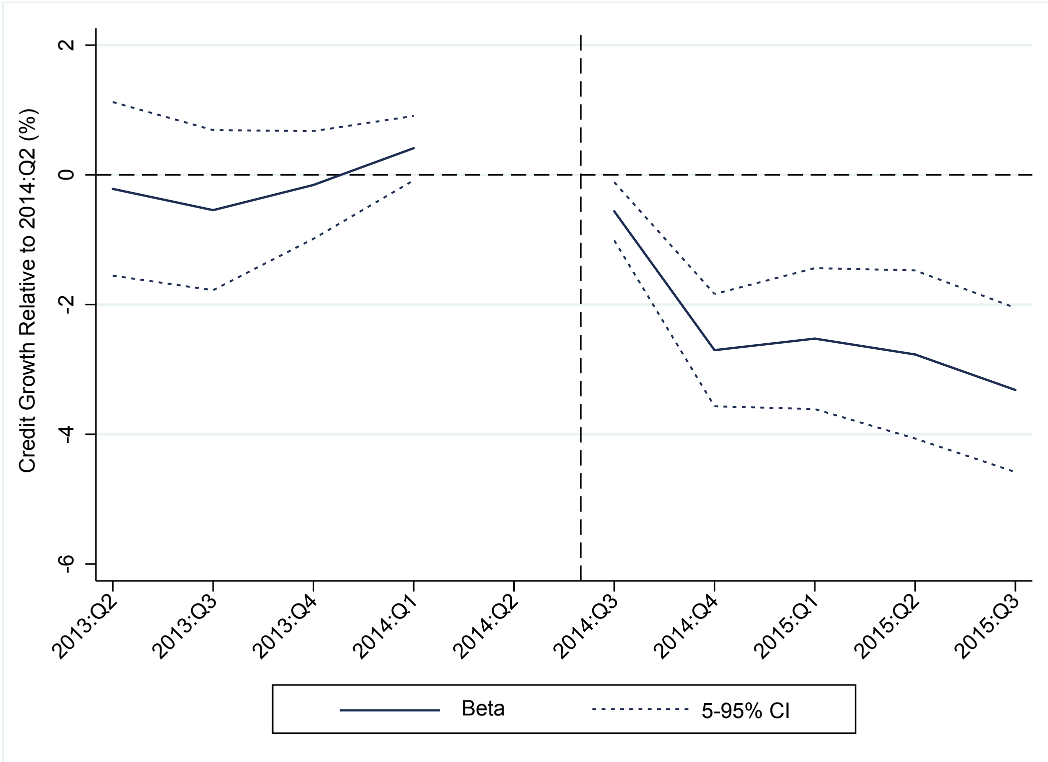

Figure 2: Impact of the bail-in on credit supply at the intensive margin. This figure presents coefficient estimates of a modified version of the within-firm specification (1) where the dependent variable ($\Delta log(Credit)_{bi}$) is regressed on $BankExposure_b$ and firm fixed-effects. Each coefficient estimate in each quarter corresponds to a different within-firm regression, where the outcome variable is the change in the log level of total committed credit between each firm-bank pair between the respective quarter and 2014:Q2. All coefficients are scaled by the corresponding variable's standard deviation. The dashed lines indicate the 5%–95% confidence interval with standard errors clustered at the bank level.

we observe are indeed supply driven and unlikely to be explained by within-firm changes in demand for overall credit or credit lines in particular. First, as stated in both its 2014 and 2015 Annual Reports, after the resolution the bailed-in bank conducted a more sustainable lending policy, with the contraction in corporate loans achieved mainly through the reduction and non-renewal of credit lines as well as a decrease in its credit exposure to large firms, with any new large loan requiring extensive review and risk committee board approval (Novo Banco, 2014). The bank's strategy to manage its capital and liquidity positions prudently by deleveraging non-core assets from the loan portfolio and optimizing risk-weighted assets led to a reduction of its balance sheet of 18 percent from the day of the resolution until the end of

2015 (Novo Banco, 2015). Given that the bailed-in bank is by far the most exposed bank to the resolution (i.e., it has the highest *Bank Exposure* to the shock as shown in Table OA1 in the Online Appendix), the restructuring plan following the intervention focused on reducing large exposures and credit lines is entirely consistent with the credit supply contraction at the intensive margin we show.

In addition, in contrast with a shift in firm demand from the bailed-in bank to other banks explained by reputational damage or even liquidity and solvency concerns, the 13 percent contraction in corporate loans from August 2014 to December 2015 was accompanied by a 7.4 percent increase in customer deposits (Novo Banco, 2015). This suggests that despite the challenges brought by the resolution measure, the bank was able to stabilize its funding sources and, at least partially, recover its customers' confidence.

Finally, as highlighted by Paravisini, Rappoport, and Schnabl (2017), our identifying assumption may also be violated if more exposed banks were specialized in certain industries or sectors such as export markets. In such segments where some banks may have more expertise than others, credit is no longer a homogeneous good offered across different banks and, as a result, sector-level demand shocks may ultimately lead to firm-bank specific loan demand. Nevertheless, untabulated results (for confidentiality reasons) suggest that firm-bank specific demand due to sector specialization is not a source of concern in our setting. In fact, the bailed-in bank was active in all main industries and did not control the majority of the lending activity in any of them. Our results could also be biased if certain banks were targeting their lending to firms in industries experiencing particularly severe (and correlated) demand-side shocks. However, when we compare the relative importance of certain industries for the bailed-in bank vis-à-vis all other banks, we observe no discernible differences across industries between the two groups.

Robustness Tests. The within-firm results presented above are robust to several important tests. First, we use an alternative bank exposure measure based on daily 5-year CDS spreads on senior unsecured debt, considering the four banks operating in Portugal that are classified as significant institutions by the ECB for which there is available CDS spread data. In detail, we define bank exposure to the shock as the bank-specific increase in CDS spreads from 2014:Q2 (one month before the resolution) to 2014:Q3 (two months after the resolution), as illustrated by the light grey area in Figure 1. Importantly, given that CDS spreads of the bailed-in bank moved in line with the rest of the banking sector until late June 2014, this indicator does not capture the market reaction to a potential failure of the bank when the exposures to its Group's entities owned by the family started to be revealed. Instead, it measures the market's perception of the default probability increase for the resolved bank as well as the magnitude of potential spillovers for the three other major Portuguese banks following the bail-in. Consistent with the estimates in the baseline regressions, the results in columns (1) to (3) of Table OA2 in the Online Appendix show that a one standard deviation increase in bank exposure to the shock captured through the reaction of CDS spreads (0.007) leads to an decrease in the supply of credit of 3.00 percent for the average firm—2.60 for SMEs and 8.20 for large firms.[21]

Second, to ensure our results are not confined to firms with multiple bank relationships, we use the complete sample of borrowing firms in Portugal, including single-bank-relationship firms, in a model that replaces firm fixed-effects with industry-location-size fixed-effects following Degryse, De Jonghe, Jakovljević, Mulier, and Schepens (2019). The group contains only the firm itself in case the firm has multiple lending relationships, while firms with single bank relationships are grouped based on the district in which they are headquartered, their industry, and deciles of loan size. The results are reported in columns (4) to (6) of Table OA2. Despite the considerable increase in the number of firms (from 40,927 to 85,216), the

[21]Table OA1 in the Online Appendix reports the values of this alternative bank exposure measure for each bank. Since there are only four banks with available CDS spread data, standard errors clustered at the bank-level would be biased. Thus, in columns (1) to (3) of Table OA2 we use heteroskedasticity-consistent standard errors instead. The coefficients of interest are still significant at conventional levels when using either the wild cluster bootstrap method of Cameron, Gelbach, and Miller (2008) or clustering standard errors at the firm level.

coefficient estimates are remarkably similar to those in the smaller sample restricted to firms with multiple bank relationships, both in terms of magnitude and statistical significance.[22]

Third, we limit our sample to loan operations and thus disregard both used and unused credit lines (Table OA3, columns 1–3). In this case, only the coefficient estimate for large firms enters significantly and is smaller in magnitude when compared to the estimate for total credit. This confirms that banks more exposed to the shock reduced credit supply primarily by extending fewer and smaller credit lines, particularly for SMEs.

Finally, in columns (4) to (6) of Table OA3 we follow Iyer, Peydró, Da-Rocha-Lopes, and Schoar (2014) and compare lending immediately before (2014:Q2) and one year after the shock (2015:Q3) instead of time-averaging the quarterly credit exposures into a pre (2013:Q4–2014:Q2) and post-resolution (2014:Q3–2015:Q3) period. Our results are the same, if not stronger, when compared to our baseline regressions.

Firm Heterogeneity. While we observe a reduction in credit supply on average and particularly for larger firms, this contraction might vary across other firm characteristics. In this respect, the results in Table 3 examine whether there is further cross-sectional variation in the effect of the resolution by introducing an interaction term between *Bank Exposure* and several firm-level characteristics measured before the shock. Columns (1) to (7) show there are no significant differential effects along any cross-sectional dimension considered, including firm age, capital, profitability, liquidity, or riskiness—measured by the interest coverage ratio, the share of NPLs in total credit, or when splitting firms according to whether they had negative equity before the resolution, a common procedure of capturing zombie firms (e.g., Bonfim, Cerqueiro, Degryse, and Ongena, 2019).

Instead, the results in column (8) show a negative and significant interaction term of *Bank Exposure* with a dummy equal to one if the firm main lender before the shock was the bailed-in bank, suggesting that those firms likely to have stronger relationships with

[22]Comparing the results across multiple relationship firms (Table 2) and all firms (Table OA2), the coefficients estimates are -0.030 vs. -0.027 for the average firm, -0.029 vs. -0.026 for SMEs, and -0.063 vs. -0.058 for large firms.

the resolved bank suffered relatively more. While this result contrasts the evidence on the insulating effect of relationship banking on the quantity of credit following negative bank shocks (Bolton, Freixas, Gambacorta, and Mistrulli, 2016; Beck, Degryse, De Haas, and Van Horen, 2018), it highlights the disruptive effect a bank bail-in can have on established firm-bank relationships.[23] In contrast, the interaction between *Bank Exposure* with a dummy equal to one if the firm main lender before the shock was not the bailed-in bank is positive and significant, irrespective of which such main bank participated in the ad-hoc loan to the Portuguese Resolution Fund (column 9) or not (column 10). This suggests that the credit supply contraction at the intensive margin after the resolution is solely driven by the bailed-in bank, with other (less exposed) banks operating in Portugal being able to at least partially counteract this effect.

Effects on Credit Conditions. We have so far focused on the consequences of the bank bail-in on the quantity of credit. Nevertheless, the resolution may have also impacted the interest rates charged on loans and credit lines, the maturity on the credit granted, or the amount of collateral required. Santos (2011) and Chodorow-Reich (2014), for instance, show using syndicated loan data that firms that had relationships with less healthy lenders during the financial crisis paid relatively higher interest rates afterwards. To examine the effects of the resolution on credit conditions, we estimate the same within-firm specification (1) using the change in interest rates, maturity, and share of collateralized credit between 2013:M12 and 2014:M7 (pre-period) and 2014:M9 and 2015:M9 (post-period) as outcome variables.

The results reported in Table 4 show a significant increase in interest rates charged on new loans and credit lines, as well as a considerable tightening of loan maturities and required collateral, from banks more exposed to the bail-in. Compared to Table 2, we now also control for other pre-period loan characteristics available in this restricted sample e.g., the pre-shock, loan-amount-weighted maturity and share of collateralized credit for a given bank-firm relationship when examining the effect on interest rates.

[23]In a different setting, Carvalho, Ferreira, and Matos (2015) find that bank distress is associated with equity valuation losses and investment cuts to firms with the strongest lending relationships.

Table 3: Bank exposure to the bail-in and credit supply – firm heterogeneity

	$\Delta logTotalCredit_{bi}$									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Bank Exposure	-0.031	-0.033**	-0.030*	-0.031*	-0.032*	-0.031*	-0.031*	-0.009	-0.059***	-0.033**
	(-1.517)	(-2.029)	(-1.845)	(-1.847)	(-1.935)	(-1.875)	(-1.848)	(-0.529)	(-3.167)	(-2.037)
Bank Exposure × Firm Age	0.000									
	(0.139)									
Bank Exposure × Firm Capital Ratio		0.010								
		(1.446)								
Bank Exposure × Firm ROA			-0.018							
			(-0.776)							
Bank Exposure × Firm Current Ratio				0.000						
				(0.465)						
Bank Exposure × Firm Interest Coverage Ratio					0.000					
					(0.506)					
Bank Exposure × Firm Share of Non-Performing Loans						0.043				
						(1.063)				
Bank Exposure × Firm has Negative Equity							0.003			
							(0.387)			
Bank Exposure × Firm Main Lender is the Bailed-in Bank								-0.063***		
								(-7.853)		
Bank Exposure × Firm Main Lender Participated in Ad-hoc Loan									0.048***	
									(6.005)	
Bank Exposure × Firm Main Lender Did Not Participate in Ad-Hoc Loan										0.034**
										(2.270)
No. Observations	116,245	116,245	116,245	116,245	116,245	116,245	116,245	116,245	116,245	116,245
No. Firms	40,927	40,927	40,927	40,927	40,927	40,927	40,927	40,927	40,927	40,927
No. Banks	98	98	98	98	98	98	98	98	98	98
Adj. R^2	0.049	0.049	0.049	0.049	0.049	0.050	0.049	0.051	0.050	0.050
Bank Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
No. Bank Relationships > 1	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

