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Abstract

We show that the speed and type of corporate deleveraging depends on the interaction between corporate and financial sector health. Based on granular bank-firm data pertaining to small and medium-sized enterprises (SME) from five stressed and two non-stressed euro area economies, we show that "zombie" firms generally continued to lever up during the 2010–2014 period. Whereas relationships with stressed banks reduce SME leverage on average, we also show that zombie firms that are tied to weak banks in euro area periphery countries increase their indebtedness even further. Sustainable economic recovery therefore requires both: deleveraging of banks and firms.

Keywords: zombie lending, debt overhang, bank stress

JEL Classification: E44, G21, G32

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1 Introduction

Excessive levels of debt are a hindrance to economic growth (Cecchetti et al., 2011; Chen et al., 2015). And whereas the question, which levels of debt exactly are "excessive" remains subject to debate, the still high level of corporate indebtedness by historical standards in many euro area countries point to remaining vulnerabilities and may hold back economic recovery (ECB, 2013). Against this background, we investigate from a granular firm-bank level perspective, whether the real economy was able to deleverage when national financial systems were (still) stressed.

While most research at the firm level in this context focuses on either the effect of policies on bank behaviour or the effect of "zombie" lending on corporate investment and recovery in isolation, we add to the few studies that assess how bank stress and "zombie lending" interact in their influence on firms' leverage choices. To this end, we construct a comprehensive matched bank-firm sample of small and medium-sized enterprises (SMEs) in both stressed and non-stressed euro area economies to analyse the interdependence of stressed banks and zombie firms towards an orderly adjustment of corporate indebtedness after 2010.

The nexus between individual bank stress and non-financial corporation (NFC) deleveraging is particularly relevant in the European case because of the interdependence of high indebtedness in various sectors of the economy. The sovereign debt crises that started in late 2009 were often the direct consequence of the need to bail out ailing financial institutions in the aftermath of the Great Financial Crisis of 2007/2008. Subsequently strongly increasing public debt and deficits often coincided with sharp recessions due to a general crisis of trust especially concerning member states' abilities in the periphery of the euro area to honor debt contracts. At least until 2012, their economic environment was characterized by severe instability of

selected national financial systems paired with soaring debt ratios among NFCs, not least due to falling asset prices and profits. Accordingly, national and European policy makers took a range of actions right after the start of financial turmoil to restore financial stability, aiming to revive financial intermediation and to repair monetary policy transmission (ECB, 2010a,b; Falagiarda and Reitz, 2015).

Concerted standard and non-standard measures taken by the European Central Bank (ECB) were quite effective to calm sovereign debt markets and thereby ease banks' funding pressure in stressed euro area economies (Krishnamurthy et al., 2015; Acharya et al., 2016), but also in non-stressed member countries (Cycon and Koetter, 2015; Koetter et al., 2017). While some authors argue that expansionary monetary policy incentivized banks in selected euro area countries to relax lending standards and extend risky loans (Jiménez et al., 2014) [1] , others note that the negative macroeconomic consequences of this credit misallocation were limited (Schivardi et al., 2017). Overall, however, scholars and policymakers agree that more needs to be done to improve corporates' resilience to debt shocks, discourage excessive debt accumulation, and promote an orderly deleveraging process (Cœuré, 2014).

Our paper relates to the few studies that investigate the nexus between weak banks and excessively leveraged firms to explain sluggish recovery in terms of real economic activity. Kalemli-Özcan et al. (2017) demonstrate for Latin American economies that firms with better access to finance – defined as having a relationship with banks that did not suffer from a financial shock – invested significantly more compared to firms with worse access to finance. We seek to complement this important evidence on Latin American listed firms with insights from the backbone of the euro area: non-listed SMEs. On

[1] They disentangle loan supply and and demand on the basis of the comprehensive credit register of Spain, which includes also all loan rejections between 2002 and 2008, see also Jiménez et al. (2012)

this account, the paper by Kalemli-Özcan et al. (2015) is closely related to ours as well. They conduct a matching exercise similar to ours and combine firm-level data obtained from the Amadeus/Orbis database with bank and sovereign information for 24 European countries. Using a difference-in-difference framework, their main conclusion is that corporate debt overhang problems paired with rollover risk implied less investment among European corporates. Underinvestment was aggravated for those firms that were tied to banks with high sovereign exposures that lost in value after the sovereign debt crisis took off in early 2010. Consequently, especially NFCs in the periphery of the euro area exhibited sluggish investment, thereby slowing down economic recovery. Our paper differs in two important respects from their work. First, whereas their focus on the relationship between debt overhang and investment, we identify the role of weak banks for NFC deleveraging in the first place – which appears to be a prerequisite for the recovery of investment. Second, we do not rely solely on the sovereign bond exposure of banks to identify stressed ones because given the home-bias of sovereign debt holdings after 2010 (see, for example, Buch et al., 2016), this approach will probably only assign banks in the periphery the status of stressed banks. Therefore, we construct a financial health indicator that gauges a broader range of bank-specific information giving rise to the identification of bank stress through a number of channels.

Specifically, we match around 423,000 SMEs to around 900 banks in five stressed euro area countries (Spain, Greece, Ireland, Portugal, and Slovenia) and two non-stressed comparison countries: Germany and France. Our analysis pertains to the sovereign debt crisis period 2010–2014. We define a firm as zombie whenever (i) its return on assets is negative, (ii) its net investments are negative, and (iii) its debt servicing capacity (defined as EBITDA over financial debt) is lower than 5% for (iv) at least two consecutive years. Bank health, in turn, is measured as the principal component pertaining to

five different bank traits that are conventionally associated with bank stress: capitalization, NPL ratio, return on assets, z-score, and maturity mismatch.

In contrast with Acharya et al. (2016) we do not find an aggravating effect of bank stress on the indebtedness of SMEs. Instead, a one standard deviation increase in bank stress is associated with a modest reduction in firm leverage by 0.1 percentage points. However, a one standard deviation increase in bank stress increases the leverage of zombie firms by 1.0 percentage points annually, which is in line with findings by Schivardi et al. (2017), and economically significant, given a yearly average reduction of firm leverage by 0.5 percentage points. These findings are in particular strong in the euro area periphery economies, whereas we do not find evidence for a significant increase in zombie leverage through bank stress in France and Germany. Overall, these results suggest that weak banks can be an important source of distortion for an orderly corporate deleveraging process in weak economies.

The remainder of the paper proceeds as follows: Section 2 reviews the related literature on zombie lending and credit misallocation. Section 3 discusses our dataset and the econometric methodology. Section 4 presents the econometric results, whereas Section 5 provides concluding remarks.

2 Related literature

Our paper relates to a strand of literature that focuses on the effects of financial policies on firm outcomes in general and on *zombie lending* in particular.[2] Peek and Rosengren (2005) were the first to provide matched bank-firm evidence that especially the least capitalized banks are most likely to "evergreen" lending to the most unproductive firms. Their case is based

[2] A number of papers focus on the related issue how ailing banks impair their subsequent abilities and incentives to lent efficiently, see, for example, Hoshi and Kashyap (2010), Philippon and Schnabl (2013), Homar (2016), or van Wijnbergen and Timotej (2017). The main result from these studies is that any recapitalization of shocked banks should occur swiftly after the shock and be of large magnitude in order to stand a chance of effectively re-vitalizing healthy credit supply through such intermediaries.

on banks and firms from Japan, an economy characterized also by weak economic growth, weak financial institutions with high levels of NPLs and a low-interest rate environment.

Relatedly, Caballero et al. (2008) investigate the extent to which zombie firms existed among Japanese firms in the aftermath of the crisis in the early 1990s. Based on matched bank-firm data for up to 2,500 Japanese firms between 1982 and 2002, they show that large banks lent too much to unproductive NFCs at excessively low rates, a pattern they coin "zombie lending". They identify zombie firms as firms that receive subsidized credits. To determine whether a loan is subsidized, they relate the actual interest rate paid to a hypothetical benchmark interest rate that serves as a lower bound. They find that among publicly traded firms, up to 30 % of firms receive subsidized credit in the aftermath of the Japanese crisis. Their theoretical model predicts a decrease in job creation and based on matched bank-firm data, they show a sizeable decrease in investment and employment growth for healthy firms in industries with a high presence of zombies.

Giannetti and Simonov (2013) follow-up with a similar set-up. They also use Japanese matched bank-firm data and ask if borrowers benefit from the Japanese bank bailouts following the 1990s crisis. The authors identify zombies as in Caballero et al. (2008) and control for credit demand using the Khwaja and Mian (2008) methodology. To identify policy shocks, they exploit the heterogeneity of recapitalization rounds by the Japanese government regarding the respective aggregate size of capital injections as well as bank-specific difference regarding differences in fulfilling capital requirements. Consistent with theoretical predictions in Diamond and Rajan (2000), recapitalizations that are too small relative to a bank's financial condition are ineffective. Only if recapitalizations are large enough to enable banks to meet capital requirements, borrowers with a strong prior lending relationship experience an increase in credit supply. Moreover, this increase in credit

supply has real implications since firms are able to improve valuations and increase investments. At the same time, zombie firms related to banks that were adequately recapitalized increase their investment. If the recapitalization is insufficient, results are reversed: Zombie firms increase investment while other borrowers invest less.

Regarding the European case, evidence is generally much more scarce. Using the same framework, Acharya et al. (2016) provide evidence for the euro area, linking the weakness of banks directly to (un)conventional monetary policy. They show that relatively poorly capitalized banks benefited the most from an "recapitalization through the backdoor" associated with the announcement of the Outright Monetary Transactions (OMT) programme in 2012. [3] Their analysis entails to match corporate data on cash, indebtedness, employment, and investment from the Amadeus database with syndicated borrowing obtained from the Dealscan database between 2009 and 2014. Their key finding is that banks, which experienced a windfall gain from the OMT announcement, passed these on in particular to low quality firms. Increased lending to these firms results, however, in increased cash holdings and higher leverage, but neither more employment nor investment. We complement this important study in two regards. First, whereas their focus on relatively few, large borrowers from the small set of large banks that act as syndicate leader, we provide evidence for a comprehensive sample of SMEs. This sampling enhances the external validity of our findings, as we cover a meaningful share of the respective overall economies. [4] Second, in contrast to focusing on the announcement of the OMT programme and its effect on selected banks solely through their respective holdings of sovereign debt as reported in the European Banking Authority (EBA) stress test of 2012, we

[3] The positive valuation effect of the ECB's unconventional monetary policy especially of sovereign debt from the euro area periphery countries, that is Greece, Italy, Ireland, Portugal, and Spain, is also documented by Krishnamurthy et al. (2015) or for the Securities Markets Programme (SMP) by Esser and Schwab (2015).

[4] The latest version of their paper does not state explicitly the number of banks and firms entering the sample; an earlier version mentions around 710 NFC borrowers and 49 banks.

gauge bank stress more directly based on observable characteristics for a large set of banks that are observed to interact with NFCs not only through syndicated loan markets.

