# DISTRESSED FIRMS, ZOMBIE FIRMS AND ZOMBIE LENDING: A TAXONOMY

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## Abstract

This papers develops a taxonomy of financially distressed and zombie firms using a rich dataset that combines detailed firm-level and bank-firm-level information in Spain. A distressed firm exhibits both cash-flow and balance-sheet insolvency whereas a zombie firm is a distressed company that has received new credit. We carry out several analyses to test the validity of these definitions. For instance, we find that being distressed is negatively correlated with the probability of receiving new credit. However, the main bank of a distressed firm is more reluctant to restrict the supply of credit to such firm than a bank with no previous exposure to the company, which may reflect the incentives of the former to engage in loan evergreening. This financial support contributes to keeping zombie firms afloat for a longer period than distressed firms. Moreover, the contraction in capital, employment and sales is much larger in distressed firms than in zombie firms.

**Keywords:** taxonomy of firms, distressed firms, zombie firms, credit supply, loan evergreening, real effects.

**JEL classification:** G21, G32, G33, L25.

## Resumen

El presente artículo desarrolla una taxonomía de empresas vulnerables y empresas zombis haciendo uso de una rica base de datos que combina información detallada a nivel de empresa y a nivel de banco-empresa en España. Una empresa vulnerable exhibe tanto insolvencia de flujo de caja como insolvencia de balance, mientras que una empresa zombi es una empresa vulnerable que ha recibido nuevo crédito bancario. En esta investigación se llevan a cabo diversos análisis para testear la validez de estas definiciones. Por ejemplo, se encuentra una correlación negativa entre la situación de vulnerabilidad y la probabilidad de obtener nuevo crédito bancario. Sin embargo, el banco principal de una empresa vulnerable es más reticente a restringir la oferta de crédito a dicha empresa que un banco sin previa exposición a la compañía, lo que puede reflejar los incentivos del banco principal a refinanciar los préstamos a esta para evitar un aumento de la morosidad y de las provisiones. Este apoyo financiero contribuye a que las empresas zombis continúen operando en el mercado durante más tiempo que las empresas vulnerables. Asimismo, la contracción del capital, el empleo y las ventas es mucho más grande en las empresas vulnerables que en las empresas zombis.

**Palabras clave:** taxonomía de empresas, empresas vulnerables, empresas zombis, oferta de crédito, refinanciaciones, efectos en la actividad económica de las empresas.

**Códigos JEL:** G21, G32, G33, L25.

## 1. Introduction

The Covid-19 crisis has had a severe negative impact on the financial conditions of many firms around the world because of the confinement and social distancing measures to contain the pandemic and the dramatic drop in the demand for some products and services. To mitigate these effects, governments and central banks have implemented a wide array of extraordinary measures such as public credit guarantee programmes, direct aid via grants, debt moratoria, bankruptcy moratoria, central bank lending and asset purchase programmes and a loosening of micro- and macro-prudential supervisory rules. While these measures have been crucial to address firms' funding deficits and to avoid the hasty liquidation and exit of many viable firms, they have renewed the debate among academics and policy-makers on the existence and the economic effects of zombie lending and zombie firms (see, inter alia, Laeven et al., 2020; Gagnon, 2020; and Acharya et al., 2021).

A high share of zombie firms in an economy is a matter of concern in the long run because it can lead to a decline in aggregate productivity through two channels, credit misallocation and zombie congestion. The credit misallocation channel arises mechanically because keeping zombie firms alive reduces aggregate productivity, but it may also take place through a crowding-out effect if zombie lending tightens the credit constraints of high-productivity firms (Andrews et al., 2017; Blattner et al., 2019; Banerjee and Hoffmann, 2020; Acharya et al., 2020; Acharya et al., 2021; Acharya et al., 2022). The zombie congestion channel occurs if a high survival rate of zombie firms distorts competition in both product and input markets because those firms may obtain credit in better terms and conditions than the rest of companies. This phenomenon reduces profits for healthy firms, lowers their investment and employment growth, discourages the entry of new companies, triggers a poor allocation of productive resources and, as a consequence, it may lead to high productivity losses in zombie-dominated industries (Caballero et al., 2008; McGowan et al., 2017; McGowan et al., 2018; Andrews and Petroulakis, 2019; Acharya et al., 2019; Acharya et al., 2020; González et al., 2021; Acharya et al., 2021; Acharya et al., 2022).

Zombie firms are usually defined as non-viable firms which, in the absence of certain financial support measures (bank refinancing or new credit from their contractual counterparties), would disappear within a short period of time (e.g. Caballero et al., 2008).

Similarly, most of the existing literature characterises zombie lending as the link between unviable firms and poorly capitalized banks, as these banks have incentives to refinance

their existing loans to those firms (i.e., loan evergreening) in order to avoid an increase in their non-performing loans (NPLs) and having to record loan loss provisions that would lead to a deterioration of their capital buffers (e.g. Peek and Rosengren, 2005; Giannetti and Simonov, 2013; Bruche and Llobet, 2014; Acharya et al., 2021; Schivardi et al., 2022).