The table presents estimation results of the within-firm specification (1) with Bank Exposure interacted with several firm-level characteristics measured before the shock. The dependent variable is the change in the log level of total committed credit between each firm-bank pair. The quarterly data for each credit exposure is collapsed (time-averaged) into a single pre (2013:Q4-2014:Q2) and post-shock (2014:Q3-2015:Q3) period. Bank Exposure is the percentage of assets of each bank exposed to the bail-in i.e., the percentage of assets that was effectively bailed-in for the resolved bank, the specific contribution to the ad-hoc loan to the Resolution Fund granted as part of the resolution for the 8 participating banks (as a percentage of assets), and 0 otherwise. Bank Controls are measured as at 2013:Q4 and include bank size (log of total assets), bank ROA (return-on-assets), bank capital ratio (equity to total assets), bank liquidity ratio (liquid to total assets) and bank NPLs (non-performing loans to total gross loans). Firm assets, no. employees, age, capital ratio, ROA, current ratio and interest coverage (gross profit over interest expense on loans) are all measured as at 2013:Q4. All coefficients are scaled by the corresponding variable's standard deviation and *t*-statistics (in parentheses) are robust to heteroskedasticity and within bank dependence. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

Table 4: Bank exposure to the bail-in and credit conditions

	$\Delta InterestRates$ $AllNewCreditOperations_{bi}$		$\Delta InterestRates$ $CreditLinesOnly_{bi}$		$\Delta Maturity_{bi}$		$\Delta Collateral_{bi}$	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Bank Exposure	0.397***		1.537***		-0.521**		0.258***	
	(7.929)		(8.683)		(-2.120)		(69.622)	
Bank Exposure × SMEs		0.395***		1.575***		-0.500**		0.258***
		(7.871)		(8.852)		(-2.025)		(69.271)
Bank Exposure × Large Firms		0.434***		0.948*		-0.937		0.272***
		(2.902)		(1.815)		(-1.325)		(29.865)
No. Observations	49,623	49,623	13,991	13,991	49,623	49,623	49,623	49,623
No. Firms	17,632	17,632	5,834	5,834	17,632	17,632	17,632	17,632
No. Banks	11	11	9	9	11	11	11	11
Adj. R^2	0.164	0.164	0.125	0.127	0.117	0.117	0.255	0.255
Pre-shock Loan Interest Rate	N	N	N	N	Y	Y	Y	Y
Pre-shock Loan Maturity	Y	Y	Y	Y	N	N	Y	Y
Pre-shock Loan Collateral	Y	Y	Y	Y	Y	Y	N	N
Bank Controls	Y	Y	Y	Y	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y	Y	Y	Y	Y
No. Bank Relationships > 1	Y	Y	Y	Y	Y	Y	Y	Y

The table presents estimation results of the within-firm specification (1), where the dependent variables are the change in the loan-amount-weighted interest rates on new credit operations, interest rates on credit lines, maturity, and share of collateralized credit between each firm-bank pair. Since the interest rate dataset only captures new operations (rather than outstanding amounts), we consider all new credit operations between a firm and a bank between 2013:M12 and 2014:M7 (pre-period) and 2014:M9 and 2015:M9 (post-period) when computing these measures. Bank Exposure is the percentage of assets of each bank exposed to the bail-in i.e., the percentage of assets that was effectively bailed-in for the resolved bank, the specific contribution to the ad-hoc loan to the Resolution Fund granted as part of the resolution for the 8 participating banks (as a percentage of assets), and 0 otherwise. Bank Controls are measured as at 2013:Q4 and include bank size (log of total assets), bank ROA (return-on-assets), bank capital ratio (equity to total assets), bank liquidity ratio (liquid to total assets), and bank NPLs (non-performing loans to total gross loans). Firm size categories are defined according to the EU Recommendation 2003/361. All coefficients are scaled by the corresponding variable's standard deviation and t-statistics (in parentheses) are robust to heteroskedasticity. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

In detail, the coefficient estimates in columns (1) and (3) indicate that a one standard deviation increase in bank exposure to the bail-in is associated with an increase in interest rates on all new credit operations and granted credit lines for the average firm of 0.40 and 1.54 percentage points, respectively. This corresponds to a 4.56 percent (18.07 percent) increase relative to the mean interest rate on all new loans (granted credit lines) before the shock. Similarly, the results in columns (5) and (7) show that a one standard deviation increase in bank exposure to the resolution is associated with a decrease in loan maturity of 7.51 percent relative to the pre-shock mean and an increase in the share of collateralized credit by 25.8 percentage points. Apart from loan maturity where the effect is concentrated on SMEs, the tightening of credit conditions by banks more exposed to the shock following the resolution is statistically significant and economically large irrespective of the firm size.[24]

5.2 Cross-Sectional Analysis

Bank Resolution and Credit Supply. So far we have gauged the effect of bank resolution to firms borrowing from banks more and less exposed to the bail-in. However, the within-firm estimations ignore credit flows from new lending relationships as well as bank relationships that were terminated from the pre- to the post-bail-in period. Therefore, we now turn to the cross-sectional (between-firm) estimations. Since we cannot use firm-fixed effects in the regressions analyzing the overall impact of bank shocks on credit supply, we control for

[24]It is important to note that while most credit registers in advanced economies do not contain this type of granular information, we make use of a recent dataset compiled by the Portuguese Central Bank that reports matched firm-bank interest rate information on new credit operations. However, in line with Cingano, Manaresi, and Sette (2016) for the case of Italy, for instance, some limitations should be remarked. First, the dataset contains interest rate, maturity, and collateral information on new credit operations rather than on total outstanding credit. Second, since the requirement that only banks with an annual volume of new corporate loans of more than €50 million have to report was only relaxed in 2015, these data is only available for the largest 11 banks. Thus, given that the sample is restricted to firms drawing new credit from at least two of these 11 banks, there is a noticeable drop in the sample size relative to the within-firm credit quantity regressions. Importantly, however, the database on Individual Information on Interest Rates has the same firm and bank identifiers as the credit register and includes both the bailed-in bank and all the banks that participated in the ad-hoc loan to the Portuguese Resolution Fund. Finally, standard errors clustered at the bank (or main bank) level would likely be biased given that the relatively few reporting banks and, as a result, we use heteroskedasticity-consistent standard errors instead. As in columns (1) to (3) of Table OA2 in the Online Appendix, our conclusions do not change when using the wild cluster bootstrap method of Cameron, Gelbach, and Miller (2008) or clustering standard errors at the firm level.

omitted firm-level factors such as credit demand with a two-step estimation based on Abowd, Kramarz, and Margolis (1999). Specifically, we include in the estimations the vector of firm-level dummies estimated in column (1) of Table 2.[25] We also include industry and district fixed effects as additional controls for unobservable demand and risk-profile differences.

The results in Table 5 show there was no decrease in overall credit after the shock for firms more exposed to the bail-in when compared to firms exposed less, including when differentiating between firms of different size. However, we do observe a binding contraction in credit lines for SMEs more exposed to the resolution. In detail, the explanatory variable of interest, *Firm Exposure*, is computed as the weighted average of *Bank Exposure* across all banks lending to a firm, using as weights the pre-period share of total credit from each bank. Columns (1) and (2) report the results on total committed credit for the average firm without and with firm and bank controls, respectively, while column (3) differentiates between SMEs and large enterprises. None of the coefficients enters significantly at conventional levels when including the full set of controls. In columns (4) to (6) we instead focus on firms with credit lines granted by multiple banks. As in the within-firm estimations reported in Table 2, this corresponds to 14,320 out of 40,927 firms. First, comparing the results in columns (2) and (4) corresponding to the full and restricted sample using the change in the log level of total committed credit as outcome variable, we observe that the coefficient estimates are statistically insignificant and have a similar magnitude, confirming again that the differential effects between total committed credit and granted credit lines are not driven by sample differences. More importantly, the results in columns (5) and (6) indicate that SMEs more exposed to the shock suffered a considerable decrease in the amount of credit lines available to them. Specifically, for a one standard deviation in firm exposure to the bail-in, SMEs experienced a 2.2 percent binding decrease in granted credit lines.

[25] If biases due to endogenous matching between firms and banks were present in our data, we should observe a substantial correlation between exposure and $\hat{\alpha}_i$ (Jiménez, Mian, Peydró, and Saurina, 2014; Cingano, Manaresi, and Sette, 2016). However, exploiting model (1), we find that the estimated vector of firm-level dummies is virtually uncorrelated with our main *Bank Exposure* measure (ρ=0.0014).

Table 5: Firm exposure to the bail-in and credit supply

	Δlog $TotalCredit_i$			Δlog $TotalCredit_i$	Δlog $CreditLines_i$	
	(1)	(2)	(3)	(4)	(5)	(6)
Firm Exposure	-0.010*	-0.005		-0.004	-0.022***	
	(-1.983)	(-0.901)		(-0.987)	(-4.103)	
Firm Exposure × SMEs			-0.005			-0.022***
			(-0.936)			(-4.316)
Firm Exposure × Large Firms			-0.003			-0.007
			(-0.287)			(-0.463)
No. Observations / Firms	40,927	40,927	40,927	14,320	14,320	14,320
No. Banks	98	98	98	95	95	95
Adj. R^2	0.363	0.378	0.378	0.393	0.175	0.175
Firm Controls	N	Y	Y	Y	Y	Y
Bank Controls	N	Y	Y	Y	Y	Y
Credit Demand	Y	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y	Y
District FE	Y	Y	Y	Y	Y	Y
No. Bank Relationships > 1	Y	Y	Y	Y	Y	Y
Credit Lines with ≠ Banks	N	N	N	Y	Y	Y

The table presents estimation results of cross-sectional model (2), where the dependent variables are the change in the log level of total committed credit or granted credit lines for each firm. The quarterly data for each credit exposure is collapsed (time-averaged) into a single pre (2013:Q4–2014:Q2) and post-shock (2014:Q3–2015:Q3) period. Firm Exposure captures the average exposure of each firm to the bail-in and is computed as the weighted average of Bank Exposure across all banks lending to a firm, using as weights the pre-period share of total credit from each bank. Bank Exposure is the percentage of assets of each bank exposed to the bail-in i.e., the percentage of assets that was effectively bailed-in for the resolved bank, the specific contribution to the ad-hoc loan to the Resolution Fund granted as part of the resolution for the 8 participating banks (as a percentage of assets), and 0 otherwise. Bank controls, averaged at the firm-level according to the pre-period share of total credit granted to the firm by each bank, are measured as at 2013:Q4 and include bank size (log of total assets), bank ROA (return-on-assets), bank capital ratio (equity to total assets), bank liquidity ratio (liquid to total assets), and bank NPLs (non-performing loans to total gross loans). Firm-level controls, defined in Table 1, are also measured in 2013:Q4. Credit demand is the vector of firm-level dummies estimated in the within-firm regression (column 1 of Table 2). All coefficients are scaled by the corresponding variable's standard deviation and t-statistics (in parentheses) are robust to heteroskedasticity and within main bank dependence. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

Robustness Tests. The results above are robust to several tests. First, we consider an alternative firm exposure measure that, as in Table OA2, is based on the reaction of CDS spreads on senior unsecured debt and considers the four banks operating in Portugal that are classified as significant institutions by the ECB. Specifically, in columns (1) to (4) of

Table OA4 in the Online Appendix *Firm Exposure* is computed as the weighted average of *Bank Exposure* across all banks lending to a firm (using as weights the pre-period share of total credit from each bank), but where bank exposure to the shock is defined as the bank-specific increase in CDS spreads from 2014:Q2 (one month before the resolution) to 2014:Q3 (two months after the resolution)—thus capturing the market's perception of the default probability increase for the resolved bank as well as the magnitude of potential spillovers for the three other major Portuguese banks following the bail-in. Second, in columns (5) to (8) of Table OA4 we follow the same procedure but define *Bank Exposure* as a dummy variable equal to one for the bailed-in bank and 0 otherwise i.e., we implicitly assume that only the bailed-in bank was affected by the resolution and there were no spillover effects to other banks in the system. In either case, our conclusions remain the same.

Finally, we also confirm our findings when comparing lending immediately before (2014:Q2) and one year after the shock (2015:Q3) instead of time-averaging the quarterly credit exposures into a pre and post-resolution period (Table OA5, columns 1–2), and when extending the sample to all firms, including those with only one lending relationship (Table OA5, columns 3–4). In the latter specifications, credit demand is the vector of firm-level dummies estimated from the within-firm regression with industry-location-size fixed-effects as in Table OA2. Together, these additional tests confirm that while more exposed firms were able to compensate the tightening of overall credit with other sources of funding, SMEs were subject to a binding contraction of funds available through credit lines.

Role of Lending Relationships and Effects on Credit Conditions. The disruption of established bank-firm relationships can ultimately have negative effects on real outcomes, particularly if borrowers are unable to replace these relationships with other lenders on equal terms (Bernanke, 1983; Ashcraft, 2005).

We start investigating this issue in Table 6 where the dependent variable is now either a dummy that takes value one if a firm takes out a loan from a bank with which it had no lending relationship before the resolution (columns 1 and 2), or a dummy that takes value one if a firm terminates an existing lending relationship with a bank after the resolution (column 3 and 4). The results show that firms more exposed to the bail-in were as likely to start a new lending relationship after the shock as firms exposed less, while more exposed SMEs were relatively less likely to terminate existing lending relationships. These results can be explained by the fact that the average firm already had 4 bank relationships before the shock (Table 1) and highlights the challenges for smaller firms more reliant on relationship lending to replace existing bank relationships due to the time it takes to build up soft information.

In addition, the coefficient estimates reported in columns (5) to (6) of Table 6 confirm that lenders other than the bailed-in bank (i.e., those banks that were less exposed to the resolution) were crucial for firms to maintain credit. Specifically, the dependent variable is now the change in the log level of total committed credit to each firm from all banks except the bailed-in bank from the pre (2013:Q4-2014:Q2) to the post-resolution period (2014:Q3-2015:Q3). The results show a significant and positive relationship between *Firm Exposure* and credit growth from banks other than the bailed-in bank. In economic terms, a one standard deviation increase in firm exposure to the bail-in is associated with a 6.0 percent increase in lending from other banks.