Ferrando et al. (2015) focus also on the effects of the OMT announcement, however, they gather a comprehensive sample of SMEs from eight stressed and non-stressed euro area economies, similar to ours. Rather than lending itself, they assess whether the OMT announcement eased access to credit for these most dependent corporates on the basis of survey data: small, opaque firms. Their results suggest that especially banks with larger exposures to stressed euro area debt were less likely to reject loan applications. Also, loan terms improved suggesting indeed that this arguably most unconventional monetary policy relieved especially SMEs. For a larger sample of Italian firms, Schivardi et al. (2017) show that low capitalized banks during the euro area sovereign debt crisis were less likely to cut lending to weak firms. This led to credit misallocation and an increase in the failure rate of healthy firms, but seemed to have only limited effects on firm growth or productivity. In both studies it remains unclear though whether these firms also managed to reduce their debt levels, which is what we focus on in this paper.

More directly related to the phenomenon of "zombie lending", Kolev et al. (2016) ask whether credit misallocation is an important reason for the investment slump in Europe. As such, their paper therefore also focuses on the response of firms in terms of investment given indebtedness rather than explaining changes in borrowing as we do. Based on Amadeus data, they examine 8.4 million individual firms from 30 industrial sectors with credit relationships to 5,195 individual bank in 22 EU countries over the period 2004-2013. They are able to link 10 % of the firms with their creditors via BankScope which allows them similar to our approach to develop a bank-specific measure of financial health. The main approach is to control for investment opportunities by incorporating a sector-specific time-varying

global price-to-earnings ratio constructed with data from Thomson Reuters. Consistent with Kalemli-Özcan et al. (2015), they find that firms with debt overhang reduce investment, especially in sectors with good global growth opportunities, a pattern consistent with "zombie lending".

Relatedly, McGowan et al. (2017) test whether the share of zombie firms within industries increased over time and how this affects productivity growth. They sample a panel of firms located in nine OECD countries [5] during the period from 2003 to 2013. Their empirical setup is a cross-country firm-level study that links the prevalence of zombie firms in a given industry with aggregate labour productivity. Using the Caballero et al. (2008) framework, they show that market congestion by zombie firms reduces business investment by healthy firms. Moreover, a high share of zombie firms inhibits productivity enhancing capital reallocation. However, their study remains mute as towards the interaction of bank health, zombie firms, and the ability to deleverage.

3 Data and Methodology

3.1 Linking firms and banks

We look at firm-bank relationships in five euro area periphery countries (Spain, Greece, Ireland, Portugal and Slovenia) [6] and two euro area core countries (Germany and France) in comparison. For this purpose, we obtain firm-level data from Bureau van Dijk's (BvD) Amadeus database, which collects information on a significant number of non-listed SMEs. The coverage of this dataset varies across countries and time and is shown in Figure 1.

[5] Belgium, Finland, France, Italy, Korea, Slovenia, Spain, Sweden, and the United Kingdom.

[6] These countries have all been severely affected by rising government bond yields during the crisis. Due to data restrictions, we cannot observe firm-bank relationships for Italy. Several authors look at firm-bank linkages in Italy based on confidential data of the Italian central bank (e.g. Albertazzi and Marchetti, 2010; Schivardi et al., 2017).

Overall, Amadeus covers at least 25% of employment per country in periphery countries, and slightly less in Germany and France.[7] Over 95% of the firms reported in Amadeus in the seven countries of interest are SMEs. Kalemli-Özcan et al. (2015) show that reported firms are representative of both firm size and share of manufacturing firms relative to the Eurostat Structural Business Statistics (SBS). Unlike other databases, Amadeus therefore provides data on SMEs, which according to SBS (2013) account for 70% of employment in Europe. Apart from financial data, Amadeus also provides information on company location, the sector of the firm's operation according to NACE Rev. 2, and the name of the firm's bank or banks.

– FIGURE 1 AROUND HERE –

We assume that a firm's reported bank relationship also reflects its borrowing relationship and match the name of the firm's bank with bank financial information in BvD's BankScope database.[8] Over 95% of all firms in the sample can be successfully matched to a bank. Around 5% of all firms report more than one bank relationship. In this case, we assign the largest domestic bank among the reported banks, in terms of total assets in 2007, as the company's main relationship.

We exclude certain observations from our dataset before further analyzing the data. First, because we are interested in firms' lending relationships with banks, we exclude observations with financial institutions that do not conduct corporate lending. Examples are central banks, clearing institutions, securities trading firms, asset and private wealth management institutions, as well as factoring and leasing companies. To ensure that the recorded bank is active and engages in lending, we exclude bank observations with assets and loans of zero and less.

[7] The share of employment covered for Germany and France is strongly underestimated, because only few firms in these countries report data on their number of employees.

[8] We match based on bank name, as Amadeus does not provide an identifier for the firms' banks.

Second, we exclude firms that are classified as large firms according to the guidelines of the European Commission and publicly listed firms. The criteria for the former are more than 250 employees and either more than €43 mn in total assets or more than €50 mn in turnover. We assume that these firms do not depend on banks for external finance. Consequently, we also do not include firms without financial debt.

Third, we exclude inactive firms and those that report inconsistent balance sheets. Specifically, we exclude firms with zero or negative total assets, negative debt, and observations in which the sum of total equity and total liabilities is below 99% or above 101% of total assets.

Finally, we exclude all companies belonging to sectors that typically show significantly different firm characteristics, especially with respect to a firm's capital structure. The sectors are the primary sector (NACE 01 - 09), the financial sector (NACE 64 - 66), public administration, defense, and mandatory social security (NACE 84), and extraterritorial organizations (such as e.g. OECD, WHO; NACE 99). This culling procedure eliminates less than 2% of all companies, and less than 3% of all observations from the sample. Further data restrictions arise from missing values in key variables, this is especially the case for small banks, which most frequently occurs in Germany.

We end up with a sample of around 423,000 firms, which we link to 971 individual banks. Table 1 provides an overview over the sample composition by country.

– TABLE 1 AROUND HERE –

3.2 Defining zombie firms

Zombie firms, which are "artificially" kept alive through evergreening credit are in the literature frequently defined as firms receiving subsidized credit.

A common approach for this identification is the use of a benchmark interest payment, as introduced by Caballero et al. (2008), which has however two major drawbacks in the context of our analysis.

First, we cannot precisely distinguish between different forms of debt held by companies in the Amadeus dataset, such as bank loans and debt securities issued. Therefore, we can also not observe actual interest payments on different forms of debt. Observable overall interest expenses may not necessarily show the actual payments during a certain year. Second, our focus on SMEs renders the choice of an appropriate benchmark interest rate non-trivial. Typically, the interest rates of AAA rated corporates are used, which are large and publicly listed and therefore significantly different from the average firm in our sample in many ways.

Other approaches use interest coverage as an indicator of firm viability, see for example McGowan et al. (2017). Apart from the same issues arising here through the use of interest expense information, this indicator also contradicts the assumption by Caballero et al. (2008) that zombie firms receive subsidized credit. Zombie firms should therefore be associated with low interest payments. As a result, they should be difficult to identify through interest coverage ratios.

While we use these two methods to cross-check our results at a later stage, we identify zombie firms in this paper as follows: A company is considered a zombie, whenever (i) its return on assets is negative, (ii) its net investments are negative, and (iii) its debt servicing capacity – measured as EBITDA over total financial debt – is lower than 5% for (iv) at least two consecutive years. Our zombie dummy is thus equal to 1, whenever the firm fulfills criteria (i) to (iii) for the current and the previous period. In combination, (i) and (ii) ensure that we only identify firms as zombies, which are neither profitable, nor invest beyond the value of their depreciation. In particular, the

negative investment constraint ensures that we do not mistakenly classify young, expanding enterprises as zombie firms. We use low debt servicing capacity instead of interest coverage to avoid classifying zombies with highly subsidized credit as healthy firms; (iii) will nonetheless ensure that we only capture highly indebted firms. Finally, (iv) ensures that our zombie definition is not driven by yearly business cycle effects.

An overview over the share of zombie firms across time is given in Figure 2. Table 1 shows the number of firms, zombie firms and banks in our sample for each country.

– FIGURE 2 AROUND HERE –

3.3 Gauging bank stress

Defining bank stress is equally challenging. As our dataset contains many small and non-listed banks, we cannot rely on market-based measures, such as CDS spreads, to identify the soundness of a bank. Instead, we also have to rely on balance sheet information. Several balance sheet-based indicators have been associated with bank (in)stability, e.g. capitalization, profitability, or the share of non-performing loans. Individually, however, these indicators can perform poorly in capturing weak banks. For instance, a high NPL ratio could be compensated with a high share of equity. Similarly, low capitalization can reflect good asset quality rather than instability.

– TABLE 2 AROUND HERE –

Our bank stress indicator therefore consists of five different bank characteristics commonly associated with bank stress: capitalization, NPL ratio, return on assets, z-score, and maturity mismatch.[9] A detailed description of

[9] Z-score is defined as total equity plus net income over the standard deviation of return on assets. It is thus an indicator for the bank's distance to bankruptcy. Maturity mismatch is given by the difference of total deposits and liquid assets over total assets.

all variables can be found in Table 2. Using principal component analysis, we determine the joint first component of these five characteristics, which we use as bank stress indicator. The eigenvalues of the individual principal components are negative for capitalization (-0.08), return on assets (-0.66) and z-score (-0.18), and positive for NPLs (0.69) and maturity mismatch (0.21). This is in line with the intuition that bank stress is associated with lower capitalization, profits, and z-score, but higher NPLs and maturity mismatch.

To further assess the suitability of our bank stress indicator, we compare the first principal component with CDS spreads for a subsample of banks, for which this information is available. For these 21 large banks, the correlation between both indicators is very high (0.68), as shown in Figure 3.

– FIGURE 3 AROUND HERE –

3.4 Methodology and descriptive statistics

We use a fixed-effects panel regression framework to assess the impact of a combination of bank stress and zombie firms on firm deleveraging. As illustrated in Equation (1), we regress the difference of a firm's leverage ($\Delta Leverage_{i,t}$) with respect to the previous year on the lagged zombie dummy ($Zombie_{i,t-1}$), the lagged bank stress indicator ($BankStress_{b,t-1}$), as well as the interaction of the two. We further use different sets of lagged control variables, including *Leverage*, *Cash Holdings*, *Tangibility*, *Return on Assets*, *Bank Size*, *GDP Growth* and *Government Bond Yield*. All variables are described in detail in Table 2.

$$\begin{aligned}\Delta Leverage_{i,t} = {} & \beta_0 Zombie_{i,t-1} + \beta_1 BankStress_{b,t-1} + \beta_2 Zombie_{i,t-1} \times BankStress_{b,t-1} \\ & + \beta_3 Controls_{i,t-1} + \alpha_i + \gamma_t (+\delta_{c \times s \times t}) + \varepsilon_{i,t}\end{aligned} \tag{1}$$

We also include several fixed effects in our regression: a firm-fixed effect (α_i) for individual unobservable firm characteristics, a year-fixed effect (γ_t) to control for cyclical components, and – in a more conservative specification – also a sector-country-year-fixed effect ($\delta_{c\times s\times t}$). Besides unobserved characteristics in different sectors across different countries, this fixed effect can also capture yearly changes in demand on this level. This is of particular importance, as we need to distinguish the supply-effect of bank stress from possible confounding demand factors.