Finally, and turning to the cross-sectional effect of the resolution on credit conditions, the results in columns (1) to (4) of Table 7 show that firms across all size groups that were more exposed to the bail-in saw a moderate increase in their interest rates on total credit, while only more exposed SMEs suffered a moderate increase in interest rates on granted credit lines. However, the economic effect is modest at best—a one standard deviation increase in firm exposure to the bail-in is associated with a 7 bps and 16 bps increase in the interest rates on total credit and credit lines for the average firm, respectively. As in Table 4, since the interest rate dataset only captures new operations rather than outstanding amounts, here we consider all new loans and credit lines between a firm and a bank between 2013:M12 and 2014:M7 (pre-period) and 2014:M9 and 2015:M9 (post-period) when computing the loan-amount-weighted measures. These results are consistent with the evidence in Khwaja

Table 6: Lending relationships and credit supply

	New Lending Relationship$_i$		*Termination of Lending Relationship$_i$*		$\Delta logCredit_i$ (Except Bailed-in Bank)	
	(1)	(2)	(3)	(4)	(5)	(6)
Firm Exposure	-0.008		-0.009**		0.060***	
	(-1.442)		(-2.324)		(9.621)	
Firm Exposure × SMEs		-0.009		-0.010**		0.059***
		(-1.464)		(-2.548)		(9.269)
Firm Exposure × Large Firms		-0.003		0.007		0.070***
		(-0.527)		(0.667)		(8.097)
No. Observations / Firms	40,927	40,927	40,927	40,927	40,927	40,927
No. Banks	98	98	98	98	98	98
Adj. R^2	0.058	0.058	0.028	0.028	0.342	0.342
Firm Controls	Y	Y	Y	Y	Y	Y
Bank Controls	Y	Y	Y	Y	Y	Y
Credit Demand	Y	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y	Y
District FE	Y	Y	Y	Y	Y	Y
No. Bank Relationships > 1	Y	Y	Y	Y	Y	Y

The table presents estimation results of cross-sectional model (2), where the dependent variables are a dummy that takes value one if a firm takes out a loan from a bank with which it had no lending relationship before the shock, a dummy that takes value one if a firm terminates an existing lending relationship with a bank after the resolution, or the the change in the log level of total (committed) credit for each firm between 2013:Q4 and 2015:Q3 excluding the bailed-in bank. Firm Exposure captures the average exposure of each firm to the bail-in and is computed as the weighted average of Bank Exposure across all banks lending to a firm, using as weights the pre-period share of total credit from each bank. Bank Exposure is the percentage of assets of each bank exposed to the bail-in i.e., the percentage of assets that was effectively bailed-in for the resolved bank, the specific contribution to the ad-hoc loan to the Resolution Fund granted as part of the resolution for the 8 participating banks (as a percentage of assets), and 0 otherwise. Bank controls, averaged at the firm-level according to the pre-period share of total credit granted to the firm by each bank, are measured as at 2013:Q4 and include bank size (log of total assets), bank ROA (return-on-assets), bank capital ratio (equity to total assets), bank liquidity ratio (liquid to total assets), and bank NPLs (non-performing loans to total gross loans). Firm controls are also measured before the shock (2013:Q4) and include firm size (log of total assets), firm age (ln(1+age)), firm ROA (net income to total assets), firm capital ratio (equity to total assets) and firm current ratio (current assets to current liabilities). Credit demand is the vector of firm-level dummies estimated in the within-firm regression (column 1 of Table 2). All coefficients are scaled by the corresponding variable's standard deviation and t-statistics (in parentheses) are robust to heteroskedasticity and within main bank dependence. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

and Mian (2008) and Cingano, Manaresi, and Sette (2016) who analyze a representative universe of firms in Pakistan and Italy and find that bank-level shocks have no meaningful effects on the interest rates charged. In line with a modest tightening of interest rates, the results in columns (5) and (6) of Table 7 show a statistically significant but economically small reduction in loan maturity across all firms, with a one standard deviation increase in firm exposure resulting in less than a month reduction in loan maturity. We also find a relatively small increase in the share of collateralized credit after the shock.

Overall, our cross-sectional analysis so far shows that both SMEs and large firms that were more exposed to the bail-in did not suffer an overall reduction in credit when compared to firms exposed less. In fact, these firms were able to compensate the reduction in credit at the intensive margin with lending from other (less exposed) financial institutions they already had a relationship with. Furthermore, despite statistically significant, the effects on credit conditions are economically small and thus unlikely to be driving by itself any potential changes in real outcomes. However, when isolating credit lines from total committed credit by focusing on firms with multiple credit lines, we show that SMEs more exposed to the resolution were subject to a binding contraction in quantity of funds available through lines of credit, a crucial component for corporate liquidity management and the dominant source of liquidity for firms around the world (e.g., Sufi, 2009; Jiménez, Lopez, and Saurina, 2009).[26]

5.3 Real Effects

Impact on Investment and Employment. What was the effect of changes in financing conditions on investment and employment decisions taken by the affected firms? On the one hand, it is not clear that we should find significant real effects given the continued access to the same overall level of external funding, though with smaller granted credit lines for SMEs. On the other hand, the results point towards higher uncertainty for more exposed firms as they had to compensate the lost funding at the intensive margin with credit from other banks and (re)-negotiate loan terms and conditions. We therefore turn to investment and employment growth as real sector outcome variables, and then focus on the role of firms' internal liquidity in driving the results.

[26] According to Berger and Udell (1995), a credit line "is an attractive vehicle for studying the bank-borrower relationship because the line of credit itself represents a formalization of this relationship".

Table 7: Firm exposure to the bail-in and credit conditions

	$\Delta InterestRates$ $AllNewCreditOperations_i$		$\Delta InterestRates$ $CreditLinesOnly_i$		$\Delta Maturity_i$		$\Delta Collateral_i$	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Firm Exposure	0.071**		0.164***		-0.595**		0.043***	
	(1.972)		(3.218)		(-2.148)		(13.690)	
Firm Exposure × SMEs		0.066*		0.164***		-0.563**		0.044***
		(1.803)		(3.214)		(-2.026)		(13.679)
Firm Exposure × Large Firms		0.212***		0.175		-1.438*		0.037***
		(3.164)		(0.986)		(-1.813)		(4.301)
No. Observations / Firms	17,632	17,632	5,834	5,834	17,632	17,632	17,632	17,632
No. Banks	11	11	9	9	11	11	11	11
Adj. R^2	0.110	0.110	0.066	0.066	0.035	0.035	0.078	0.078
Pre-shock Loan Interest Rate	N	N	N	N	Y	Y	Y	Y
Pre-shock Loan Maturity	Y	Y	Y	Y	N	N	Y	Y
Pre-shock Loan Collateral	Y	Y	Y	Y	Y	Y	N	N
Firm Controls	Y	Y	Y	Y	Y	Y	Y	Y
Bank Controls	Y	Y	Y	Y	Y	Y	Y	Y
Credit Demand	Y	Y	Y	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y	Y	Y	Y
District FE	Y	Y	Y	Y	Y	Y	Y	Y
No. Bank Relationships > 1	Y	Y	Y	Y	Y	Y	Y	Y

The table presents estimation results of cross-sectional model (2), where the dependent variable is the firm-specific change in the loan-amount-weighted interest rates on new credit operations, interest rates on credit lines, maturity, and share of collateralized credit. Since the interest rate dataset only captures new operations (rather than outstanding amounts), we consider all new credit operations between a firm and a bank between 2013:M12 and 2014:M7 (pre-period) and 2014:M9 and 2015:M9 (post-period) when computing these measures. Firm Exposure captures the average exposure of each firm to the bail-in and is computed as the weighted average of Bank Exposure across all banks lending to a firm, using as weights the pre-period share of total credit from each bank. Bank Exposure is the percentage of assets of each bank exposed to the bail-in i.e., the percentage of assets that was effectively bailed-in for the resolved bank, the specific contribution to the ad-hoc loan to the Resolution Fund granted as part of the resolution for the 8 participating banks (as a percentage of assets), and 0 otherwise. Firm size categories are defined according to the EU Recommendation 2003/361. Bank controls, averaged at the firm-level according to the pre-period share of total credit granted to the firm by each bank, are measured as at 2013:Q4 and include bank size (log of total assets), bank ROA (return-on-assets), bank capitalization (regulatory capital ratio), bank liquidity ratio (liquid to total assets), and bank NPLs (non-performing loans to total gross loans). Firm controls are also measured before the shock (2013:Q4) and include firm size (log of total assets), firm age (ln(1+age)), firm ROA (net income to total assets), firm capital ratio (equity to total assets) and firm current ratio (current assets to current liabilities). Credit demand is the vector of firm-level dummies estimated in the within-firm regression (column 1 of Table 2). All coefficients are scaled by the corresponding variable's standard deviation and t-statistics (in parentheses) are robust to heteroskedasticity. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

The results in Table 8 show a relative reduction in investment for SMEs that were more exposed to the resolution. The dependent variable in columns (1) to (3) is the change in the log level of tangible assets for each firm between 2013:Q4 and 2015:Q4, with column (1) presenting a regression for the 14,320 firms with multiple credit lines at different banks, and columns (2) and (3) focusing on our main sample of 40,927 with more than one bank relationship. As before, all specifications include firm and bank controls, a proxy for credit demand, and industry and district fixed effects. In both cases, *Firm Exposure* enters negatively and significantly. This reduction in investment, however, is only significant for SMEs (column 3), with a one standard deviation increase in firm exposure to the bail-in associated with a 2.0 percent relative reduction in investment among small and medium-sized enterprises. Our results remain the same when using as dependent variable the change in the log level of fixed assets (Table 8, columns 4–6), our two alternative firm exposure measures as in Table OA4 (Table OA6, columns 1–4), when normalizing the change in tangible assets or fixed assets by the firms' pre-period total assets (Table OA6, columns 5–8), or when including firms with only one bank relationship in the analysis (Table OA7, columns 1–2).

In line with the evidence for investment, columns 1 to 3 of Table 9 show a significant and negative relationship between firm exposure to the bail-in and the growth of the number of employees at firms. As before, this effect is concentrated in SMEs and is not significant for large enterprises.[27] Controlling for firm and bank characteristics, we find a 1.3 percent relative drop in the number of employees at SMEs for a one standard deviation increase in exposure to the resolution. Our conclusion is therefore consistent with Chodorow-Reich (2014) and Berton, Mocetti, Presbitero, and Richiardi (2018) that find that smaller firms are particularly vulnerable to the negative impact of a credit crunch on employment. Bottero, Lenzu, and Mezzanotti (2018) also show that while the credit supply contraction in Italy

[27]In Table OA8 in the Online Appendix we split firms into four size groups according to (i) the EU classification (micro, small, medium, and large firms); (ii) total assets (€0–€14.33 million, €14.34–€28.66 million, €28.67–€43 million, >€43 million); and (iii) no. employees (0–83, 84–166, 167–250, >250). Overall, the binding contraction in credit lines and the negative effects on investment and employment are present among micro, small, and medium firms but not large firms irrespective of the definition used.

Table 8: Firm exposure to the bail-in and investment

	$\Delta logTangibleAssets_i$			$\Delta logFixedAssets_i$		
	(1)	(2)	(3)	(4)	(5)	(6)
Firm Exposure	-0.020***	-0.019***		-0.016***	-0.013***	
	(-3.611)	(-4.838)		(0.249)	(-3.112)	
Firm Exposure × SMEs			-0.020***			-0.013***
			(-4.766)			(-2.983)
Firm Exposure × Large Firms			-0.006			-0.006
			(-0.718)			(-0.577)
No. Observations / Firms	14,320	40,927	40,927	14,320	40,927	40,927
No. Banks	95	98	98	95	98	98
Adj. R^2	0.045	0.041	0.041	0.043	0.039	0.039
Firm Controls	Y	Y	Y	Y	Y	Y
Bank Controls	Y	Y	Y	Y	Y	Y
Credit Demand	Y	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y	Y
District FE	Y	Y	Y	Y	Y	Y
No. Bank Relationships > 1	Y	Y	Y	Y	Y	Y
Credit Lines with ≠ Banks	Y	N	N	Y	N	N

The table presents estimation results of cross-sectional model (2), where the dependent variables are the change in the log level of tangible assets and in the log level of fixed assets for each firm between 2013:Q4 and 2015:Q4. Firm Exposure captures the average exposure of each firm to the bail-in and is computed as the weighted average of Bank Exposure across all banks lending to a firm, using as weights the pre-period share of total credit from each bank. Bank Exposure is the percentage of assets of each bank exposed to the bail-in i.e., the percentage of assets that was effectively bailed-in for the resolved bank, the specific contribution to the ad-hoc loan to the Resolution Fund granted as part of the resolution for the 8 participating banks (as a percentage of assets), and 0 otherwise. Bank controls, averaged at the firm-level according to the pre-period share of total credit granted to the firm by each bank, are measured as at 2013:Q4 and include bank size (log of total assets), bank ROA (return-on-assets), bank capital ratio (equity to total assets), bank liquidity ratio (liquid to total assets), and bank NPLs (non-performing loans to total gross loans). Firm controls are also measured before the shock (2013:Q4) and include firm size (log of total assets), firm age (ln(1+age)), firm ROA (net income to total assets), firm capital ratio (equity to total assets) and firm current ratio (current assets to current liabilities). Credit demand is the vector of firm-level dummies estimated in the within-firm regression (column 1 of Table 2). All coefficients are scaled by the corresponding variable's standard deviation and t-statistics (in parentheses) are robust to heteroskedasticity and within main bank dependence. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

following the European sovereign crisis was similar in magnitude for large and small firms, it led to a reduction in investment and employment only in smaller firms.

To capture different margins of adjustment of employment, we also consider the log change in the total number of hours worked by all firm employees as an alternative outcome variable. The results are reported in columns 4 to 6 of Table 9. As before, the reduction in employment

Table 9: Firm exposure to the bail-in and employment

	$\Delta logNo.Employees_i$			$\Delta logNo.WorkedHours_i$		
	(1)	(2)	(3)	(4)	(5)	(6)
Firm Exposure	-0.014***	-0.012***		-0.020***	-0.015***	
	(-2.994)	(-4.116)		(0.326)	(-3.794)	
Firm Exposure × SMEs			-0.013***			-0.015***
			(-4.213)			(-3.820)
Firm Exposure × Large Firms			-0.002			-0.004
			(-0.488)			(-0.713)
No. Observations / Firms	14,320	40,927	40,927	14,320	40,927	40,927
No. Banks	95	98	98	95	98	98
Adj. R^2	0.080	0.066	0.066	0.054	0.047	0.047
Firm Controls	Y	Y	Y	Y	Y	Y
Bank Controls	Y	Y	Y	Y	Y	Y
Credit Demand	Y	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y	Y
District FE	Y	Y	Y	Y	Y	Y
No. Bank Relationships > 1	Y	Y	Y	Y	Y	Y
Credit Lines with ≠ Banks	Y	N	N	Y	N	N

The table presents estimation results of cross-sectional model (2), where the dependent variables are the change in the log level of no. employees and in the log level of total no. worked hours for each firm between 2013:Q4 and 2015:Q4. Firm Exposure captures the average exposure of each firm to the bail-in and is computed as the weighted average of Bank Exposure across all banks lending to a firm, using as weights the pre-period share of total credit from each bank. Bank Exposure is the percentage of assets of each bank exposed to the bail-in i.e., the percentage of assets that was effectively bailed-in for the resolved bank, the specific contribution to the ad-hoc loan to the Resolution Fund granted as part of the resolution for the 8 participating banks (as a percentage of assets), and 0 otherwise. Bank controls, averaged at the firm-level according to the pre-period share of total credit granted to the firm by each bank, are measured as at 2013:Q4 and include bank size (log of total assets), bank ROA (return-on-assets), bank capital ratio (equity to total assets), bank liquidity ratio (liquid to total assets), and bank NPLs (non-performing loans to total gross loans). Firm controls are also measured before the shock (2013:Q4) and include firm size (log of total assets), firm age (ln(1+age)), firm ROA (net income to total assets), firm capital ratio (equity to total assets) and firm current ratio (current assets to current liabilities). Credit demand is the vector of firm-level dummies estimated in the within-firm regression (column 1 of Table 2). All coefficients are scaled by the corresponding variable's standard deviation and t-statistics (in parentheses) are robust to heteroskedasticity and within main bank dependence. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

is only present in more exposed SMEs—a 1.5 percent relative decrease for a one standard deviation increase in firm exposure.[28]

[28]Our findings also remain the same when (i) considering our two alternative firm exposure variables computed as the weighted average of *Bank Exposure* across all banks lending to a firm (using as weights the pre-period share of total credit from each bank), but where bank exposure to the shock is defined as the bank-specific increase in CDS spreads from 2014:Q2 to 2014:Q3 (Table OA9, columns 1 and 2), or as a dummy variable equal to one for the bailed-in bank and 0 otherwise (Table OA9, columns 3 and 4), and (ii) when including firms with only one bank relationship in the analysis (Table OA7, columns 3–4).

These results are particularly important given our crucial SMEs are for the overall Portuguese economy, not only constituting 98 percent of the firms in our sample (Table 1) but also having 52 percent of total tangible assets and 57 percent of total employees—57 and 63 percent, respectively, if we account for single bank-relationship firms. Using the coefficient estimates from Tables 8, 9, and OA7 to assess the impact of the bail-in, the loss in tangible assets due to lower investment at a one standard deviation change in firm exposure to the shock is €1.22 billion, while the corresponding employment loss is 14,354 jobs—€0.77 billion and 7,974 jobs, respectively, when accounting for single bank-relationship firms.[29]

Indirect Spillover Effects. To shed light on the potential aggregate effects of the bail-in, we follow Huber (2018) and examine in Table OA10 in the Online Appendix whether there is evidence of indirect spillover effects for firms operating in districts with high dependence on banks more exposed to the shock. While these indirect spillover effects would arise through changes in aggregate economic conditions within a district due to the direct effect on affected firms, they would be independent of the individual firms' bank relationships. Specifically, we extend the cross-sectional model (2) to account for the average dependence of firms other than firm i within a district d on banks more exposed to the shock as follows:

$$\Delta log(Y)_{id} = \beta(FirmExposure_{id}) + \lambda(\overline{FirmExposure_{-id}}) + \tau' F_{id} + \delta' \overline{X_{id}} + \hat{\alpha_{id}} + \varepsilon_{id} \quad (3)$$

where $\Delta log(Y)_{id}$ is the log change in tangible assets or in the no. employees between 2013:Q4 and 2015:Q4 from all banks to firm i based in district d. $\overline{FirmExposure_{-id}}$ is the average exposure to the shock across all firms other than firm i operating in the same district d. Unlike Huber (2018), we also include bank controls $\overline{X_{id}}$ averaged at the firm-level according to the

[29]To help put into perspective a standard deviation change in our context, consider two identical firms i and k that, before the shock, had both €10 million in total committed credit from BES and Caixa Geral de Depósitos (CGD), the largest bank in Portugal. Firm i had €5 million in credit from each, and thus an exposure to the shock of 3.49% according to our measure (Table OA1) i.e., 50% from BES and 50% from CGD. Given that a one standard deviation increase in Firm Exposure corresponds to 1.3% (Table 1), firm k would be one standard deviation apart from firm i if it had €7 million in credit from BES and €3 million from CGD i.e., 70% from BES and 30% from CGD. Thus, firm k's investment and employment after the bail-in would be (up to) 2.0 and 1.5 percent lower than firm i's, respectively (Tables 8 and 9).

share of total credit granted to the firm by each bank prior to the shock as well as a control for credit demand ($\hat{\alpha_{id}}$) estimated from the within-firm model (1). In fact, the control variables used in this alternative specification are the same as those in the corresponding Tables 8 and 9, except there are no district fixed effects in columns (1), (2), (4), and (5) of Table OA10, and no district and industry fixed-effects in columns (3) and (6).

Column 1 shows the direct treatment effect for firm i's investment—a 2.2 percent decrease in investment for a one standard deviation increase in firm exposure to the bail-in, in line with the results in Table 8. Column 2, however, shows there are negative spillover effects to other firms in the same district of firm i. In detail, if the same firm i had operated in a district where the overall exposure to the bail-in of the other firms had been one standard deviation greater, investment of this firm i would have fallen by a total of 3.3 percent. In this district, firms not exposed to the bail-in at all would still reduce investment by 1.2 percent solely due to such indirect spillover effect. The conclusions remain the same when examining indirect spillover effects on investment within a district-industry combination instead (column 3).

Finally, the coefficient estimates reported in columns (4) to (6) of Table OA10 suggest that while the bank resolution had direct effects on firm i's employment decisions as we show in Table 9, it did not lead to any statistically significant spillover effects for firms operating in districts or district-industry pairs with high dependence on banks more exposed to the shock. The lack of indirect spillover effects for employment and the smaller direct effect in terms of economic magnitude when compared to investment is consistent with a stronger persistence in employment than in investment decisions.[30]

The role of firms' internal liquidity. The option for firms to access liquidity from credit lines should be more valuable when internal liquidity is scarce (e.g., Campello, Giambona, Graham, and Harvey, 2011). Thus, if the adverse effects of the bank resolution on real

[30] It is important to note that these results assume symmetric spillover effects for treated and control group firms. Nevertheless, we also obtain similar results, if not stronger, when allowing for asymmetric spillover effects for treated and control group firms as proposed by Berg and Streitz (2019). As in the credit supply shock in Germany analyzed by Huber (2018) and Berg and Streitz (2019), the negative spillover effects on investment are purely driven by the control group firms.

outcomes are indeed driven by a reduction in granted credit lines for SMEs, we should observe heterogeneous effects according to their pre-shock liquidity position i.e., if firms view cash and lines of credit as liquidity substitutes and given the tighter credit line limits, illiquid SMEs might respond to the funding shock by increasing cash holdings while decreasing investment and employment. Berg (2018), for instance, shows in a different setting that while liquid SMEs are able to absorb credit supply shocks by using existing cash buffers, their illiquid counterparts increase cash holdings when a loan application is rejected, cutting non-cash assets by more than the requested loan amount, and thus investment and employment.

We analyze this channel explicitly in Table 10 where we split SMEs (Panel A) and large firms (Panel B) according to their ex-ante liquidity position—low liquidity firms (cash holdings-to-assets ratio before the shock lower than the median) vs. high liquidity firms (cash holdings-to-assets ratio before the shock higher than the median). Columns (1), (4), (6), and (8) focus on the full sample of firms with multiple bank relationships, while columns (2), (3), (5), (7), and (9) report the results based on the restricted sample of firms with credit lines granted by at least two different banks to better trace the effects of the supply driven contraction in granted credit lines to real outcomes.

The estimates in columns (4) and (5) show a significant increase in cash holdings by low liquidity SMEs more exposed to the bail-in. This effect is not present across large firms. Conversely, in line with a precautionary savings motive where firms hold cash as a buffer against adverse shocks (e.g., Duchin, Ozbas, and Sensoy, 2010), high liquidity firms more exposed to the bail-in decrease cash holdings considerably—even though low- and high-liquidity firms (both SMEs and large firms) were subject to a similar credit supply shock i.e., no overall effect on total committed credit for all firm types (columns 1 and 2), but a binding contraction of funds available through credit lines for both low and high-liquidity SMEs (column 3). In economic terms, a one standard deviation increase in firm exposure to the bail-in leads to an increase in cash holdings for low liquidity SMEs of 11.2 to 13.7 percent, but to a decrease in cash holdings for high liquidity SMEs of 18.8 to 32.8 percent.

Columns (6) and (7) report the coefficient estimates for investment, while columns (8) and (9) focus on employment. The results show that the negative real effects are concentrated in SMEs with low pre-period levels of internal liquidity, corresponding to those firms that increased cash holdings as a result of the shock. This suggests that while more exposed SMEs with high liquidity before the bail-in were able to use their available internal liquidity buffers to compensate for the binding contraction in granted credit lines and thus maintain employment and investment, low liquidity SMEs more exposed to the bail-in responded by increasing cash holdings while decreasing investment and employment. These results therefore highlight the "dark side" of precautionary savings first documented by Berg (2018) where an update in beliefs about the optimal level of cash holdings leads to negative real effects. While Berg (2018) compares accepted and rejected loan applicants at a single German bank, we help to generalize his findings by analyzing the entire Portuguese banking sector in the context of supply driven credit line reduction.

A potential concern regarding the results in Table 10 is that low levels of firm liquidity prior to the shock might reflect declining demand for investment given that cash holdings are chosen at least partially based on anticipated growth opportunities (e.g., Opler, Pinkowitz, Stulz, and Williamson, 1999). To help ruling out this possibility, in Table OA11 in the Online Appendix we split high and low liquidity SMEs according to the firm-specific pre-shock asset growth before the shock i.e., below and above the median of the overall sample. Our results hold across the two sub-samples. Specifically, SMEs with both lower and higher growth opportunities before the resolution increase cash holdings and decrease investment and employment if they had low levels of internal liquidity, and both decrease cash holdings and maintain employment and investment if they were highly liquid before the shock.[31]

[31] It is important to note that low prior liquidity may also reflect unobservably lower costs of external finance. If that is the case, this would imply we are actually underestimating the effect since we are treating liquidity differences as random.

Table 10: Firm exposure to the bail-in and internal liquidity

	Δlog $TotalCredit_i$		Δlog $CreditLines_i$	$\Delta logCash$ $Holdings_i$		Δlog $Investment_i$		$\Delta logNo.$ $Employees_i$	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel A: SMEs									
Firm Exposure × High Liquidity Firms	0.003	0.005	-0.017***	-0.188***	-0.328***	-0.002	0.012	-0.002	-0.005
	(0.374)	(1.225)	(-2.653)	(-3.055)	(-4.491)	(-0.210)	(1.091)	(-0.420)	(-0.720)
Firm Exposure × Low Liquidity Firms	-0.008	-0.006	-0.023***	0.137***	0.112**	-0.028***	-0.028***	-0.018***	-0.017***
	(-1.615)	(-1.604)	(-4.341)	(2.805)	(2.611)	(-8.614)	(-5.131)	(-9.258)	(-4.146)
No. Observations / Firms	40,236	13,993	13,993	40,236	13,993	40,236	13,993	40,236	13,993
No. Banks	98	92	92	98	92	98	92	98	92
Adj. R^2	0.382	0.394	0.174	0.019	0.027	0.042	0.046	0.067	0.082
Panel B: Large Firms									
Firm Exposure × High Liquidity Firms	-0.020	0.014	-0.014	-0.214**	-0.686***	-0.009	-0.035	0.030	0.108
	(-1.315)	(0.701)	(-0.109)	(-2.443)	(-4.742)	(-0.210)	(-1.377)	(1.139)	(1.427)
Firm Exposure × Low Liquidity Firms	-0.004	-0.015	-0.058	0.009	0.117	-0.034	-0.015	-0.002	0.050
	(-0.137)	(-1.573)	(-0.940)	(0.094)	(0.602)	(-1.359)	(-0.577)	(-0.078)	(1.139)
No. Observations / Firms	691	327	327	691	327	691	327	691	327
No. Banks	16	14	14	16	14	16	14	16	14
Adj. R^2	0.225	0.396	0.224	0.073	0.134	0.009	0.122	0.091	0.133
Firm and Bank Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y
Credit Demand	Y	Y	Y	Y	Y	Y	Y	Y	Y
Industry and District FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
No. Bank Relationships > 1	Y	Y	Y	Y	Y	Y	Y	Y	Y
Credit Lines with ≠ Banks	N	Y	Y	N	Y	N	Y	N	Y

The table presents estimation results of cross-sectional model (2), where firms are split according to their ex-ante liquidity position i.e., low liquidity (cash holdings-to-total assets ratio before the shock lower than the median) vs. high liquidity firms (cash holdings-to-total assets ratio before the shock higher than the median). The dependent variables are the change in the log level of cash holdings, investment (tangible assets), and employment (no. employees) for each firm between 2013:Q4 and 2015:Q4. Panel A focuses on the sub-sample of SMEs and Panel B on large firms. Firm Exposure captures the average exposure of each firm to the bail-in and is computed as the weighted average of Bank Exposure across all banks lending to a firm, using as weights the pre-period share of total credit from each bank. Bank Exposure is the percentage of assets of each bank exposed to the bail-in i.e., the percentage of assets that was effectively bailed-in for the resolved bank, the specific contribution to the ad-hoc loan to the Resolution Fund granted as part of the resolution for the 8 participating banks (as a percentage of assets), and 0 otherwise. Bank controls, averaged at the firm-level according to the pre-period share of total credit granted to the firm by each bank, are measured as at 2013:Q4 and include bank size (log of total assets), bank ROA (return-on-assets), bank capital ratio (equity to total assets), bank liquidity ratio (liquid to total assets), and bank NPLs (non-performing loans to total gross loans). Firm controls are also measured before the shock (2013:Q4) and include firm size (log of total assets), firm age (ln(1+age)), firm ROA (net income to total assets), firm capital ratio (equity to total assets) and firm current ratio (current assets to current liabilities). Credit demand is the vector of firm-level dummies estimated in the within-firm regression (column 1 of Table 2). All coefficients are scaled by the corresponding variable's standard deviation and t-statistics (in parentheses) are robust to heteroskedasticity and within main bank dependence. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

Overall, the results in Tables 8, 9, and 10 show that although there was on average and across the different firm size groups no reduction in overall borrowing after the bank resolution, SMEs still decreased investment and employment. This is explained by smaller firms with low levels of internal liquidity before the shock reacting to the tightening of credit line limits by hoarding cash while at the same time cutting back on investment and employment. The negative impact of the bank resolution shock on investment and employment can thus be explained with heightened liquidity risk.