Table 3 shows summary statistics for all variables for our sample period 2010–2014.

– TABLE 3 AROUND HERE –

4 Results

4.1 Main results

Table 4 depicts our main results. In column (1), we specify the two direct terms of our main testing variables, *Zombie* and *BankStress*, and are most interested in their interaction to explain year-on-year changes in NFC leverage. Column (1) indicates that the average zombie NFC located in stressed and non-stressed economies increased its leverage annually by 2.4 percentage points relative to non-zombie firms. Against an average change in leverage amongst the sampled 328,502 firms of minus 5 basis points, this effect is economically quite significant, indicating rather severe deterioration of weak firms' financial health since the peak of the sovereign debt crisis in 2010.

– TABLE 4 AROUND HERE –

Contrary to Acharya et al. (2016), however, we do not find direct evidence

that a relation of NFC with weak banks aggravates indebtedness. The estimate of the direct effect of a NFC being connected to a stressed bank is in fact significantly negative, indicating a modest contraction of annual leverage growth by around 0.1 percentage points for each standard deviation increase in bank stress. The most likely reconciliation with studies like Acharya et al. (2016) is the difference in sampling a very large number of SMEs as opposed to overall much fewer and larger listed firms that participate in the syndicated loan market from which they source bank-firm relationships.

Since a number of studies already investigated the effects of poor financial health on firms' and banks' abilities to contribute to economic recovery in isolation, our main interest is the estimate of the interaction effect in column (1). Based on this sample we document a large positive effect on the change in leverage if weak firms are tied to weak banks. Zombie firms that are connected to a bank that experience an increase of stress by one standard deviation increase their leverage by 90 basis points (=8.3% x 10.9%). Given an average contraction of leverage by 5 basis points, this effect is substantial and supports zombie lending evidence in the prior literature.

Note that this effect is not contaminated by the distribution of leverage in the cross-section of firms. The specification of leverage levels indicates, in turn, that more indebted firms indeed are more likely to reduce their debt after the turmoil on sovereign resilience doubts peaked in 2010 as confirmed by the significantly negative point estimate for the according coefficient in column (1).

Whereas the share of explained variation in this fairly large sample of firms appears to be high, an important concern is that we unearth spurious correlation due to omitted variable bias. Therefore, we purge the specification in column (2) with both firm- and bank-specific control variables on top of the already estimated bank- and firm-fixed effects to account for unobservables.

Relative to the omitted category of micro firms (along the EC definition), both small and medium sized firms exhibit a slower annual leverage growth on the order of 4 and 8 basis points, respectively. Against the backdrop of the result by Ferrando et al. (2015), this effect suggests that it was the smallest firms that increased leverage the most.

We also find that firms holding more cash exhibit significantly slower leverage growth. As also documented by Acharya et al. (2016), this might indicate that firms increased their liquidity holdings for precautionary motives amid increased financial uncertainty.

Those firms holding assets of higher tangibility, in turn, increase their leverage, which might indicate favourable conditions for those few smaller and medium-sized NFCs in our sample that possess marketable collateral to borrow from banks that are seeking increasingly desperately for good credit risks in times of country stress.

Profitable NFCs seem less willing to increase their debt ratios and exhibit according to our estimations a significantly negative relationship with changes in annual leverage. Profitable firms might thus prefer especially in times of uncertainty internal financing over any form of external debt in general and (stressed) bank debt in particular.

Finally, we add in column (2) size as a bank trait. If the stress of banks is correlated with the importance of a single institution in its resident country, our bank stress indicator might be flawed. However, we find that the connection of NFCs to larger banks in terms of total assets reduces the increase in leverage.

In columns (3) and (4) we tackle the important concern that deleveraging efforts of the economy depend much more on the state of macro- rather than micro-economic conditions in two ways. First, we specify observable

country traits to gauge the respective business cycles in both stressed and non-stressed economies. In line with intuition we find that economies with buoyant business cycle developments also do see an expansion of leverage whereas increasing risk premia reflected by sovereign debt yields induce NFCs to contract their debt. Second, we specify joint fixed effects for each sector in each country in each year to also account for unobservable effects beyond business cycles and country risk, such as shifts in sectoral demand for credit.

Importantly, neither the inclusion of explicit firm-, bank-, and country-level controls nor alternative fixed effects affect our baseline effect that connections between stressed banks and zombie firms hamper deleveraging the economy.

– FIGURE 4 AROUND HERE –

We illustrate the effect of bank stress on zombie firms' leverage in Figure 4, which is based on the results in Table 4, column (4). The underlying histogram demonstrates that the level of bank stress across the 594 financial institutions included in the main specification is rather dense. The mass of the distribution is centred around zero and the plotted line of marginal effects indicates for a large share of observations indeed a positive interaction between firm leverage if a relationship exists to a stressed bank. However, for the large mass of banks with moderate levels of bank stress around zero, the increase in leverage appears mildly positive, turning even significantly negative for the most stable banks.

4.2 First concerns and quibbles

How reliable are these baseline results? A first concern is that we are comparing NFCs from arguably historically stressed economies like Greece

or Ireland with economies like France and Germany. In either (group of) countries the distribution of indebtedness across firms as well as the state of the financial sector might be very different indeed, up to the point of incomparability.

Based on the most conservative specification in column (4) of Table 4, we therefore re-estimate our baseline results separately for stressed and non-stressed countries. We report the respective results in columns (1) and (2) of Table 5.

– TABLE 5 AROUND HERE –

The motivation to separate French and German NFCs from those in the periphery of the euro area is that the distribution of bank stress shown in Figure 4 might be systematically tilted towards low stress in the former group of countries and vice versa for the periphery of the euro area. The interaction terms between *Zombie* and *BankStress* in columns (1) and (2) confirm indeed opposing effects on annual changes of NFC leverage whereas all remaining control variables maintain both their significance, magnitude, and most importantly their direction of effects. Whereas a one standard deviation increase in bank stress to which a zombie firm is connected increases corporate leverage by around one percentage point annually in the periphery of the euro area, the identical increase in our measure of bank fragility results in the two core euro area countries in a contraction of leverage of a comparable magnitude. The result that a further impairment of bank stability in stressed countries induces in particular weak firms to further increase their debt would be in line with the evidence in Acharya et al. (2016) based on syndicated loan data. Stressed banks in poorly performing economies might be more inclined to conduct very risky lending to particularly weak credit risks, possibly in attempts to gamble for resurrection. Under more favourable macroeconomic conditions, in turn, the contraction of leverage might reflect

NFCs' ability to turn to internal sources of funding and a generally weak demand for bank credit from those banks that are arguably under stress. This result would be in line with clinical evidence on sluggish credit demand despite drastically reduced corporate lending rates in Germany (Cycon and Koetter, 2015).

Columns (1) and (2) arguably present results for firms marked by different characteristics already before our sample period starting in 2010. Especially firm debt ratios have been much higher in stressed countries, while profitability was significantly lower. To better compare the effect of weak banks on firm leverage between the two groups of countries, we construct a matched sample based on all firm control variables, firm sector (NACE letter code), investment and debt servicing capacity, as well as several bank traits (bank size, capitalization, NPLs, return on assets, and maturity mismatch) . Specifically, we employ a one-to-one propensity score matching technique on the two years before our sample period (2008 and 2009) and only include firms and banks, which do not show significant differences in all variables for both years (Caliendo and Kopeinig, 2008). We refer to Table 9 in the appendix for summary statistics before and during our sample period.

Columns (3) and (4) in Table 5 show the results for the matched sample. The significant reduction in sample size further indicates the initial differences between firms and banks in both groups of countries. While results remain robust for the group of stressed countries, we no longer find a significant negative effect of bank stress on zombie firm leverage in Germany and France. Instead, we find a positive effect, which is similar in size to the periphery countries, but not significant.

– FIGURE 5 AROUND HERE –

To visualise potential differences in these effects when evaluating the effect on changes in leverage across the range of bank stress observed, consider

Figure 5. The left panel depicts conditional marginal effects for the subsample of periphery countries (column (3)) whereas the right panel shows the same for the two core countries (column (4)). Three issues are noteworthy.

First, also in stressed euro area countries there are banks that are not stressed. Importantly, for NFCs connected to these banks, we find no positive effect on leverage growth. Therefore, an important potential policy conclusion of this empirical exercise is that strengthening the resilience of the banking system in stressed economies might be an important building block towards deleveraging the real economy in general and small and medium-sized non-financial corporations in particular.

Second, already only mildly increasing levels of bank stress quickly lead to statistically significant and economically large increases in NFC leverage. Thus, containing in particular extremely unstable financial institutions lending activities in general and those to weak firms in particular appears to be of first order importance to pave the way for deleveraging stressed euro area economies successfully.

Third, the distribution of bank stress in the two core economies considered for comparison is considerably more densely distributed, yet it also features a few extreme outliers. When assessing conditional marginal effects, this feature gives rise to an important result that contrasts with the insignificant estimate of the interaction term in column (4) of Table 5. For periphery countries we do not find a significant effect of stressed banks' lending to zombie firms' leverage change. Thus, whereas connections of NFCs to weak banks imply an incrase in leverage in the periphery of the euro area, this is not the case in core countries.

4.3 Further results

4.3.1 Alternative dependent variables

So far, we focused on the implications of zombie firms borrowing from stressed banks on the observed annual change of NFC leverage between 2010 and 2014. In Table 6 we scrutinize our main finding that weak firms increase their indebtedness if they are connected to weak banks.

– TABLE 6 AROUND HERE –

In column (1), we consider the overall deleveraging between 2010 and 2014, rather than year-on-year deleveraging during this period. The dependent variable is thus firm leverage in 2014 less firm leverage in 2010. Instead of lagged control variables, we condition on the initial level of NFC leverage and specify the remaining independent variables as means during the entire period. Deleveraging balance sheets that already suffered from very high levels of liabilities when the sovereign crisis peaked in 2010 might be substantially more challenging compared to debt-reducing strategies of firms that started with cleaner slates. Compared to the baseline result in column (4) of Table 4, we do find qualitatively the same results. The interaction between zombie firms and stressed banks remains significantly positive whereas higher levels of, in this case, initial debt reduce annual debt increases.

But similar to the distinction in columns (3) and (4) of Table 5, the effect on the rate of leverage change might depend first and foremost on the choice of the firm to either deleverage the balance sheet or whether to continue levering up. Therefore, we specify in column (2) a discrete indicator equal to one as the dependent variable if the firm reduced leverage in a given year or zero otherwise. Independent of their bank relationship, zombie firms are generally around 3.1% less likely to reduce their leverage. Given a sample proportion of 56% of all firms exhibiting negative debt growth, this

magnitude is substantial in and of itself. More importantly, a connection of weak firms and banks suggests a reduction of 3% in the odds to observe leverage reduction for each standard deviation increase in bank stress. This result strongly supports the notion that financial stability in the banking system is an important ingredients to permit deleveraging in the corporate sector.