5.4 Bail-in vs. bail-out

Our evidence pointing towards negative real effects after a bank bail-in is particularly relevant given the growing evidence that, even if setting the stage for aggressive risk-taking and future fragility, bank bail-outs can be effective in supporting borrowers and the real economy in the short-term.[32] Therefore, a final question is whether a bank bail-out would generate the same negative effects we show in the paper for a bail-in. While we cannot make this comparison directly due to the lack of a counterfactual (e.g., a bank that was bailed-out during the same period), we shed some light into this issue by exploiting the fact that the bail-in of shareholders and junior bondholders we analyze so far in this paper differed significantly from the approach taken by the Portuguese authorities during earlier bank failures during the crisis. Notably, in June 2012 3 of the largest 5 banks (Caixa Geral de Depósitos, Banco Millennium BCP, and Banco BPI) received government-funded capital injections as well as the smaller BANIF in December 2012. The bail-outs allowed banks to comply with stricter minimum capital requirements defined by the EBA.

To assess the effects of the bail-outs on credit supply and real outcomes, we use both within- and cross-firm regressions, with data averaged between the fourth quarter of 2011

[32]See, for instance, Giannetti and Simonov (2013) for Japanese crisis of the 1990s, Augusto and Félix (2014) for the bail-outs in Portugal during the European sovereign debt crisis, and Berger and Roman (2017) for the TARP-funded bail-outs in the US. Laeven and Valencia (2013) examine financial sector interventions in 50 countries after the 2007–2009 financial crisis and show that these improved the value added growth of financially dependent firms.

and the second quarter of 2012 as pre-bail-out period and between the fourth quarter of 2012 and the fourth quarter of 2013 as post-bail-out period—see Figure OA1 in the Online Appendix. We have data on 45,062 firms who had relationships with at least two banks, including the four bailed-out banks, for a total of 122,749 firm-bank relationships. *Bank Exposure* is a dummy variable that takes on the value one for bailed-out banks and zero otherwise in the baseline case. Overall, 54 percent of all firms had a relationship with the bailed-out banks.

The results in Table OA12 show no significant difference in credit growth at the intensive margin between the bailed-out and other banks for the same borrower and no significant variation in firm-level credit supply, investment or employment with exposure to bailed-out banks, suggesting that the bail-outs fulfilled their objectives of protecting borrowers of failing banks.[33] In summary, we find no evidence of a negative impact of the bank bail-outs in 2012 on the relative credit supply by bailed-out vs. non-bailed-out banks. Consequently, there was also no relative decline in investment or employment by firms more exposed to the bailed-in banks. While this points to rather sharp differences between bail-out and bail-in of banks, we urge caution in interpreting this comparison directly since (i) the macroeconomic situation was different during these two episodes, (ii) the more systemic nature of the bank fragility preceding the bail-out in 2012 was different from the more isolated bank fragility during the bail-in in 2014, and (iii) unlike the exogenous nature of the bail-in event, the bail-out of the four banks in 2012 was arguably endogenous to previous lending decisions and borrowers' performance. Moreover, previous evidence has shown the detrimental impact on bank risk-taking generated by public guarantees such as bail-outs (Dam and Koetter, 2012) or even deposit insurance (Calomiris and Jaremski, 2019). Instead, despite being an issue outside the scope of this paper, bank bail-ins should reduce moral-hazard due to creditors' expectation of bearing the losses in case of distress (Schäfer, Schnabel, and Weder, 2017).

[33] In robustness tests available in Table OA13 in the Online Appendix, we find no significant effects of the bail-out for either large firms or SMEs, and show that our findings are robust to an alternative measure of *Bank Exposure* defined as a continuous treatment variable equal to the injection amount as a share of assets for each of the bailed-out banks and zero otherwise.

6 Conclusion

Using loan-level data and exploiting within-firm and cross-sectional variation in exposure to different banks, including a failed and subsequently resolved bank, we show that banks more exposed to a bail-in significantly reduced credit supply and tightened credit conditions after the shock but that affected firms were able to compensate the overall credit contraction with funding from other banks they already had relationships with. However, SMEs more exposed to the resolution were subject to a binding contraction in the quantity of funds available through lines of credit. As a result, SMEs reduced both investment and employment, an effect that is concentrated among smaller firms with low pre-shock internal liquidity that increased cash holdings at the expense of investment and employment.

Our findings show that a well-designed bank resolution framework that includes a bail-in of shareholders and bondholders can mitigate the impact of bank failures on credit supply and thus provide supporting evidence for the move from bail-outs to bail-ins. In line with the theoretical framework of Lambrecht and Tse (2019), we show that bail-ins can be a superior alternative to bail-outs if the policy-makers' objective is to keep the amount of lending as well as the banks' probability of default low. The trade-off, however, is that banks grow more slowly and generate less value under the bail-in regime, leading to negative effects to the real economy. Such a resolution mechanism is therefore not a silver bullet—rather, only the combination of a robust supervisory and resolution frameworks can ensure a sound banking system and minimize the adverse effects of bank distress on the real economy.

References

Abowd, J. M., Kramarz, F., Margolis, D. N., 1999. High wage workers and high wage firms. Econometrica 67 (2), 251–333.

Aiyar, S., Calomiris, C. W., Hooley, J., Korniyenko, Y., Wieladek, T., 2014a. The international transmission of bank capital requirements: Evidence from the UK. Journal of Financial Economics 113 (3), 368–382.

Aiyar, S., Calomiris, C. W., Wieladek, T., 2014b. Does macro-prudential regulation leak? evidence from a UK policy experiment. Journal of Money, Credit and Banking 46 (s1), 181–214.

Almeida, H., Campello, M., Weisbach, M. S., 2004. The cash flow sensitivity of cash. Journal of Finance 59 (4), 1777–1804.

Ashcraft, A. B., 2005. Are banks really special? New evidence from the FDIC-induced failure of healthy banks. American Economic Review 95 (5), 1712–1730.

Augusto, F., Félix, S., 2014. The impact of bank recapitalization on firms' access to credit: evidence from Portugal. Banco de Portugal, Financial Stability Papers 2-2014 .

Avgouleas, E., Goodhart, C., 2015. Critical reflections on bank bail-ins. Journal of Financial Regulation 1 (1), 3–29.

Banco de Portugal, 2014a. Address by Mr Carlos da Silva Costa, Governor of Banco de Portugal, on the decision to apply a resolution measure to Banco Espírito Santo.

Banco de Portugal, 2014b. Deliberation of the Board of Directors of Banco de Portugal of 3 August 2014.

Banco de Portugal, 2015. Deliberation of the Board of Directors of Banco de Portugal of 29 December 2015.

Banco de Portugal, 2017. Address by the Governor of Banco de Portugal on the conclusion of the sale of Novo Banco.

Beck, T., 2011. Bank resolution: a conceptual framework. Financial Regulation at the Crossroads: Implications for Supervision, Institutional Design and Trade 12, 53.

Beck, T., Degryse, H., De Haas, R., Van Horen, N., 2018. When arm's length is too far: Relationship banking over the credit cycle. Journal of Financial Economics 127 (1), 174–196.

Berg, T., 2015. Playing the devil's advocate: The causal effect of risk management on loan quality. Review of Financial Studies 28 (12), 3367–3406.

Berg, T., 2018. Got rejected? Real effects of not getting a loan. Review of Financial Studies 31 (12), 4912–4957.

Berg, T., Saunders, A., Steffen, S., Streitz, D., 2017. Mind the gap: The difference between us and european loan rates. Review of Financial Studies 30 (3), 948–987.

Berg, T., Streitz, D., 2019. Handling spillover effects in empirical research: An application using credit supply shocks.

Berger, A. N., Himmelberg, C. P., Roman, R. A., Tsyplakov, S., 2019. Bank bailouts, bail-ins, or no regulatory intervention? A dynamic model and empirical tests of optimal regulation.

Berger, A. N., Roman, R. A., 2017. Did saving Wall Street really save Main Street? The real effects of TARP on local economic conditions. Journal of Financial and Quantitative Analysis 52 (5), 1827–1867.

Berger, A. N., Udell, G. F., 1995. Relationship lending and lines of credit in small firm finance. Journal of Business , 351–381.

Bernanke, B. S., 1983. Nonmonetary effects of the financial crisis in the propagation of the great depression. American Economic Review , 257–276.

Bernard, B., Capponi, A., Stiglitz, J. E., 2018. Bail-ins and bail-outs: Incentives, connectivity, and systemic stability.

Berton, F., Mocetti, S., Presbitero, A. F., Richiardi, M., 2018. Banks, firms, and jobs. Review of Financial Studies 31 (6), 2113–2156.

Bertrand, M., Duflo, E., Mullainathan, S., 2004. How much should we trust differences-in-differences estimates? Quarterly Journal of Economics 119 (1), 249–275.

BES, 2014. Balanco Individual e Notas Explicativas a 4 de Agosto de 2014.

Bolton, P., Freixas, X., Gambacorta, L., Mistrulli, P. E., 2016. Relationship and transaction lending in a crisis. Review of Financial Studies 29 (10), 2643–2676.

Bolton, P., Oehmke, M., 2019. Bank resolution and the structure of global banks. Review of Financial Studies 32 (6), 2384–2421.

Bonaccorsi di Patti, E., Sette, E., 2016. Did the securitization market freeze affect bank lending during the financial crisis? Evidence from a credit register. Journal of Financial Intermediation 25, 54–76.

Bonfim, D., Cerqueiro, G., Degryse, H., Ongena, S., 2019. On-site inspecting zombie lending.

Bottero, M., Lenzu, S., Mezzanotti, F., 2018. Sovereign debt exposure and the bank lending channel: Impact on credit supply and the real economy.

Brown, M., Evangelou, I., Stix, H., 2018. Banking crises, bail-ins and money holdings.

Calomiris, C. W., Jaremski, M., 2019. Stealing deposits: Deposit insurance, risk-taking, and the removal of market discipline in early 20th-century banks. Journal of Finance 74 (2), 711–754.

Calomiris, C. W., Mason, J. R., 2003. Consequences of bank distress during the great depression. American Economic Review 93 (3), 937–947.

Cameron, A. C., Gelbach, J. B., Miller, D. L., 2008. Bootstrap-based improvements for inference with clustered errors. Review of Economics and Statistics 90 (3), 414–427.

Campello, M., Giambona, E., Graham, J. R., Harvey, C. R., 2011. Liquidity management and corporate investment during a financial crisis. Review of Financial Studies 24 (6).

Carvalho, D., Ferreira, M. A., Matos, P., 2015. Lending relationships and the effect of bank distress: evidence from the 2007–2009 financial crisis. Journal of Financial and Quantitative Analysis 50 (06), 1165–1197.

Chodorow-Reich, G., 2014. The employment effects of credit market disruptions: Firm-level evidence from the 2008–9 financial crisis. Quarterly Journal of Economics 129 (1), 1–59.

Cingano, F., Manaresi, F., Sette, E., 2016. Does credit crunch investment down? New evidence on the real effects of the bank-lending channel. Review of Financial Studies 29 (10), 2737–2773.

Colliard, J.-E., Gromb, D., 2018. Financial restructuring and resolution of banks.

Conlon, T., Cotter, J., 2014. Anatomy of a bail-in. Journal of Financial Stability 15, 257–263.

Dam, L., Koetter, M., 2012. Bank bailouts and moral hazard: Evidence from Germany. Review of Financial Studies 25 (8), 2343–2380.

Degryse, H., De Jonghe, O., Jakovljević, S., Mulier, K., Schepens, G., 2019. Identifying credit supply shocks with bank-firm data: Methods and applications. Journal of Financial Intermediation, forthcoming .

Dewatripont, M., 2014. European banking: Bailout, bail-in and state aid control. International Journal of Industrial Organization 34, 37–43.

Duchin, R., Ozbas, O., Sensoy, B. A., 2010. Costly external finance, corporate investment, and the subprime mortgage credit crisis. Journal of Financial Economics 97 (3), 418–435.

Economist, 2014. Banco Espirito Santo: Sharing the pain - August 9, 2014 .