The results on the effects on firm leverage reported so far do not yet shed light on the channel *how* NFCs reduced or increased the share of liabilities net off provisions relative to total assets: by reducing debt or by increasing balance sheets. Therefore, we specify in columns (3) and (4) the change in NFC debt rather than leverage and the discrete indicator of debt rather than leverage reduction, respectively. These results mimic the ones obtained for leverage. Stressed banks that are connected to weak firms increase the indebtedness of NFC and render deleveraging significantly less likely.

4.3.2 Bank stress and zombie firms: alternative measures

Recall that we develop a continuous balance sheet based bank stress indicator. To test whether this choice has implications for our findings, we specify in columns (1) of Table 7 an indicator equal to one if the principal component is larger than the median value in the cross-section of banks rather than the continuous indicator itself. The positive interaction term remains statistically significant and qualitatively virtually identical regarding the magnitude of the effect.

– TABLE 7 AROUND HERE –

In column (2), we define bank stress based on banks' CDS spreads, which is a market-based rather than an accounting-based indicator of default risk. Since most European banks are not listed on capital markets and only for few credit insurance contracts are traded, the number of banks is significantly reduced

from 594 to 21 banks. But since these banks are amongst the most important ones in each of our sampled countries, the number of observations is not reduced as drastically, from around 1.2 mn observations to 655,995. However, the source of cross-sectional variation remains of course much more limited. Against this backdrop it is remarkable that we still estimate a statically significant, positive effect of bank stress on NFCs' change in leverage. In line with our baseline results, the impact of a one standard deviation increase in the CDS spread on firm leverage is around one percentage point.

Aside from the definition of bank stress, another dimension where we differ from previous studies is our definition of zombie firms based on a combination of thresholds on accounting based performance indicators. In contrast, McGowan et al. (2017) use the ability of firms to cover interest payments from operating results as an indicator of excessive indebtedness. Therefore we follow their approach and specify in column (3) zombie firms and the according interaction if the interest coverage, defined as EBITDA over interest paid, is smaller than two. This scheme to identify stressed firms yields qualitatively the same effects as our baseline gauge of zombie firms.

In column (4), in turn, we follow the approach suggested in Caballero et al. (2008) and seek to identify subsidised credit. The main measurement challenge is here that contrary to either the Japanse bank-firm data or facility-level information including loan terms in syndicated lending we cannot observe contracted interested rates. Therefore, we impute interest rates paid as the ratio of interest expenditures and borrowed funds and define zombie firms as those that pay (imputed) interest of less than 10 percent of the average interest rate German banks charge on outstanding debt to non-financial corporations. Given the associated plethora of sources for measurement error, it is not too surprising that we fail to estimate a statically significant interaction effect for this specification.

Finally, we identify zombie banks solely on the basis of their debt level relative to total assets being larger than 85%. Gebauer et al. (2017) show for several euro area countries that this level of debt to assets is a threshold beyond which investment is severely impeded by debt overhang. We confirm again the significantly positive interaction term between weak firms borrowing from weak banks implying a larger change of leveraging up the NFC.

In sum, we find for a range of alternative NFC and bank stress indicators that lending relationships between the weakest agents in both the financial and the real sector is not conducive to deleveraging in particular small and medium-sized corporates.

4.3.3 Addressing further issues

A further important concern is that also with core economies a number of NFCs fulfill our zombie definition, and conversely a considerable number of firms in the periphery of the euro area exist that deleveraged their balance sheets considerably. Therefore, we test in columns (1) and (2) of Table 8 if the sensitivity of leverage changes that is exhibited by zombie firms in response towards bank stress differs depending on the fundamental choice of the firm whether to lever up or whether to attempt to deleverage the firm. We split the sample into approximately 161,000 firms that increase their leverage by 6.7% on average and compare estimates to a subsample of around 215,000 firms that reduced their leverage by 5.9% on average. For both groups of NFCs we estimate significantly positive interaction terms. An important difference is though that zombie firms exhibiting increasing leverage anyhow also increase the pace of leveraging up by another 4 percentage points, which is economically significant. This interaction effect of weak banks being tied to weak firms is still positive for firms that deleveraged their balance sheets as shown in column (4). However, the magnitude is substantially smaller at

a coefficient of 0.019 and also only statistically significant at the 10%-level. Hence, firms that pursue arguably a strategy to reduce their indebtedness do indeed slow down in these efforts when connected to a stressed bank. But the overall effect on annual changes in debt remains negative at the mean of both bank stress and leverage distributions.

– TABLE 8 AROUND HERE –

Furthermore, we acknowledge that leverage might respond only slowly to either borrowing from stressed banks or the firm exhibiting stress itself. Therefore, we lag all covariates in column (1) by two rather than one period. Results remain qualitatively identical, although the magnitude of the effect declines somewhat.

Next, NFCs in France and Germany might simply already have been very different from the very onset of the financial crisis starting in 2007, rendering a comparison of leverage between 2010 until 2014 difficult. We therefore re-estimate our baseline results including all countries on the subsample of matched firms, in analogy to our results in Table 5. Both the positive interaction as well as direct zombie firm effect on change in leverage are confirmed.

Finally, in addition to systematically different firms we might also fall prey to spurious correlation if banks differ systematically. Therefore, we additionally match on observable bank traits (bank size, capitalization, NPLs, return on assets, and maturity mismatch) and accordingly provide summary statistics in Table 9. Column (3) of Table 8 confirms again direction, magnitude, and significance of our baseline results.

In sum, the increase in firm leverage is very unlikely the spurious result of unobserved systemic differences either among firms or banks.

5 Conclusion

The aim of this paper is to investigate the impact of stressed banks on the deleveraging process of small and medium-size enterprises (SMEs), with a focus on euro area periphery countries. In particular, we test whether banks in distress delay the deleveraging of non-viable firms. To this end, we combine SME balance sheet information from the Amadeus database with bank balance sheet data of BankScope by string-matching the information on bank-firm relationships. The resulting borrower-lender database allows us to identify the transmission of banking sector developments to the NFC sector.

Our paper adds to the recent literature on bank-firm linkages in several respects: First, our sample includes a large number of small and medium-sized enterprises as opposed to the previous literature that predominantly analyses firm-bank relationships based on smaller samples of large firms. Second, while the previous literature typically focuses on real economy effects of leverage, our emphasis is on the implications of bank stress for NFC deleveraging, which appears to be a prerequisite for the recovery in investment and employment. Third, we construct a new continuous measure of bank stress based on the principal component related to five bank indicators (capitalization, NPL ratio, return on assets, z-score and maturity mismatch), which also allows to capture bank stress for small, unlisted banks.

Our results document that, after controlling for firm- and bank-specific characteristics as well as demand-side effects, bank stress in general has a small decreasing effect on firm leverage by around 0.1 percentage points annually for each standard deviation increase in bank stress. However, we find that a one standard deviation increase in bank stress is associated with an increase in firm leverage of zombie firms of around one percentage

point. This effect is only significant in the euro area periphery countries. Similarly to periphery countries, we find that zombie firms in core countries continued to lever up between 2010 and 2014, but – when accounting for differences in firms and banks between stressed and non-stressed countries – there was no significant impact of bank stress on zombie firm leverage in France and Germany. This suggests that the NFC deleveraging process is hindered by bank weakness, possibly because weak banks have an incentive to evergreen loans to their impaired borrowers to avoid having to declare outstanding loans non-performing. Our results are thus in line with Acharya et al. (2016) and Schivardi et al. (2017): by evergreening loans to zombie firms, banks in distress were delaying the realization of losses and gambling for resurrection in the hope that an economic recovery improves the situation of their currently insolvent borrowers. This behaviour led to an inefficient allocation of credit, since a higher share of loan supply is provided to low productive distressed borrowers thereby crowding out growth opportunities of productive firms.

We test our results across a wide set of robustness checks. In particular, we find that our results are largely unaffected if we replace the change in the leverage ratio with the change in absolute debt levels. This further strengthens the evidence for zombie lending of stressed banks as our results do not seem to be driven by asset valuations. Our results are also qualitatively similar if we replace our bank stress indicator with the banks' respective CDS spread, apply an alternative zombie definition, or re-run our baseline regression on a matched subsample.

Overall, the analysis thus highlights the importance of sound banks for the deleveraging process of the corporate sector. Policies aimed at swiftly addressing the remaining bank weakness and facilitating bank deleveraging, most notably by increasing bank capitalization, or by providing incentives for banks to move more decisively with the workout of bad assets, could also

support the deleveraging of the corporate sector in general, and in particular SMEs.

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Appendix

– TABLE 10 AROUND HERE –

– TABLE 9 AROUND HERE –

Figures

Figure 1.
Share employment covered in Bureau van Dijk's Amadeus database
The graph shows the percentage share of employment of firms in the Amadeus database relative to the overall number of employees as reported by the Eurostat Structural Business Statistics. Coverage in Germany and France appears much lower, as around 50% of firms in these countries do not report employment information in Amadeus.

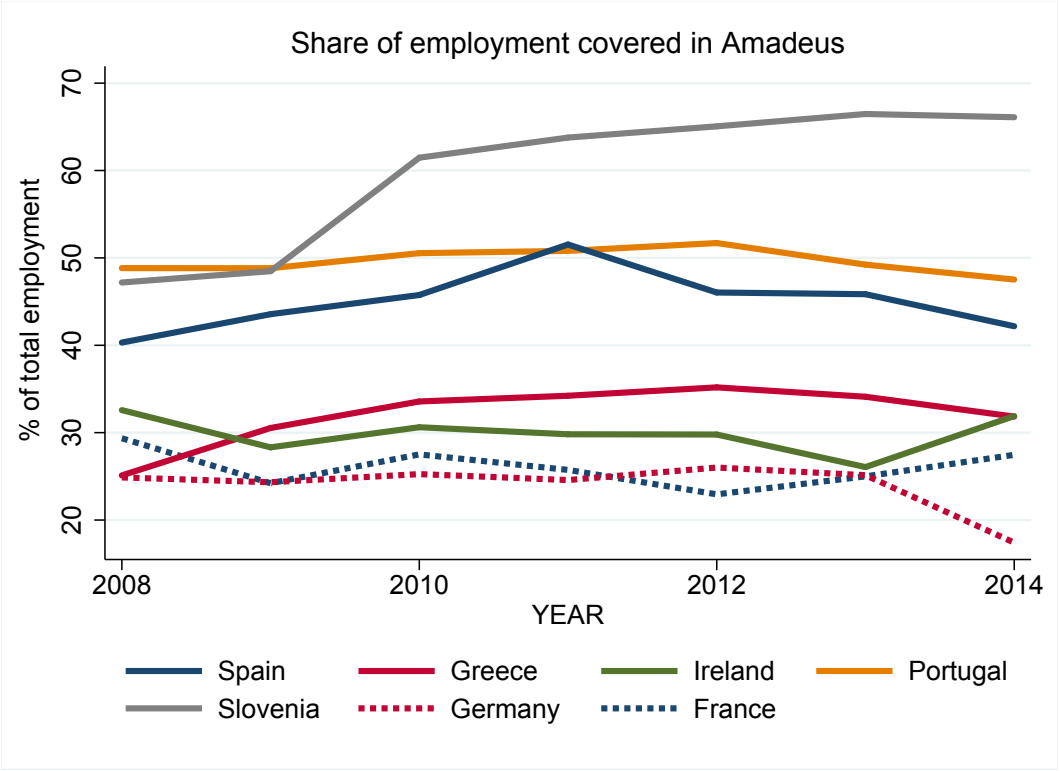


Figure 2.