Expresso, 2019. Ha 21 credores a reclamar mais de 50 milhoes ao BES. So dois sao portugueses: veja quais (in Portuguese).

FT, 2014. Banco Espirito Santo: Family fortunes - September 11, 2014.

FT, 2016. Investors cry foul over bank bail-ins - January 7, 2016.

Giannetti, M., Simonov, A., 2013. On the real effects of bank bailouts: Micro evidence from Japan. American Economic Journal: Macroeconomics 5 (1), 135–167.

Gropp, R., Hakenes, H., Schnabel, I., 2011. Competition, risk-shifting, and public bail-out policies. Review of Financial Studies 24 (6), 2084–2120.

Gropp, R., Mosk, T., Ongena, S., Wix, C., 2019. Banks response to higher capital requirements: Evidence from a quasi-natural experiment. Review of Financial Studies 32 (1), 266–299.

Havemann, R., 2018. Can creditor bail-in trigger contagion? The experience of an emerging market. Review of Finance 1, 26.

Huber, K., 2018. Disentangling the effects of a banking crisis: evidence from german firms and counties. American Economic Review 108 (3), 868–98.

Hüser, A.-C., Hałaj, G., Kok, C., Perales, C., van der Kraaij, A., 2018. The systemic implications of bail-in: a multi-layered network approach. Journal of Financial Stability 38, 81–97.

IMF, 2018. Trade-offs in bank resolution. by G. Dell'Ariccia, M. S. Martinez Peria, D. Igan, E. A. Awadzi, M. Dobler, and D. Sandri in IMF Staff Discussion Note No.18/02 .

Ippolito, F., Peydró, J.-L., Polo, A., Sette, E., 2016. Double bank runs and liquidity risk management. Journal of Financial Economics 122 (1), 135–154.

Iyer, R., Peydró, J.-L., Da-Rocha-Lopes, S., Schoar, A., 2014. Interbank liquidity crunch and the firm credit crunch: Evidence from the 2007–2009 crisis. Review of Financial Studies 27 (1), 347–372.

Jiménez, G., Lopez, J. A., Saurina, J., 2009. Empirical analysis of corporate credit lines. Review of Financial Studies 22 (12), 5069–5098.

Jiménez, G., Mian, A., Peydró, J.-L., Saurina, J., 2014. The real effects of the bank lending channel.

Jiménez, G., Ongena, S., Peydró, J.-L., Saurina, J., 2017. Macroprudential policy, countercyclical bank capital buffers, and credit supply: evidence from the Spanish dynamic provisioning experiments. Journal of Political Economy 125 (6), 2126–2177.

Kahn, C., Winton, A., 2004. Moral hazard and optimal subsidiary structure for financial institutions. Journal of Finance 59 (6), 2531–2575.

Keister, T., Mitkov, Y., 2018. Bailouts, bail-ins and banking crises.

Khwaja, A. I., Mian, A., 2008. Tracing the impact of bank liquidity shocks: Evidence from an emerging market. American Economic Review 98 (4), 1413–1442.

Klimek, P., Poledna, S., Farmer, J. D., Thurner, S., 2015. To bail-out or to bail-in? Answers from an agent-based model. Journal of Economic Dynamics and Control 50, 144–154.

Laeven, L., Valencia, F., 2013. The real effects of financial sector interventions during crises. Journal of Money, Credit and Banking 45 (1), 147–177.

Lambrecht, B. M., Tse, A. S., 2019. Liquidation, bailout, and bail-in: Insolvency resolution mechanisms and bank lending. CEPR Discussion Paper No. DP13734 .

Novo Banco, 2014. 2014 Annual Report.

Novo Banco, 2015. 2015 Annual Report.

Opler, T., Pinkowitz, L., Stulz, R., Williamson, R., 1999. The determinants and implications of corporate cash holdings. Journal of Financial Economics 52 (1), 3–46.

Paravisini, D., Rappoport, V., Schnabl, P., 2017. Specialization in bank lending: Evidence from exporting firms. CEPR Discussion Paper No. 12156 .

Peek, J., Rosengren, E. S., 2000. Collateral damage: Effects of the japanese bank crisis on real activity in the united states. American Economic Review 90 (1), 30–45.

Philippon, T., Salord, A., 2017. Bail-ins and bank resolution in Europe: a progress report. Geneva Reports on the World Economy Special Report 4 .

Puri, M., Rocholl, J., Steffen, S., 2011. Global retail lending in the aftermath of the us financial crisis: Distinguishing between supply and demand effects. Journal of Financial Economics 100 (3), 556–578.

Reis, R., 2015. Looking for a success in the euro crisis adjustment programs: the case of Portugal. Brookings Papers on Economic Activity 2015 (2), 433–458.

Santos, J. A., 2011. Bank corporate loan pricing following the subprime crisis. Review of Financial Studies 24 (6), 1916–1943.

Schäfer, A., Schnabel, I., Weder, B., 2017. Expecting bail-in? Evidence from European Banks.

Segura, A., Vicente, S., 2019. Bank resolution and public backstop in an asymmetric banking union.

Silva, A. F., 2019. Strategic liquidity mismatch and financial sector stability. Review of Financial Studies, forthcoming .

Sufi, A., 2009. Bank lines of credit in corporate finance: An empirical analysis. Review of Financial Studies 22 (3), 1057–1088.

Walther, A., White, L., 2019. Bail-ins and bail-outs in bank resolution. Review of Financial Studies, forthcoming .

World Bank, 2016. Banco Espirito Santo, S.A.: Resolution via a bridge bank including a re-transfer. By Ana Rita Garcia in “Bank Resolution and Bail-in in the EU: Selected Case Studies Pre- and Post-BRRD , 52–60.

Online Appendix

Sharing the Pain? Credit Supply and Real Effects of Bank Bail-ins

Thorsten Beck, Samuel Da-Rocha-Lopes, and André F. Silva

September 2019

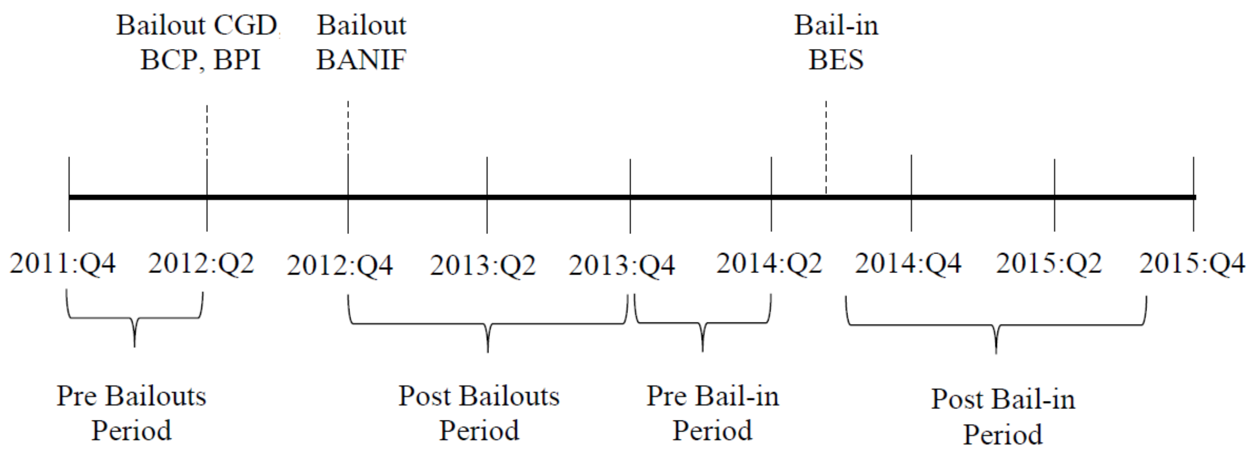

Figure OA1: Timeline of events – bail-outs and bail-in. This figure shows the timeline of the different bank resolutions in Portugal: (i) June 2012 for Caixa Geral de Depósitos, Banco BPI and Banco Millennium BCP; (ii) December 2012 for BANIF; and (iii) August 2014 for BES.

Table OA1: Exposure to the Shock of Largest 10 Banks as of 2013

Bank Name	Assets (€bn as of 2013)	Bank Exposure	
		% Assets Exposed to the Bail-in	Δ CDS Spread
	(1)	(2)	(3)
Caixa Geral de Depósitos	93.84	0.19%	0.003
Banco Millennium BCP	76.79	0.23%	0.001
Banco Espírito Santo (BES)	66.17	6.79%	0.018
Banco BPI	41.17	0.28%	0.005
Banco Santander Totta	40.26	0.29%	
Caixa Económica Montepio Geral	26.47	0.26%	
Banco Internacional do Funchal (BANIF)	14.69	0%	
Caixa Central Crédito Agrícola	14.62	0.04%	
Banco Popular Portugal	9.222	0.25%	
Banco BIC Português	5.446	0.37%	

The table presents the assets (in €bn) and exposure to the shock of the largest 10 banks operating in Portugal as of 2013:Q4. In column (2), Bank Exposure is defined as the percentage of assets of each bank exposed to the bail-in i.e., the percentage of assets that was effectively bailed-in for the resolved bank, the specific contribution to the ad-hoc loan to the Resolution Fund granted as part of the resolution for the 8 participating banks (as a percentage of assets), and 0 otherwise. In column (3), Bank Exposure is defined as the bank-specific increase in CDS spreads from 2014:Q2 (one month before the resolution) to 2014:Q3 (two months after the resolution).

Table OA2: Credit supply and firm size, within-firm – robustness tests A

	$\Delta logTotalCredit_{bi}$					
	Alternative Bank Exposure Measure (CDS Spread Reaction)			Including Firms With Only One Bank Relationship		
	(1)	(2)	(3)	(4)	(5)	(6)
Bank Exposure	-0.039***	-0.030***		-0.023***	-0.027**	
	(-8.162)	(-5.893)		(-4.823)	(-2.061)	
Bank Exposure × SMEs			-0.026***			-0.026*
			(-5.183)			(-1.968)
Bank Exposure × Large Firms			-0.082***			-0.058***
			(-3.376)			(-4.360)
No. Observations	40,783	40,783	40,783	160,534	160,534	160,534
No. Banks	4	4	4	98	98	98
No. Firms	17,445	17,445	17,445	85,216	85,216	85,216
Adj. R^2	0.051	0.054	0.054	0.053	0.055	0.055
Bank Controls	N	Y	Y	N	Y	Y
Firm FE	Y	Y	Y	N	N	N
Industry-Location-Size FE	N	N	N	Y	Y	Y
No. Bank Relationships > 1	Y	Y	Y	N	N	N

The table presents estimation results of the within-firm specification (1), where the dependent variable is the change in the log level of total (committed) credit between each firm-bank pair. The quarterly data for each credit exposure is collapsed (time-averaged) into a single pre (2013:Q4-2014:Q2) and post-shock (2014:Q3-2015:Q3) period. Bank Exposure is defined as the bank-specific increase in CDS spreads from 2014:Q2 (one month before the resolution) to 2014:Q3 (two months after the resolution) in columns (1) to (3), and the percentage of assets of each bank exposed to the bail-in in columns (4) to (6) i.e., the percentage of assets that was effectively bailed-in for the resolved bank, the specific contribution to the ad-hoc loan to the Resolution Fund granted as part of the resolution for the 8 participating banks (as a percentage of assets), and 0 otherwise. Bank Controls are measured as at 2013:Q4 and include bank size (log of total assets), bank ROA (return-on-assets), bank capital ratio (equity to total assets), bank liquidity ratio (liquid to total assets), and bank NPLs (non-performing loans to total gross loans). Firm size categories are defined according to the EU Recommendation 2003/361. In columns (4) to (6) we control for credit demand by replacing the firm fixed-effect in the within-firm regressions by a group (industry-location-size) fixed-effect. The group contains only the firm itself in case the firm has multiple lending relationships, while firms with single bank relationships are grouped based on their industry, the district in which they are headquartered, and deciles of loan size in the credit register. All coefficients are scaled by the corresponding variable's standard deviation and t-statistics (in parentheses) are robust to heteroskedasticity in columns (1) to (3), and to heteroskedasticity and within bank dependence in columns (4) to (6). Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

Table OA3: Credit supply and firm size, within-firm – robustness tests B

	$\Delta logCredit_{bi}$ (Excluding Credit Lines)			$\Delta logCredit_{bi}$ (2014:Q2-2015:Q3)		
	(1)	(2)	(3)	(4)	(5)	(6)
Bank Exposure	-0.019***	-0.022		-0.033***	-0.040**	
	(-2.634)	(-1.372)		(-5.199)	(-2.422)	
Bank Exposure × SMEs			-0.021			-0.036**
			(-1.319)			(-2.177)
Bank Exposure × Large Firms			-0.038*			-0.108***
			(-1.951)			(-5.888)
No. Observations	96,584	96,584	96,584	97,130	97,130	97,130
No. Banks	98	98	98	98	98	98
No. Firms	35,365	35,365	35,365	34,861	34,861	34,861
Adj. R^2	0.013	0.015	0.015	0.027	0.029	0.030
Bank Controls	N	Y	Y	N	Y	Y
Firm FE	Y	Y	Y	Y	Y	Y
No. Bank Relationships > 1	Y	Y	Y	Y	Y	Y

The table presents estimation results of the within-firm specification (1), where the dependent variables are the change in the log level of total credit between each firm-bank pair without considering used and unused credit lines (columns 1–3) and the change in the log level of total committed credit between each firm-bank pair from 2014:Q2 to 2015:Q3 (columns 4–6). Bank Exposure is the percentage of assets of each bank exposed to the bail-in i.e., the percentage of assets that was effectively bailed-in for the resolved bank, the specific contribution to the ad-hoc loan to the Resolution Fund granted as part of the resolution for the 8 participating banks (as a percentage of assets), and 0 otherwise. Bank Controls are measured as at 2013:Q4 and include bank size (log of total assets), bank ROA (return-on-assets), bank capital ratio (equity to total assets), bank liquidity ratio (liquid to total assets), and bank NPLs (non-performing loans to total gross loans). Firm size categories are defined according to the EU Recommendation 2003/361. All coefficients are scaled by the corresponding variable's standard deviation and t-statistics (in parentheses) are robust to heteroskedasticity and within bank dependence. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