Share of zombie firms 2010-2014 by country

The graph shows the percentage share of firms that have been classified as zombies in a given year and country. Zombie firms are firms, that for at least two consecutive years have negative returns, negative investment, and debt servicing capacity (EBITDA/financial debt) below 5%.

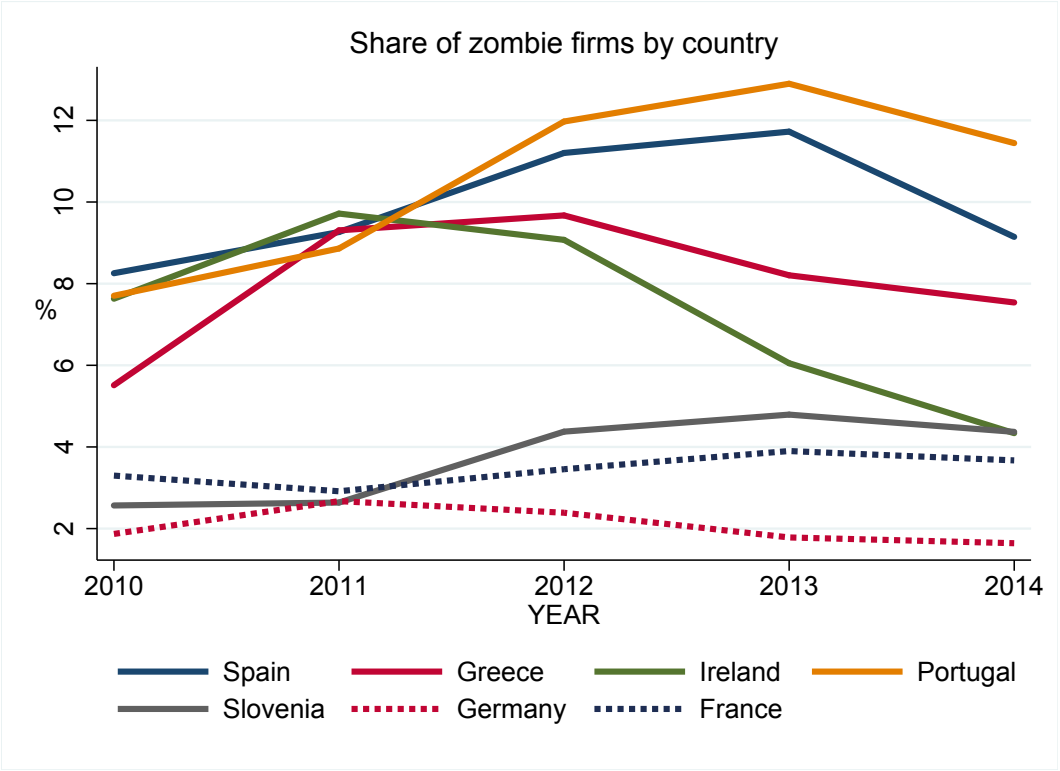


Figure 3.

Bank stress indicator and CDS spreads, 2007-2014

The graph shows yearly medians for a sample of 21 large banks (all banks in our sample, for which CDS data are available). The overall correlation coefficient of the principal component with the respective banks' CDS spread is 0.68.

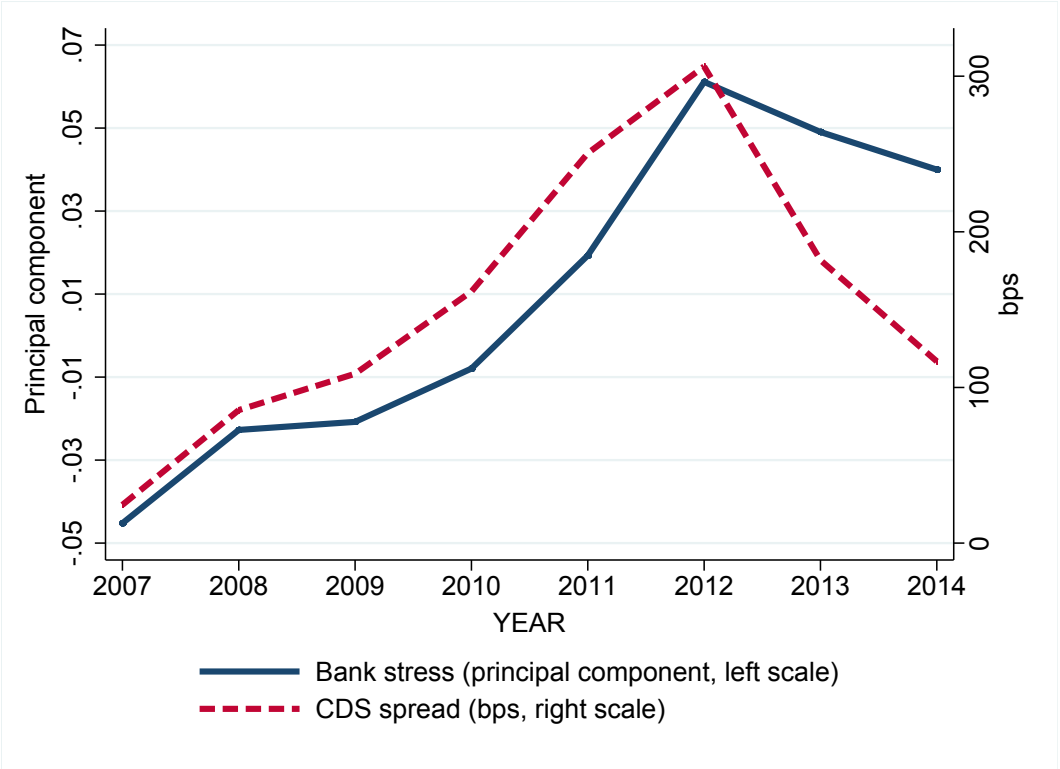


Figure 4.

Marginal effect of bank stress on zombie firm leverage

The graph shows the overall effect of bank stress on zombie firm's leverage across different levels of bank stress in percentage points (left scale), as given by the regression result in Table 4, column (4). Dashed lines depict the 95% confidence interval of the marginal conditional effect. The histogram indicates the share of banks in the sample associated with the individual stress levels (right scale).

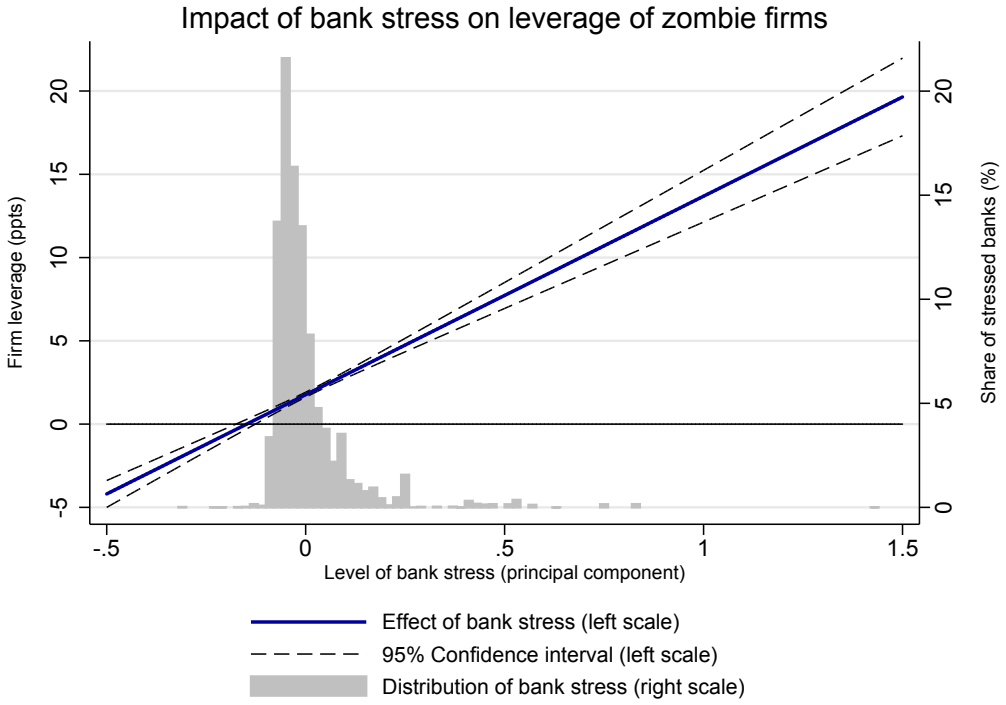
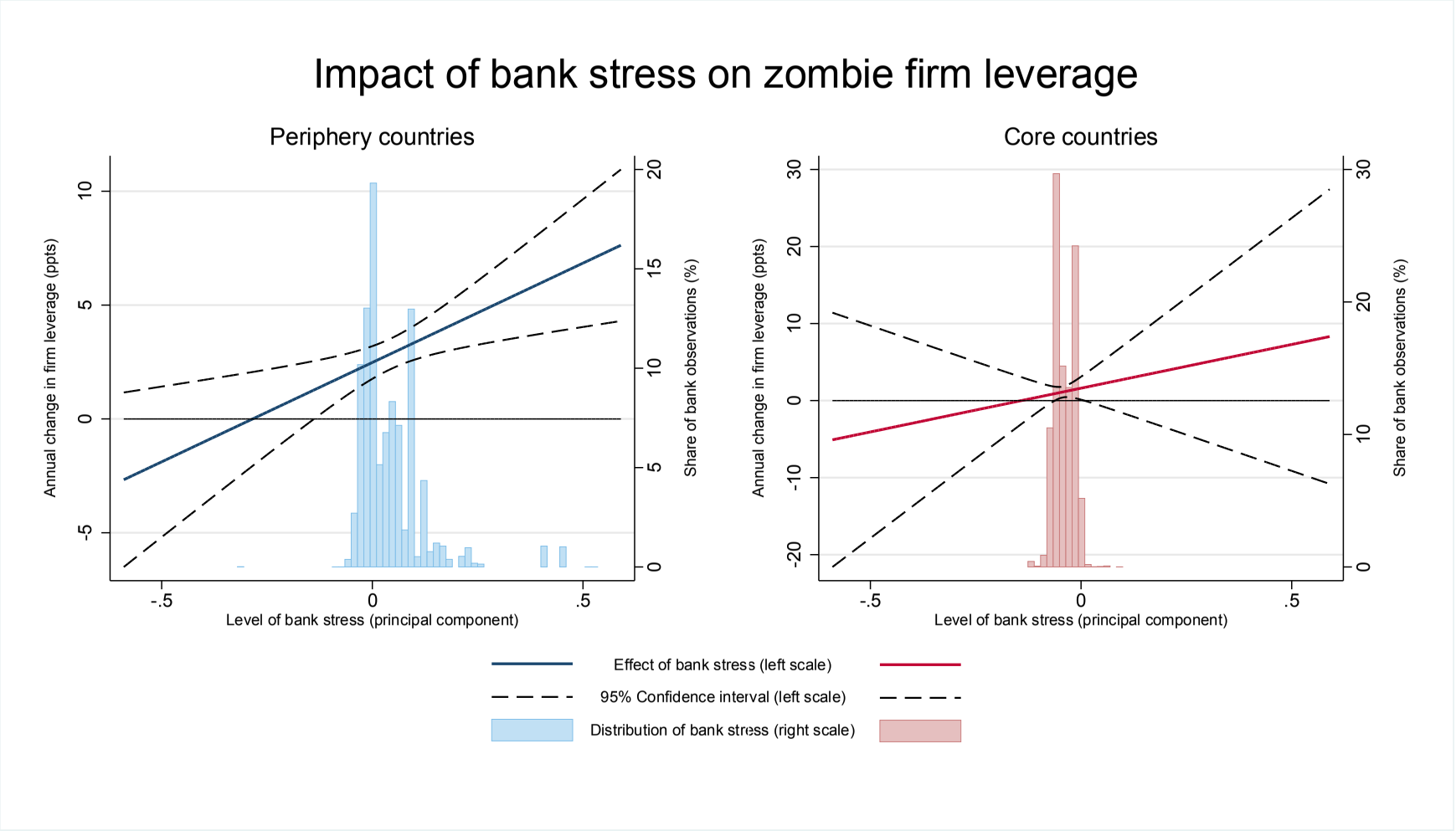


Figure 5.

Marginal effect of bank stress on zombie firm leverage by country group

The graphs show the overall effect of bank stress on zombie firm's leverage across different levels of bank stress in percentage points (left scale), as given by the regression result in Table 5, columns (3) and (4). The graph on the left-hand side only includes euro area periphery countries (Spain, Greece, Ireland, Portugal, and Slovenia) and the graph on the right-hand side only includes core countries (France and Germany). The respective estimation samples only include firms and banks that showed similar observable characteristics during 2008 and 2009 (see Table 9 for summary statistics). Dashed lines depict the 95% confidence interval of the marginal conditional effect. The histograms indicate the share of banks in the sample associated with the individual stress levels (right scale).



Tables

Table 1
Sample composition
The table reports the number of firms, zombie firms and banks by country. 'Zombie firms' are firms with negative returns, negative debt, and debt servicing capacity (EBITDA/financial debt) below 5%, for at least two consecutive years. Firms are reported according to their country of incorporation, banks according to their country of operation (i.e. the country of the firm it is attached to). Banks may therefore be present in several countries.

	Periphery Countries					Core Countries		
	ES	GR	IE	PT	SI	DE	FR	Total
No. of firms	126,737	13,482	2,232	70,583	30,910	5,226	174,095	423,265
No. of zombie firms	24,989	2,319	311	15,454	2,439	160	15,016	60,688
No. of banks	31	8	10	86	16	706	138	995

Table 2
Definition of variables

Variable	Description	Data source
Leverage	Total liabilities less provisions over total assets	Amadeus
Firm Size	1=Micro, 2=Small, 3=Medium; EU classification based on total assets and operating revenue	Amadeus
Cash Holdings	Cash and cash equivalents over total assets	Amadeus
Tangibility	Tangible fixed assets over total assets	Amadeus
Return on Assets	Net income over total assets	Amadeus
Zombie	Dummy variable equal to 1 for firms with negative returns, negative investment, and debt servicing capacity below 5% for at least two consecutive years, and zero otherwise, where:	
Returns	Return on assets, as defined above	Amadeus
Investment	Net change in total fixed assets relative to previous year	Amadeus
Debt Servicing Capacity	EBITDA over financial debt	Amadeus
Bank Stress	Principal component derived from the following variables:	
Capitalization	Equity over total assets	Bankscope
Non-Performing Loans	Non-performing loans over total loans	Bankscope
Return on Assets	Net income over total assets	Bankscope
Z-Score	Equity and net income over SD(Return on Assets)	Bankscope
Maturity Mismatch	Deposits less liquid assets over total assets	Bankscope
Bank Size	ln(Total Assets) in m EUR of 2000	Bankscope
GDP Growth	Change in annual GDP relative to previous year	AMECO
Government Bond Yield	Average of monthly yield on outstanding 10 year government bonds	ECB

Table 3

Firm, bank and country characteristics

The table shows descriptive statistics for the years 2010 to 2014, for seven euro area countries (Spain, Greece, Ireland, Portugal, Slovenia, France, and Germany). Reported variables for firms are *Leverage* (total liabilities less provisions over total assets), *Firm Size* (EC definition, 1=micro, 2=small, 3=medium), *Cash Holdings* (total cash over total assets), *Tangibility* (total tangible fixed assets over total assets), and *Return on Assets* (net income over total assets). *Zombie* is a dummy equal to 1 for firms with negative return, negative debt and EBITDA to financial debt below 5% for at least two consecutive years, and zero otherwise. Bank variables are *Bank Stress* (principal component indicator derived from bank capitalization, non-performing loans, z-score, return on assets, and maturity mismatch), as well as *Bank Size* (ln(total assets) in m EUR of 2000). Country-specific control variables are *GDP Growth*, and *Government Bond Yield* (10-year yield). All variables, with the exception of *Zombie* and *Bank Stress*, are reported in percentages.Firm variables are trimmed by 1% at both ends.

		N	Mean	SD	p5	p50	p95
	Firms						
Leverage	423,265	1,397,926	0.604	0.274	0.172	0.603	1.009
Firm Size	423,265	1,397,926	1.496	0.652	1.000	1.000	3.000
Cash Holdings	423,265	1,397,926	0.150	0.174	0.002	0.080	0.534
Tangibility	423,265	1,397,926	0.210	0.217	0.006	0.128	0.689
Return on Assets	423,265	1,397,926	0.023	0.085	-0.122	0.019	0.157
Zombie	423,265	1,397,926	0.068	0.252	0.000	0.000	1.000
	Banks						
Bank Size	971	1,397,926	11.032	1.801	7.814	11.364	13.915
Bank Stress	971	1,397,926	0.002	0.083	-0.077	-0.014	0.127
	Countries						
GDP Growth	7	1,397,926	0.008	0.252	-0.044	0.013	0.037
Government Bond Yield	7	1,397,926	0.045	0.031	0.017	0.033	0.102

Table 4

Baseline regressions

Regression results refer to the period 2010 to 2014. The dependent variable 'Δ Leverage' is the difference in a firm's leverage relative to the previous year in percentages. *Zombie* is a dummy equal to 1 for firms with negative return, negative debt and EBITDA to financial debt below 5% for at least two consecutive years, and zero otherwise. *Bank Stress* is a principal component indicator derived from bank capitalization, non-performing loans, z-score, return on assets, and maturity mismatch (for a more detailed description see Table 2). Firm control variables are *Leverage* (total liabilities less provisions over total assets), dummy variables for *Small Firm* and *Medium Firm* (EC definition, omitted category is micro), *Cash Holdings* (total cash over total assets), *Tangibility* (total tangible fixed assets over total assets), and *Return on Assets* (net income over total assets). Further control variables are *Bank Size* (ln(total assets) in m EUR of 2000), *GDP Growth*, and *Government Bond Yield* (10-year yield). All variables, with the exception of *Zombie* and *Bank Stress*, are reported in percentages. All independent variables are lagged by one period. Firm variables are trimmed by 1% at both ends, standard errors clustered by firm in parenthesis. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Dependent variable: Δ Leverage	(1) Firm- and year-FE	(2) + Firm- and bank controls	(3) + Country controls	(4) + Sector-country-year-FE
Zombie	0.024***	0.018***	0.018***	0.018***
	(0.001)	(0.001)	(0.001)	(0.001)
Bank Stress	-0.016***	-0.019***	-0.024***	-0.000
	(0.002)	(0.002)	(0.002)	(0.004)
Bank Stress x Zombie	0.109***	0.125***	0.125***	0.119***
	(0.008)	(0.008)	(0.008)	(0.008)
Leverage	-0.617***	-0.649***	-0.649***	-0.650***
	(0.002)	(0.002)	(0.002)	(0.002)
Small Firm		-0.004***	-0.004***	-0.004***
		(0.000)	(0.000)	(0.000)
Medium Firm		-0.008***	-0.008***	-0.009***
		(0.001)	(0.001)	(0.001)
Cash Holdings		-0.033***	-0.033***	-0.034***
		(0.002)	(0.002)	(0.002)
Tangibility		0.027***	0.027***	0.028***
		(0.002)	(0.002)	(0.002)
Return on Assets		-0.129***	-0.130***	-0.129***
		(0.003)	(0.003)	(0.003)
Bank Size		-0.001***	-0.001***	-0.000
		(0.000)	(0.000)	(0.000)
GDP Growth			0.001***	
			(0.000)	
Government Bond Yield			-0.016***	
			(0.006)	
R2	0.48	0.49	0.49	0.49
R2 (adjusted)	0.28	0.29	0.29	0.29
N	1,193,205	1,193,205	1,193,205	1,193,204
Mean dependent variable	-0.005	-0.005	-0.005	-0.005
SD dependent variable	0.102	0.102	0.102	0.102
Mean Bank Stress	0.002	0.002	0.002	0.002
SD Bank Stress	0.083	0.083	0.083	0.083
No. of banks	594	594	594	594
No. of firms	328,502	328,502	328,502	328,502
No. of zombie firms	46,460	46,460	46,460	46,460
Firm-FE	Yes	Yes	Yes	Yes
Year-FE	Yes	Yes	Yes	No
Sector x Country x Year-FE	No	No	No	Yes