Table OA4: Credit supply and firm size, between-firm – robustness tests A

	$\Delta logTotalCredit_i$		$\Delta logCreditLines_i$		$\Delta logTotalCredit_i$		$\Delta logCreditLines_i$	
	Alternative Firm Exposure Measure (Bank Exposure: CDS Spread Reaction)				Alternative Firm Exposure Measure (Bank Exposure: Dummy = 1 for Bailed-in Bank)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Firm Exposure	-0.003		-0.030***		-0.006		-0.021***	
	(-0.445)		(-3.480)		(-1.289)		(-3.800)	
Firm Exposure × SMEs		-0.003		-0.031***		-0.006		-0.021***
		(-0.612)		(-3.656)		(-1.327)		(-3.976)
Firm Exposure × Large Firms		0.010		-0.015		-0.005		-0.006
		(0.678)		(-1.048)		(-0.507)		(-0.432)
No. Observations / Firms	17,445	17,445	5,420	5,420	40,927	40,927	14,320	14,320
No. Banks	4	4	4	4	98	98	95	95
Adj. R^2	0.299	0.299	0.163	0.163	0.378	0.378	0.175	0.175
Firm Controls	Y	Y	Y	Y	Y	Y	Y	Y
Bank Controls	Y	Y	Y	Y	Y	Y	Y	Y
Credit Demand	Y	Y	Y	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y	Y	Y	Y
District FE	Y	Y	Y	Y	Y	Y	Y	Y
No. Bank Relationships > 1	Y	Y	Y	Y	Y	Y	Y	Y
Credit Lines with ≠ Banks	N	N	Y	Y	N	N	Y	Y

The table presents estimation results of the cross-sectional model (2). Firm Exposure captures the average exposure of each firm to the bail-in and is computed as the weighted average of Bank Exposure across all banks lending to a firm, using as weights the pre-period share of total credit from each bank. Bank Exposure is defined as the bank-specific increase in CDS spreads from 2014:Q2 (one month before the resolution) to 2014:Q3 (two months after the resolution) in columns (1) to (4), and a dummy variable equal to one for the bailed-in bank and 0 otherwise in columns (5) to (8). Bank controls, averaged at the firm-level according to the pre-period share of total credit granted to the firm by each bank, are measured as at 2013:Q4 and include bank size (log of total assets), bank ROA (return-on-assets), bank capital ratio (equity to total assets), bank liquidity ratio (liquid to total assets), and bank NPLs (non-performing loans to total gross loans). Firm controls are also measured before the shock (2013:Q4) and include firm size (log of total assets), firm age (ln(1+age)), firm ROA (net income to total assets), firm capital ratio (equity to total assets) and firm current ratio (current assets to current liabilities). Credit demand is the vector of firm-level dummies estimated in the corresponding within-firm regression. All coefficients are scaled by the corresponding variable's standard deviation and t-statistics (in parentheses) are robust to heteroskedasticity in columns (1) to (4) and to heteroskedasticity and within main bank dependence in columns (5) to (8). Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

Table OA5: Credit supply and firm size, between-firm – robustness tests B

	$\Delta logCredit_i$ (2014:Q2-2015:Q3)		$\Delta logCreditLines_i$ (Including Firms With Only One Bank Relationship)	
	(1)	(2)	(3)	(4)
Firm Exposure	-0.006		-0.016*	
	(-0.818)		(-1.968)	
Firm Exposure × SMEs		-0.007		-0.016*
		(-0.946)		(-1.952)
Firm Exposure × Large Firms		0.008		-0.009
		(0.468)		(-0.786)
No. Observations / Firms	34,861	34,861	24,725	24,725
No. Banks	98	98	97	97
Adj. R^2	0.419	0.419	0.231	0.231
Firm Controls	Y	Y	Y	Y
Bank Controls	Y	Y	Y	Y
Credit Demand	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y
District FE	Y	Y	Y	Y
No. Bank Relationships > 1	Y	Y	N	N
Credit Lines with $\neq$ Banks	N	N	Y	Y

The table presents estimation results of cross-sectional model (2). Firm Exposure captures the average exposure of each firm to the bail-in and is computed as the weighted average of Bank Exposure across all banks lending to a firm, using as weights the pre-period share of total credit from each bank. Bank Exposure is the percentage of assets of each bank exposed to the bail-in i.e., the percentage of assets that was effectively bailed-in for the resolved bank, the specific contribution to the ad-hoc loan to the Resolution Fund granted as part of the resolution for the 8 participating banks (as a percentage of assets), and 0 otherwise. Bank controls, averaged at the firm-level according to the pre-period share of total credit granted to the firm by each bank, are measured as at 2013:Q4 and include bank size (log of total assets), bank ROA (return-on-assets), bank capital ratio (equity to total assets), bank liquidity ratio (liquid to total assets), and bank NPLs (non-performing loans to total gross loans). Firm controls are also measured before the shock (2013:Q4) and include firm size (log of total assets), firm age (ln(1+age)), firm ROA (net income to total assets), firm capital ratio (equity to total assets) and firm current ratio (current assets to current liabilities). Credit demand is the vector of firm-level dummies estimated in the corresponding within-firm regression. All coefficients are scaled by the corresponding variable's standard deviation and t-statistics (in parentheses) are robust to heteroskedasticity and within main bank dependence. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

Table OA6: Firm exposure to the bail-in and investment – robustness tests

	$\Delta logTangibleAssets_i$				$\Delta FixedAssets$ $/TotalAssets_i$		$\Delta TangibleAssets$ $/TotalAssets_i$	
	Alternative Firm Exposure Measure (Bank Exposure: CDS Spread Reaction)		Alternative Firm Exposure Measure (Bank Exposure: Dummy = 1 for) for Bailed-in Bank)					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Firm Exposure	-0.036***		-0.020***		-0.003***		-0.003***	
	(-5.222)		(-4.902)		(-3.272)		(-3.336)	
Firm Exposure × SMEs		-0.037***		-0.020***		-0.003***		-0.003***
		(-5.281)		(-4.828)		(-3.446)		(-3.599)
Firm Exposure × Large Firms		-0.021		-0.007		0.001		0.001
		(-1.584)		(-0.708)		(0.835)		(0.633)
No. Observations / Firms	17,445	17,445	40,927	40,927	40,927	40,927	40,927	40,927
No. Banks	4	4	98	98	98	98	98	98
Adj. R^2	0.038	0.038	0.041	0.041	0.062	0.062	0.065	0.065
Firm Controls	Y	Y	Y	Y	Y	Y	Y	Y
Credit Demand	Y	Y	Y	Y	Y	Y	Y	Y
Bank Controls	Y	Y	Y	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y	Y	Y	Y
District FE	Y	Y	Y	Y	Y	Y	Y	Y
No. Bank Relationships > 1	Y	Y	Y	Y	Y	Y	Y	Y

The table presents estimation results of cross-sectional model (2). Firm Exposure captures the average exposure of each firm to the bail-in and is computed as the weighted average of Bank Exposure across all banks lending to a firm, using as weights the pre-period share of total credit from each bank. Bank Exposure is defined as the bank-specific increase in CDS spreads from 2014:Q2 (one month before the resolution) to 2014:Q3 (two months after the resolution) in columns (1) and (2), a dummy variable equal to one for the bailed-in bank and 0 otherwise in columns (3) and (4), and the percentage of assets of each bank exposed to the bail-in in columns (5) to (8) i.e., the percentage of assets that was effectively bailed-in for the resolved bank, the specific contribution to the ad-hoc loan to the Resolution Fund granted as part of the resolution for the 8 participating banks (as a percentage of assets), and 0 otherwise. Bank controls, averaged at the firm-level according to the pre-period share of total credit granted to the firm by each bank, are measured as at 2013:Q4 and include bank size (log of total assets), bank ROA (return-on-assets), bank capital ratio (equity to total assets), bank liquidity ratio (liquid to total assets), and bank NPLs (non-performing loans to total gross loans). Firm controls are also measured before the shock (2013:Q4) and include firm size (log of total assets), firm age (ln(1+age)), firm ROA (net income to total assets), firm capital ratio (equity to total assets) and firm current ratio (current assets to current liabilities). Credit demand is the vector of firm-level dummies estimated in the corresponding within-firm regression. All coefficients are scaled by the corresponding variable's standard deviation and t-statistics (in parentheses) are robust to heteroskedasticity in columns (1) and (2), and heteroskedasticity and within main bank dependence in columns (3) to (8). Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

Table OA7: Firm exposure to the bail-in, investment, and employment – including firms with only one bank relationship

	$\Delta logTangibleAssets_i$		$\Delta logNo.Employees_i$	
	(1)	(2)	(3)	(4)
Firm Exposure	-0.011***		-0.005***	
	(-2.832)		(-4.879)	
Firm Exposure × SMEs		-0.011***		-0.005***
		(-2.852)		(-4.787)
Firm Exposure × Large Firms		-0.005		-0.008*
		(-0.412)		(-1.923)
No. Observations / Firms	85,216	85,216	85,216	85,216
No. Banks	98	98	98	98
Adj. R^2	0.025	0.025	0.049	0.049
Firm Controls	Y	Y	Y	Y
Credit Demand	Y	Y	Y	Y
Bank Controls	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y
District FE	Y	Y	Y	Y
No. Bank Relationships > 1	N	N	N	N

The table presents estimation results of cross-sectional model (2). Firm Exposure captures the average exposure of each firm to the bail-in and is computed as the weighted average of Bank Exposure across all banks lending to a firm, using as weights the pre-period share of total credit from each bank. Bank Exposure is the percentage of assets of each bank exposed to the bail-in i.e., the percentage of assets that was effectively bailed-in for the resolved bank, the specific contribution to the ad-hoc loan to the Resolution Fund granted as part of the resolution for the 8 participating banks (as a percentage of assets), and 0 otherwise. Bank controls, averaged at the firm-level according to the pre-period share of total credit granted to the firm by each bank, are measured as at 2013:Q4 and include bank size (log of total assets), bank ROA (return-on-assets), bank capital ratio (equity to total assets), bank liquidity ratio (liquid to total assets), and bank NPLs (non-performing loans to total gross loans). Firm controls are also measured before the shock (2013:Q4) and include firm size (log of total assets), firm age (ln(1+age)), firm ROA (net income to total assets), firm capital ratio (equity to total assets) and firm current ratio (current assets to current liabilities). Credit demand is the vector of firm-level dummies estimated in the corresponding within-firm regression. All coefficients are scaled by the corresponding variable's standard deviation and t-statistics (in parentheses) are robust to heteroskedasticity and within main bank dependence. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

Table OA8: Firm exposure to the bail-in, investment, and employment – splitting firms into different size groups

	$\Delta logTotalCredit_i$			$\Delta logCreditLines_i$			$\Delta logInvestment_i$			$\Delta logNo.Employees_i$		
	EU Classi-fication	Total Assets	No. Emplo-yees	EU Classi-fication	Total Assets	No. Emplo-yees	EU Classi-fication	Total Assets	No. Emplo-yees	EU Classi-fication	Total Assets	No. Emplo-yees
Firm Exposure × Size 1	-0.010**	-0.006	-0.006	-0.030***	-0.021***	-0.022***	-0.025***	-0.017***	-0.021***	-0.003	-0.012***	-0.012***
(smallest)	(-2.217)	(-1.025)	(-1.038)	(-5.024)	(-4.222)	(-4.422)	(-3.677)	(-3.624)	(-5.016)	(-0.576)	(-4.684)	(-3.966)
Firm Exposure × Size 2	-0.003	0.008	0.006	-0.015***	-0.021*	0.001	-0.016***	-0.042***	-0.014***	-0.023***	-0.010	-0.018***
	(-0.558)	(1.047)	(1.484)	(-3.190)	(-1.752)	(0.057)	(-4.606)	(-4.698)	(-3.071)	(-9.867)	(-1.382)	(-6.434)
Firm Exposure × Size 3	0.009	0.008	0.010	-0.022*	-0.085***	-0.052***	-0.010**	-0.054***	-0.016*	-0.018***	-0.020***	-0.014***
	(1.436)	(1.558)	(1.585)	(-1.774)	(-6.286)	(-5.404)	(-2.376)	(-9.116)	(-1.712)	(-4.708)	(-3.301)	(-3.180)
Firm Exposure × Size 4	-0.001	-0.007	-0.001	-0.005	0.012	-0.017	-0.004	-0.027	-0.010	-0.006	-0.000	-0.001
(largest)	(-0.072)	(-1.158)	(-0.057)	(-0.308)	(0.790)	(-1.185)	(-0.413)	(-1.347)	(-1.441)	(-1.054)	(-0.034)	(-0.267)
No. Observations / Firms	40,927	40,927	40,927	14,320	14,320	14,320	40,927	40,927	40,927	40,927	40,927	40,927
No. Banks	98	98	98	98	98	98	98	98	98	98	98	98
Adj. R^2	0.378	0.378	0.378	0.175	0.176	0.175	0.041	0.041	0.041	0.067	0.066	0.066
Firm Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Bank Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Credit Demand	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
District FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
No. Bank Relationships > 1	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Credit Lines with ≠ Banks > 1	N	N	N	Y	Y	Y	N	N	N	N	N	N