Table 5

Subsample regressions

Regression results refer to the period 2010 to 2014. Δ *Leverage* is the difference in firm leverage relative to the previous year in percentages. *Zombie* is a dummy equal to 1 for firms with negative return, negative debt and EBITDA to financial debt below 5% for at least two consecutive years, and zero otherwise. *Bank Stress* is a principal component indicator derived from bank capitalization, non-performing loans, z-score, return on assets, and maturity mismatch (for a more detailed description see Table 2). Control variables are *Leverage* (total liabilities less provisions over total assets), dummy variables for *Small Firm* and *Medium Firm* (EC definition, omitted category is micro), *Cash Holdings* (total cash over total assets), *Tangibility* (total tangible fixed assets over total assets), *Return on Assets* (net income over total assets), and *Bank Size* (ln(total assets) in m EUR of 2000). Column (1) only includes firms in euro area periphery countries (Spain, Greece, Ireland, Portugal, and Slovenia). Column (2) only includes euro area core countries (France and Germany). Columns (3) and (4) show results for periphery and core countries, respectively, for a subsample of propensity score matched firms and banks. All independent variables are lagged by one period. Firm variables are trimmed by 1% at both ends, standard errors clustered by firm in parenthesis. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Dependent variable: Δ Leverage	(1) Periphery countries	(2) Core Countries	(3) Periphery (matched)	(4) Core (matched)
Zombie	0.015***	0.011***	0.025***	0.016**
	(0.001)	(0.003)	(0.004)	(0.008)
Bank Stress	0.000	-0.011	-0.025	-0.069
	(0.004)	(0.018)	(0.021)	(0.048)
Bank Stress x Zombie	0.119***	-0.122**	0.087***	0.114
	(0.009)	(0.051)	(0.030)	(0.154)
Leverage	-0.629***	-0.684***	-0.577***	-0.631***
	(0.003)	(0.003)	(0.009)	(0.010)
Small Firm	-0.005***	-0.003***	-0.005**	-0.000
	(0.001)	(0.001)	(0.002)	(0.002)
Medium Firm	-0.010***	-0.007***	-0.008	-0.008**
	(0.001)	(0.001)	(0.005)	(0.004)
Cash Holdings	-0.048***	-0.025***	-0.049***	-0.025***
	(0.003)	(0.002)	(0.007)	(0.007)
Tangibility	0.025***	0.037***	0.023**	0.043***
	(0.003)	(0.004)	(0.010)	(0.011)
Return on Assets	-0.163***	-0.106***	-0.228***	-0.146***
	(0.004)	(0.003)	(0.012)	(0.010)
Bank Size	-0.000	-0.001	-0.005	0.005
	(0.000)	(0.002)	(0.005)	(0.004)
R2	0.49	0.48	0.45	0.44
R2 (adjusted)	0.29	0.30	0.28	0.26
N	655,624	537,580	57,659	58,107
Mean dependent variable	-0.005	-0.006	-0.003	-0.005
SD dependent variable	0.108	0.095	0.106	0.090
Mean Bank Stress	0.042	-0.046	0.043	-0.039
SD Bank Stress	0.092	0.029	0.080	0.025
No. of banks	70	535	38	103
No. of firms	186,122	142,380	13,567	14,023
No. of zombie firms	34,206	12,254	2,361	1,522
Firm-FE	Yes	Yes	Yes	Yes
Sector x Country x Year-FE	Yes	Yes	Yes	Yes

Table 6

Alternative dependent variables

Regression results refer to the period 2010 to 2014 . 'Δ Leverage 2010-2014' is the difference in firm leverage between 2010 and 2014 in percentages. 'Decrease in leverage (debt)' is a dummy equal to 1 if a firm's leverage (debt) is less than the previous year's leverage (debt). 'Δ Debt' is the difference in debt to the previous year's debt, divided by the previous year's debt. *Zombie* is a dummy equal to 1 for firms with negative return, negative debt and EBITDA to financial debt below 5% for at least two consecutive years, and zero otherwise. *Bank Stress* is a principal component indicator derived from bank capitalization, non-performing loans, z-score, return on assets, and maturity mismatch (for a more detailed description see Table 2). Control variables are *Leverage* (total liabilities less provisions over total assets), dummy variables for *Small Firm* and *Medium Firm* (EC definition, omitted category is micro), *Cash Holdings* (total cash over total assets), *Tangibility* (total tangible fixed assets over total assets), *Return on Assets* (net income over total assets), and *Bank Size* (ln(total assets) in m EUR of 2000). Independent variables in column (1) – with the exception of 'Leverage in 2010' – refer to means during the period 2010 to 2014. Independent variables in columns (2) to (4) are lagged by one period. Firm variables are trimmed by 1% at both ends, standard errors clustered by firm in parenthesis. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

	(1) Cross section	(2) LPM	(3) Active deleveraging	(4) LPM active deleveraging
Dependent variable:	Δ Leverage 2010–2014	Decrease in leverage (0/1)	Δ Debt (yearly)	Decrease in debt (0/1)
Zombie	0.050***	-0.031***	0.084***	-0.072***
	(0.001)	(0.003)	(0.002)	(0.003)
Bank Stress	-0.002**	0.002	-0.010	0.013
	(0.001)	(0.016)	(0.016)	(0.016)
Bank Stress x Zombie	0.020***	-0.367***	0.367***	-0.281***
	(0.002)	(0.028)	(0.022)	(0.029)
Leverage in 2010	-0.247***			
	(0.002)			
Leverage		2.186***	-1.920***	1.744***
		(0.009)	(0.010)	(0.008)
Small Firm	0.015***	0.030***	-0.064***	0.062***
	(0.001)	(0.002)	(0.002)	(0.003)
Medium Firm	0.024***	0.072***	-0.135***	0.115***
	(0.001)	(0.005)	(0.004)	(0.005)
Cash Holdings	-0.097***	0.116***	-0.132***	0.256***
	(0.003)	(0.007)	(0.008)	(0.008)
Tangibility	-0.017***	-0.127***	0.104***	-0.237***
	(0.002)	(0.010)	(0.013)	(0.010)
Return on Assets	-0.755***	0.429***	-0.628***	0.561***
	(0.009)	(0.009)	(0.009)	(0.009)
Bank Size	-0.000	-0.000	0.001	0.000
	(0.000)	(0.001)	(0.001)	(0.001)
R2	0.22	0.40	0.38	0.36
R2 (adjusted)	0.21	0.17	0.14	0.12
N	192,624	1,193,204	1,156,392	1,193,204
Mean dependent variable	-0.035	0.568	0.030	0.539
SD dependent variable	0.164	0.495	0.395	0.498
Mean Bank Stress	-0.031	0.002	0.002	0.002
SD Bank Stress	0.033	0.083	0.083	0.083
No. of banks	171	594	572	594
No. of firms	192,624	328,502	319,285	328,502
No. of zombie firms	23,429	46,460	44,455	46,460
Firm-FE	No	Yes	Yes	Yes
Sector x Country-FE	Yes	No	No	No
Sector x Country x Year-FE	No	Yes	Yes	Yes

Table 7

Alternative definitions of bank stress and zombie firms

Regression results refer to the period 2010 to 2014. 'Δ Leverage' is the difference in a firm's leverage relative to the previous year in percentages. Columns (1) and (2) employ the same zombie firm definition as in Table 4. In column (1), bank stress is alternatively defined as a dummy equal to 1 for banks with below-median principal component and 0 otherwise. Column (2) only includes banks with available CDS spread data and defines bank stress as the bank CDS spread in percentage points. Columns (3) through (5) use different zombie definitions. Firms in column (3) are considered zombies whenever their interest coverage (EBITDA/interest paid) is below 2. Zombies in column (4) are firms with subsidized credit, defined as firms paying interest of less than 10 percent of the average German interest rate banks charge on outstanding debt to non-financial corporations. In column (5) 'Zombie' is equal to 1 for firms with debt exceeding 85% of total assets and zero otherwise. Control variables (output omitted) are firm Leverage, dummies for Small and Medium Firm, Cash Holdings, Tangibility, Return on Assets and Bank Size. For detailed variable descriptions see Table 2. All independent variables are lagged by one period. Firm variables are trimmed by 1% at both ends, standard errors clustered by firm in parenthesis. * $p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Dependent variable:	(1)	(2)	(3)	(4)	(5)
Δ Leverage	Bank stress dummy	Bank stress CDS spread	Zombie interest coverage	Zombie subsidised credit	Zombie leverage
Zombie	0.009***	0.003*			
	(0.001)	(0.001)			
Bank Stress (Dummy)	-0.001*				
	(0.001)				
Bank Stress (Dummy) x Zombie	0.013***				
	(0.002)				
Bank Stress (CDS)		-0.000			
		(0.000)			
Bank Stress (CDS) x Zombie		0.003***			
		(0.000)			
Zombie (Interest Coverage)			0.007***		
			(0.000)		
Bank Stress			-0.013***	0.003	-0.007*
			(0.004)	(0.006)	(0.004)
Bank Stress x Zombie (Interest Coverage)			0.109***		
			(0.004)		
Zombie (Interest Benchmark)				0.001	
				(0.001)	
Bank Stress x Zombie (Interest Benchmark)				-0.001	
				(0.009)	
Zombie (Leverage)					0.014***
					(0.001)
Bank Stress x Zombie (Leverage)					0.083***
					(0.006)
R2	0.49	0.48	0.49	0.50	0.49
R2 (adjusted)	0.29	0.29	0.29	0.29	0.29
N	1,193,204	655,995	1,192,281	528,893	1,193,204
Mean dependent variable	-0.005	-0.004	-0.005	-0.007	-0.005
SD dependent variable	0.102	0.105	0.102	0.096	0.102
Mean Bank Stress	0.002	4.173	0.002	0.020	0.002
SD Bank Stress	0.083	3.368	0.083	0.071	0.083
No. of banks	594	21	594	59	594
No. of stressed banks	177				
No. of firms	328,502	177,269	328,405	155,463	328,502
No. of zombie firms	46,460	31,596	125,276	21,574	79,151
Firm-FE	Yes	Yes	Yes	Yes	Yes
Sector x Country x Year-FE	Yes	Yes	Yes	Yes	Yes
Control variables	Yes	Yes	Yes	Yes	Yes

Table 8

Addressing additional specification challenges

Regression results refer to the period 2010 to 2014. Δ *Leverage* is the difference in firm leverage relative to the previous year in percentages. *Zombie* is a dummy equal to 1 for firms with negative return, negative debt and EBITDA to financial debt below 5% for at least two consecutive years, and zero otherwise. *Bank Stress* is a principal component indicator derived from bank capitalization, non-performing loans, z-score, return on assets, and maturity mismatch (for a more detailed description see Table 2). Control variables are *Leverage* (total liabilities less provisions over total assets), dummy variables for *Small Firm* and *Medium Firm* (EC definition, omitted category is micro), *Cash Holdings* (total cash over total assets), *Tangibility* (total tangible fixed assets over total assets), *Return on Assets* (net income over total assets), and *Bank Size* (ln(total assets) in m EUR of 2000). Columns (1) and (2) only include firms which increased or decreased their leverage relative to the previous year, respectively. In column (3) all firm control variables and *Bank Size* are lagged by two periods instead of one period. Columns (4) and (5) present results on matched samples between the euro area periphery countries and the core countries. In column (2) firms of the two sample groups have similar characteristics during 2008 and 2009, in column (3) both firm and bank characteristics have been matched for 2008 and 2009. For summary statistics of the matched samples see Tables 10 and 9. All independent variables in columns (2) and (3) are lagged by one period. Firm variables are trimmed by 1% at both ends, standard errors clustered by firm in parenthesis. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Dependent variable:	(1)	(2)	(3)	(4)	(5)
Δ Leverage	Increasing leverage	Decreasing leverage	2 lags	Matched firms	Matched firms and banks
Zombie	0.018***	0.004***	-0.013***	0.019***	0.021***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Bank Stress	0.004	0.001	0.000	0.004	-0.030
	(0.007)	(0.003)	(0.004)	(0.006)	(0.019)
Bank Stress x Zombie	0.040***	0.019*	0.041***	0.147***	0.154***
	(0.008)	(0.011)	(0.008)	(0.013)	(0.027)
Leverage	-0.250***	-0.421***	-0.253***	-0.618***	-0.599***
	(0.004)	(0.003)	(0.002)	(0.003)	(0.007)
Small Firm	-0.004***	0.000	0.000	-0.005***	-0.003*
	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)
Medium Firm	-0.013***	0.003***	-0.000	-0.010***	-0.008**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.003)
Cash Holdings	-0.006**	-0.022***	0.000	-0.038***	-0.036***
	(0.003)	(0.002)	(0.002)	(0.002)	(0.005)
Tangibility	-0.063***	0.061***	-0.042***	0.027***	0.029***
	(0.004)	(0.003)	(0.002)	(0.003)	(0.007)
Return on Assets	-0.117***	-0.077***	0.006**	-0.149***	-0.177***
	(0.004)	(0.002)	(0.003)	(0.004)	(0.008)
Bank Size	0.001*	-0.001***	0.000	-0.000	0.001
	(0.000)	(0.000)	(0.000)	(0.000)	(0.003)
R2	0.55	0.60	0.33	0.46	0.44
R2 (adjusted)	0.26	0.37	0.08	0.27	0.27
N	405,271	594,818	1,160,244	559,529	115,766
Mean dependent variable	0.067	-0.059	-0.005	-0.005	-0.004
SD dependent variable	0.084	0.068	0.102	0.097	0.098
Mean Bank Stress	0.001	0.001	0.002	-0.004	0.002
SD Bank Stress	0.078	0.081	0.083	0.073	0.072
No. of banks	342	445	590	412	135
No. of firms	161,091	215,043	319,490	139,223	27,590
No. of zombie firms	32,983	31,230	44,735	20,014	3,883
Firm-FE	Yes	Yes	Yes	Yes	Yes
Sector x Country x Year-FE	Yes	Yes	Yes	Yes	Yes

Table 9

Summary statistics for the sample matched on banks and firms

The sample only contains firms and banks with similar observable characteristics during 2008 and 2009, after applying propensity score matching on both bank and firm observables.

	Core Countries						Periphery Countries						Difference	
	N	Mean	SD	p5	p50	p95	N	Mean	SD	p5	p50	p95	Δ	SE
						2008–2009								
	Firms						*Firms*							
Leverage	15,303	30,497	0.638	0.200	0.290	0.649	0.941	14,975	29,882	0.638	0.217	0.243	0.664	0.944	-0.000	0.002
Total Assets (m EUR)	15,303	30,498	1.332	1.511	0.115	0.721	4.820	14,975	29,888	1.313	1.492	0.101	0.720	4.715	-0.019	0.012
Cash Holdings	15,303	30,304	0.133	0.129	0.003	0.093	0.399	14,975	29,781	0.132	0.134	0.005	0.084	0.417	-0.001	0.001
Tangibility	15,303	30,495	0.179	0.160	0.013	0.128	0.517	14,975	29,880	0.178	0.154	0.012	0.134	0.489	-0.002	0.001
Return on Assets	15,303	30,447	0.027	0.076	-0.102	0.028	0.135	14,975	29,796	0.027	0.062	-0.062	0.020	0.125	0.000	0.001
Debt Servicing Capacity	15,303	30,440	0.165	0.192	-0.088	0.136	0.510	14,975	29,598	0.165	0.184	-0.046	0.126	0.504	0.000	0.002
Net Investment	15,303	30,115	0.044	0.585	-0.392	-0.109	0.963	14,975	29,604	0.047	0.606	-0.428	-0.086	1.006	0.004	0.005
	Banks						*Banks*							
Bank Size	107	30,498	11.045	2.212	8.158	10.251	14.245	41	29,892	11.058	0.863	9.168	11.455	11.576	0.013	0.014
Capitalization	107	30,498	0.057	0.031	0.021	0.047	0.109	41	29,892	0.057	0.016	0.033	0.055	0.085	0.000	0.000
Non-Performing Loans	107	30,405	0.021	0.009	0.010	0.019	0.037	41	29,754	0.021	0.006	0.009	0.019	0.029	-0.000	0.000
Return on Assets	107	30,497	0.004	0.004	-0.003	0.004	0.012	41	29,890	0.004	0.003	0.002	0.003	0.009	0.000	0.000
Maturity Mismatch	107	30,498	-0.408	0.278	-0.750	-0.460	-0.034	41	29,892	-0.407	0.127	-0.636	-0.425	-0.239	0.001	0.002
						2010–2014								
	Firms						*Firms*							
Leverage	15,290	66,975	0.617	0.231	0.249	0.615	0.962	14,968	68,652	0.609	0.273	0.167	0.619	1.005	-0.008***	0.001
Total Assets (m EUR)	15,290	67,170	1.455	1.789	0.109	0.773	5.150	14,968	69,333	1.360	1.716	0.088	0.709	4.920	-0.095***	0.009
Cash Holdings	15,290	65,260	0.149	0.148	0.003	0.101	0.455	14,968	68,011	0.132	0.149	0.003	0.075	0.457	-0.017***	0.001
Tangibility	15,290	66,573	0.161	0.158	0.008	0.108	0.495	14,968	67,626	0.178	0.174	0.005	0.122	0.540	0.016***	0.001
Return on Assets	15,290	66,344	0.027	0.087	-0.126	0.030	0.152	14,968	67,602	0.002	0.086	-0.162	0.009	0.116	-0.026***	0.000
Debt Servicing Capacity	15,290	66,103	0.176	0.234	-0.136	0.138	0.595	14,968	63,964	0.136	0.238	-0.163	0.093	0.567	-0.040***	0.001
Net Investment	15,290	65,462	0.024	0.610	-0.474	-0.117	1.009	14,968	65,814	0.005	0.592	-0.511	-0.081	0.871	-0.019***	0.003
	Banks						*Banks*							
Bank Size	107	67,206	11.118	2.108	8.272	10.360	14.071	41	69,485	11.067	0.883	9.329	11.368	11.992	-0.051***	0.009
Capitalization	107	67,206	0.062	0.032	0.026	0.051	0.124	41	69,485	0.046	0.029	-0.008	0.049	0.091	-0.017***	0.000
Non-Performing Loans	107	66,141	0.023	0.009	0.012	0.022	0.040	41	69,049	0.064	0.041	0.019	0.051	0.134	0.041***	0.000
Return on Assets	107	66,154	0.005	0.004	0.001	0.004	0.010	41	69,477	-0.008	0.022	-0.027	-0.005	0.004	-0.013***	0.000
Maturity Mismatch	107	67,206	-0.418	0.276	-0.786	-0.510	-0.041	41	69,485	-0.386	0.154	-0.706	-0.380	-0.157	0.032***	0.001

Table 10
Summary statistics for the sample matched on firms
The sample only contains firms with similar observable characteristics during 2008 and 2009, after applying propensity score matching on firm observables.

	Core Countries						Periphery Countries						Difference	
	N	Mean	SD	p5	p50	p95	N	Mean	SD	p5	p50	p95	Δ	SE
						2008–2009								
	Firms						*Firms*							
Leverage	83,653	165,109	0.624	0.211	0.256	0.638	0.940	83,521	165,709	0.624	0.232	0.207	0.653	0.950	0.000	0.001
Total Assets (m EUR)	83,653	165,121	1.938	2.620	0.103	0.778	8.114	83,521	165,738	1.930	2.440	0.103	0.959	7.538	-0.008	0.009
Cash Holdings	83,653	162,981	0.133	0.137	0.002	0.088	0.418	83,521	164,477	0.133	0.140	0.004	0.082	0.432	-0.000	0.000
Tangibility	83,653	165,084	0.178	0.170	0.010	0.123	0.542	83,521	165,528	0.178	0.166	0.008	0.127	0.523	-0.001	0.001
Return on Assets	83,653	163,708	0.029	0.079	-0.107	0.028	0.148	83,521	165,039	0.028	0.069	-0.077	0.021	0.144	-0.000	0.000
Debt Servicing Capacity	83,653	163,656	0.179	0.224	-0.110	0.139	0.595	83,521	163,522	0.180	0.227	-0.065	0.123	0.619	0.001	0.001
Net Investment	83,653	162,241	0.078	0.647	-0.422	-0.096	1.246	83,521	159,919	0.080	0.687	-0.467	-0.081	1.285	0.002	0.002
	Banks						*Banks*							
Bank Size	796	165,135	10.698	2.143	7.839	9.896	14.245	68	165,766	11.298	1.406	7.747	11.473	12.883	0.599***	0.006
Capitalization	796	165,135	0.063	0.036	0.017	0.056	0.117	68	165,766	0.054	0.035	0.033	0.055	0.077	-0.009***	0.000
Non-Performing Loans	796	135,324	0.020	0.012	0.010	0.018	0.037	68	120,186	0.025	0.024	0.012	0.022	0.030	0.005***	0.000
Return on Assets	796	165,098	0.004	0.005	-0.003	0.004	0.012	68	165,475	0.004	0.008	0.001	0.005	0.009	0.000***	0.000
Maturity Mismatch	796	165,135	-0.451	0.261	-0.754	-0.576	-0.034	68	165,683	-0.377	0.150	-0.612	-0.356	-0.217	0.074***	0.001
						2010–2014								
	Firms						*Firms*							
Leverage	83,527	364,198	0.605	0.237	0.223	0.607	0.956	83,452	381,934	0.590	0.280	0.140	0.599	0.993	-0.015***	0.001
Total Assets (m EUR)	83,527	364,820	2.083	2.908	0.099	0.841	8.662	83,452	384,785	1.944	2.574	0.091	0.951	7.529	-0.138***	0.006
Cash Holdings	83,527	354,012	0.148	0.154	0.002	0.097	0.468	83,452	374,454	0.130	0.150	0.003	0.073	0.455	-0.018***	0.000
Tangibility	83,527	360,929	0.164	0.167	0.007	0.107	0.523	83,452	374,228	0.175	0.178	0.004	0.115	0.556	0.011***	0.000
Return on Assets	83,527	354,339	0.030	0.086	-0.121	0.031	0.156	83,452	376,388	0.003	0.085	-0.155	0.010	0.120	-0.026***	0.000
Debt Servicing Capacity	83,527	351,253	0.189	0.252	-0.131	0.142	0.651	83,452	352,526	0.140	0.253	-0.173	0.090	0.610	-0.049***	0.001
Net Investment	83,527	354,266	0.033	0.621	-0.478	-0.108	1.032	83,452	364,406	0.005	0.587	-0.501	-0.078	0.826	-0.028***	0.001
	Banks						*Banks*							
Bank Size	793	365,465	10.766	2.056	8.079	10.048	14.071	68	385,844	11.492	1.240	8.692	11.520	12.906	0.726***	0.004
Capitalization	793	365,465	0.068	0.036	0.025	0.057	0.130	68	385,844	0.056	0.040	0.011	0.058	0.091	-0.012***	0.000
Non-Performing Loans	793	327,207	0.021	0.010	0.011	0.020	0.039	68	374,358	0.061	0.038	0.022	0.051	0.114	0.041***	0.000
Return on Assets	793	362,578	0.004	0.003	0.000	0.004	0.009	68	384,837	-0.005	0.021	-0.026	0.001	0.007	-0.010***	0.000
Maturity Mismatch	793	365,465	-0.425	0.318	-0.770	-0.556	0.143	68	385,761	-0.374	0.152	-0.618	-0.376	-0.148	0.052***	0.001

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