The table presents estimation results of cross-sectional model (2) when splitting firms into four size groups according to (i) the EU classification (micro, small, medium, and large firms); (ii) total assets (€0–€14.33 million, €14.34–€28.66 million, €28.67–€43 million, >€43 million); and (iii) no. employees (0–83, 84–166, 167–250, >250). Firm Exposure captures the average exposure of each firm to the bail-in and is computed as the weighted average of Bank Exposure across all banks lending to a firm, using as weights the pre-period share of total credit from each bank. Bank Exposure is the percentage of assets of each bank exposed to the bail-in i.e., the percentage of assets that was effectively bailed-in for the resolved bank, the specific contribution to the ad-hoc loan to the Resolution Fund granted as part of the resolution for the 8 participating banks (as a percentage of assets), and 0 otherwise. Bank controls, averaged at the firm-level according to the pre-period share of total credit granted to the firm by each bank, are measured as at 2013:Q4 and include bank size (log of total assets), bank ROA (return-on-assets), bank capital ratio (equity to total assets), bank liquidity ratio (liquid to total assets), and bank NPLs (non-performing loans to total gross loans). Firm controls are also measured before the shock (2013:Q4) and include firm size (log of total assets), firm age (ln(1+age)), firm ROA (net income to total assets), firm capital ratio (equity to total assets) and firm current ratio (current assets to current liabilities). Credit demand is the vector of firm-level dummies estimated in the corresponding within-firm regression. All coefficients are scaled by the corresponding variable's standard deviation and t-statistics (in parentheses) are robust to heteroskedasticity and within main bank dependence. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

Table OA9: Firm exposure to the bail-in and employment – robustness tests

	$\Delta logNo.Employees_i$			
	Alternative Firm Exposure Measure (Bank Exposure: CDS Spread Reaction)		Alternative Firm Exposure Measure (Bank Exposure: Dummy = 1 for Bailed-in Bank)	
	(1)	(2)	(3)	(4)
Firm Exposure	-0.020***		-0.012***	
	(-5.059)		(-3.809)	
Firm Exposure × SMEs		-0.020***		-0.012***
		(-5.131)		(-3.958)
Firm Exposure × Large Firms		-0.010*		-0.000
		(-1.883)		(-0.075)
No. Observations / Firms	17,445	17,445	40,927	40,927
No. Banks	4	4	98	98
Adj. R^2	0.066	0.066	0.066	0.066
Firm Controls	Y	Y	Y	Y
Credit Demand	Y	Y	Y	Y
Bank Controls	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y
District FE	Y	Y	Y	Y
No. Bank Relationships > 1	Y	Y	Y	Y

The table presents estimation results of cross-sectional model (2). Firm Exposure captures the average exposure of each firm to the bail-in and is computed as the weighted average of Bank Exposure across all banks lending to a firm, using as weights the pre-period share of total credit from each bank. Bank Exposure is defined as the bank-specific increase in CDS spreads from 2014:Q2 (one month before the resolution) to 2014:Q3 (two months after the resolution) in columns (1) and (2) and a dummy variable equal to one for the bailed-in bank and 0 otherwise in columns (3) and (4). Bank controls, averaged at the firm-level according to the pre-period share of total credit granted to the firm by each bank, are measured as at 2013:Q4 and include bank size (log of total assets), bank ROA (return-on-assets), bank capital ratio (equity to total assets), bank liquidity ratio (liquid to total assets), and bank NPLs (non-performing loans to total gross loans). Firm controls are also measured before the shock (2013:Q4) and include firm size (log of total assets), firm age (ln(1+age)), firm ROA (net income to total assets), firm capital ratio (equity to total assets) and firm current ratio (current assets to current liabilities). Credit demand is the vector of firm-level dummies estimated in the corresponding within-firm regression. All coefficients are scaled by the corresponding variable's standard deviation and t-statistics (in parentheses) are robust to heteroskedasticity in columns (1) and (2), and heteroskedasticity and within main bank dependence in columns (3) and (4). Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

Table OA10: Direct and indirect spillover effects on investment and employment

	$\Delta logTangibleAssets_i$			$\Delta logNo.Employees_i$		
	(1)	(2)	(3)	(4)	(5)	(6)
Firm Exposure	-0.022***	-0.021***	-0.018***	-0.012***	-0.012***	-0.013***
	(-3.408)	(-3.212)	(-4.462)	(-3.590)	(-3.878)	(-3.799)
Firm Exposure of Other Firms in Same District		-0.012***			0.005	
		(-4.332)			(1.414)	
Firm Exposure of Other Firms in Same District and Industry			-0.014**			0.004
			(-2.822)			(0.872)
No. Observations/Firms	40,927	40,927	40,927	40,927	40,927	40,927
No. Banks	98	98	98	98	98	98
Adj. R^2	0.040	0.040	0.001	0.064	0.064	0.059
Firm and Bank Controls	Y	Y	Y	Y	Y	Y
Credit Demand	Y	Y	Y	Y	Y	Y
Industry FE	Y	Y	N	Y	Y	N
District FE	N	N	N	N	N	N
No. Bank Relationships > 1	Y	Y	Y	Y	Y	Y

The table presents estimation results of cross-sectional model (3) that accounts for the average dependence of firms other than firm i within a district d on banks more exposed to the shock. Firm Exposure captures the average exposure of each firm to the bail-in and is computed as the weighted average of Bank Exposure across all banks lending to a firm, using as weights the pre-period share of total credit from each bank. Bank Exposure is the percentage of assets of each bank exposed to the bail-in i.e., the percentage of assets that was effectively bailed-in for the resolved bank, the specific contribution to the ad-hoc loan to the Resolution Fund granted as part of the resolution for the 8 participating banks (as a percentage of assets), and 0 otherwise. Bank controls, averaged at the firm-level according to the pre-period share of total credit granted to the firm by each bank, are measured as at 2013:Q4 and include bank size (log of total assets), bank ROA (return-on-assets), bank capital ratio (equity to total assets), bank liquidity ratio (liquid to total assets), and bank NPLs (non-performing loans to total gross loans). Firm controls are also measured before the shock (2013:Q4) and include firm size (log of total assets), firm age (ln(1+age)), firm ROA (net income to total assets), firm capital ratio (equity to total assets) and firm current ratio (current assets to current liabilities). Credit demand is the vector of firm-level dummies estimated in the corresponding within-firm regression. All coefficients are scaled by the corresponding variable's standard deviation and t-statistics (in parentheses) are robust to heteroskedasticity and within main bank dependence. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

Table OA11: Firm exposure to the bail-in and liquidity – robustness tests

	$\Delta logCashHoldings_i$		$\Delta logTangibleAssets_i$		$\Delta logNo.Employees_i$	
	Low Asset Growth Firms	High Asset Growth Firms	Low Asset Growth Firms	High Asset Growth Firms	Low Asset Growth Firms	High Asset Growth Firms
	(1)	(2)	(3)	(4)	(5)	(6)
Firm Exposure × High Liquidity Firms	-0.182***	-0.176***	0.004	-0.012	-0.002	-0.006
	(4.122)	(5.045)	(0.909)	(0.704)	(0.455)	(0.335)
Firm Exposure × Low Liquidity Firms	0.102***	0.167***	-0.024***	-0.023***	-0.016***	-0.012***
	(3.034)	(4.883)	(0.438)	(0.462)	(0.213)	(0.181)
No. Observations / Firms	19,331	20,030	19,331	20,030	19,331	20,030
Adj. R^2	0.017	0.023	0.031	0.036	0.044	0.058
Firm and Bank Controls	Y	Y	Y	Y	Y	Y
Credit Demand	Y	Y	Y	Y	Y	Y
Industry and District FE	Y	Y	Y	Y	Y	Y
No. Bank Relationships > 1	Y	Y	Y	Y	Y	Y

The table presents estimation results of cross-sectional model (2) where SMEs are split according to their ex-ante asset growth and liquidity (cash holdings-to-total assets) positions i.e., below and above the median. Firm Exposure captures the average exposure of each firm to the bail-in and is computed as the weighted average of Bank Exposure across all banks lending to a firm, using as weights the pre-period share of total credit from each bank. Bank Exposure is the percentage of assets of each bank exposed to the bail-in i.e., the percentage of assets that was effectively bailed-in for the resolved bank, the specific contribution to the ad-hoc loan to the Resolution Fund granted as part of the resolution for the 8 participating banks (as a percentage of assets), and 0 otherwise. Bank controls, averaged at the firm-level according to the pre-period share of total credit granted to the firm by each bank, are measured as at 2013:Q4 and include bank size (log of total assets), bank ROA (return-on-assets), bank capital ratio (equity to total assets), bank liquidity ratio (liquid to total assets), and bank NPLs (non-performing loans to total gross loans). Firm controls are also measured before the shock (2013:Q4) and include firm size (log of total assets), firm age (ln(1+age)), firm ROA (net income to total assets), firm capital ratio (equity to total assets) and firm current ratio (current assets to current liabilities). Credit demand is the vector of firm-level dummies estimated in the corresponding within-firm regression. All coefficients are scaled by the corresponding variable's standard deviation and t-statistics (in parentheses) are robust to heteroskedasticity and within main bank dependence. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

Table OA12: Credit supply and real effects of the 2012 bail-outs

	Within-firm estimates	Cross-sectional estimates		
	$\Delta logCredit_{bi}$	$\Delta logCredit_i$	$\Delta logTangibleAssets_i$	$\Delta logNo.Employees_i$
	(1)	(2)	(3)	(4)
Bank Exposure	0.020			
	(0.728)			
Firm Exposure		-0.010	0.007	-0.003
		(-1.081)	(0.811)	(-0.607)
No. Observations	122,749	45,062	45,062	45,062
No. Firms	45,062	45,062	45,062	45,062
Adj. R^2	0.066	0.472	0.039	0.076
Bank Controls	Y	Y	Y	Y
Firm FE	Y	N	N	N
Credit Demand	N	Y	Y	Y
Firm Controls	N	Y	Y	Y
Industry FE	N	Y	Y	Y
District FE	N	Y	Y	Y
No. Bank Relationships > 1	Y	Y	Y	Y

The table presents estimation results of specifications (1) and (2) where Bank Exposure is a dummy variable that takes on the value one for the four Portuguese banks bailed-out in 2012 and zero otherwise. Firm Exposure captures the average exposure of each firm to the bail-outs and is computed as the weighted average of Bank Exposure across all banks lending to a firm, using as weights the pre-period share of total credit from each bank. The quarterly data for each credit exposure is collapsed (time-averaged) into a single pre (2011:Q4–2012:Q2) and post-shock (2012:Q4–2013:Q4) period. Bank Controls are measured as at 2011:Q4 and include bank size (log of total assets), bank ROA (return-on-assets), bank capital ratio (equity to total assets), bank liquidity ratio (liquid to total assets), and bank NPLs (non-performing loans to total gross loans). Firm controls are also measured before the shock (2011:Q4) and include firm size (log of total assets), firm age (ln(1+age)), firm ROA (net income to total assets), firm capital ratio (equity to total assets) and firm current ratio (current assets to current liabilities). Credit demand is the vector of firm-level dummies estimated in the corresponding within-firm regression. All coefficients are scaled by the corresponding variable's standard deviation and t-statistics (in parentheses) are robust to heteroskedasticity and within bank dependence in column (1), and to heteroskedasticity and within main bank dependence in columns (2) to (4). Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

Table OA13: Credit supply and real effects of the 2012 bail-outs – robustness tests

	Within-firm estimates				Cross-sectional estimates			
	$\Delta logCredit_{bi}$				$\Delta logCredit_{i}$			
	Dummy Treatment Variable		Continuous Treatment Variable		Dummy Treatment Variable		Continuous Treatment Variable	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Bank (col 1–6)/Firm (col 7–12) Exposure	0.020		0.030		-0.010		0.005	
	(0.728)		(1.386)		(-1.081)		(0.625)	
Bank (col 1–6)/Firm (col 7–12) Exposure × SMEs		0.021		0.030		-0.010		0.005
		(0.777)		(1.384)		(-1.078)		(0.636)
Bank (col 1–6)/Firm (col 7–12) Exposure × Large Firms		-0.011		0.027		-0.012		0.004
		(-0.234)		(0.641)		(-1.036)		(0.222)
No. Observations	122,749	122,749	122,749	122,749	45,062	45,062	45,062	45,062
No. Firms	45,062	45,062	45,062	45,062	45,062	45,062	45,062	45,062
Adj. R^2	0.066	0.066	0.066	0.066	0.472	0.472	0.472	0.472
Bank Controls	Y	Y	Y	Y	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y	N	N	N	N
Credit Demand	N	N	N	N	Y	Y	Y	Y
Firm Controls	N	N	N	N	Y	Y	Y	Y
Industry and District FE	N	N	N	N	Y	Y	Y	Y
No. Bank Relationships > 1	Y	Y	Y	Y	Y	Y	Y	Y

The table presents estimation results of specifications (1) and (2) where Bank Exposure is a dummy variable that takes on the value one for the four Portuguese banks bailed-out in 2012 and zero otherwise in columns (1)–(2) and (5)–(6), and a continuous variable equal to the injection amount as a share of assets for each of the bailed-out banks, as zero otherwise in columns (3)–(4) and (7)–(8). Firm Exposure captures the average exposure of each firm to the bail-outs and is computed as the weighted average of Bank Exposure across all banks lending to a firm, using as weights the pre-period share of total credit from each bank. The quarterly data for each credit exposure is collapsed (time-averaged) into a single pre (2011:Q4-2012:Q2) and post-shock (2012:Q4-2013:Q4) period. Bank Controls are measured as at 2011:Q4 and include bank size (log of total assets), bank ROA (return-on-assets), bank capital ratio (equity to total assets), bank liquidity ratio (liquid to total assets), and bank NPLs (non-performing loans to total gross loans). Firm controls are also measured before the shock (2011:Q4) and include firm size (log of total assets), firm age (ln(1+age)), firm ROA (net income to total assets), firm capital ratio (equity to total assets) and firm current ratio (current assets to current liabilities). Credit demand is the vector of firm-level dummies estimated in the corresponding within-firm regression. All coefficients are scaled by the corresponding variable's standard deviation and t-statistics (in parentheses) are robust to heteroskedasticity and within bank dependence in columns (1) to (4), and to heteroskedasticity and within main bank dependence in columns (5) to (8). Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.