However, in practice, to identify zombie firms correctly is rather difficult. Accordingly, the previous literature has used a myriad of proxies of zombie firms, ranging from receiving credit at subsidised rates (e.g. Caballero et al., 2008) or the inability to pay interest expenses from operating income (e.g. McGowan et al., 2017; McGowan et al., 2018)[1] –sometimes coupled with market valuations such as the Tobin's q (Banerjee and Hofmann, 2020; De Martiis et al., 2021)- to the persistent lack of profitability and high leverage (e.g., Storz et al., 2017; Schivardi et al., 2022). The problem of most of those definitions is that they are likely to misclassify financially distressed firms[2] as zombie firms. Accordingly, Nurmi et al. (2020), using the population of non-financial firms with at least 1 employee in Finland, show that the typical classifications used in the literature often mislabel companies with temporarily low revenues relative to interest payments as zombie firms, as roughly two thirds of these firms recover and become healthy firms again. In the same vein, based on a sample of US publicly traded corporations, Acharya et al. (2022) argue that it is crucial to distinguish between distressed firms and firms that actually receive zombie loans (i.e., loans at subsidised rates) from their banks.

In essence, the aforementioned problem hinges on two basic premises: (i) financial distress is a necessary but not sufficient condition for a company to become a zombie firm; (ii) there are no zombie firms in the absence of zombie lending. Therefore, research that relies exclusively on firm-level data is unlikely to identify zombie firms correctly. In addition to firm-level data to measure companies' financial soundness, bank-firm level data that contain information on the lending relationships between credit institutions and their corporate borrowers are also required.

[1] Pelosi et al. (2021) find that proxies of "zombieness" based on comparing firm profits to interest expenses appear to be better able to identify firms with poor economic performance (low labour productivity and ROA) and high default risk (low credit rating, equity below the legal limit and low liquidity) than measures based on the presence of subsidised credit. By contrast, Acharya et al. (2022) find that only definitions that are based on interest rates subsidies are able to detect the negative spillover effects of zombie firms on non-zombie firms.

[2] According to Ross et al. (2005), financial distress is a situation in which a firm is close to default and it needs to take corrective action, such a selling major assets, merging with another firm or filing for bankruptcy.

Against this backdrop, we first assemble a rich dataset of more than 8.5 million observations that combines balance sheet information of a very large sample of Spanish non-financial corporations with the comprehensive Credit Register of Banco de España, which contains information on virtually all bank-firm relationships for credit institutions operating in Spain. We then use these data to develop a definition of financially distressed firms and three definitions of zombie firms.[3]

According to our proposed definition, a firm is *financially distressed* (for short, *distressed*) if it is at least 5 years old and it has both an interest coverage ratio - EBITDA over interest expense - lower than 1 and negative equity during at least 3 consecutive years.[4] In addition, a firm with no debt is never distressed. But note that, while we propose a measure of financial distress, we do not attempt to find the *best* measure in terms of the prediction of corporate bankruptcy or business failure, the subject of a vast literature that started with the seminal work of Altman (1968). Our aim is simply to propose a *plausible* measure of distress that can be used to distinguish between financially distressed firms and zombie firms in large samples of companies. This is the reason why, as most Spanish companies are not publicly traded, we do not use market-based information as in the indicators of Shumway (2001), Chava and Jarrow (2004), Campbell et al. (2008), Banerjee and Hofmann (2020) and De Martiis et al. (2021), amongst others.

Our definitions of zombie firms are quite intuitive. According to our baseline definition, a company is classified as *zombie firm* in year *t* if it is financially distressed in year *t* and has received new credit from any bank in that year. Therefore, zombie firms are a subset of distressed firms. In addition, to confirm the validity of our results, we construct two fine-tuned definitions of zombie firms. According to the first definition, a company is classified as a *zombie firm* in year *t* if it is financially distressed in year *t* and has obtained new credit from its *main* bank in that year. The underlying intuition is that a firm's main bank may have strong incentives to roll over their existing loans to the distressed

[3] The Spanish economy is an appealing laboratory because, according to McGowan et al. (2018), it had the largest share of financially distressed firms across 9 OECD countries during the previous economic crisis, reaching 10% in 2013. It is also characterised by a lethargic business demography that hampers creative destruction (Schumpeter, 1942). In particular, Nuñez (2004) showed that the turnover rate (sum of entry and exit rates) in Spain was 16 % lower than that in other countries analysed except Germany, while López-García and Puente (2007) reached the same conclusion in the context of OECD countries. García-Posada and Mora-Sanguinetti (2014) also found that both entry and exit rates in Spain were lower than the European average.

[4] Altman (2021) explains that, while a common definition, a company with an interest coverage ratio less than 1 during 3 consecutive years, is a useful starting point, some countries have an astonishingly high percentage of over 20% of zombie firms among *listed* companies according to this measure, which would imply an even higher percentage of zombie firms among private, *non-listed* companies. This is the reason why we add a second criterion to have a stricter definition: 3 consecutive years of negative equity.

company, keeping zombie firms afloat, to avoid loan loss recognition. By contrast, a new bank, i.e., a bank with no previous exposure to the firm, does not have those incentives when deciding whether to grant credit to the distressed company or not. However, banks may also want to refinance its loans to distressed companies to preserve valuable relationships, rather than because of "perverse incentives". In particular, to the extent that relationship lenders have an informational advantage over transaction lenders, this may allow them to grant credit to those firms in crisis times (Bolton et al., 2016).[5] As these two competing hypotheses have opposite implications in terms of economic efficiency, we control for relationship lending in our empirical exercises. According to the second definition, a company is classified as a *zombie firm* in year *t* if it is financially distressed in year *t*, has obtained new credit from its *main* bank in that year and the bank is *poorly capitalised*. The rationale behind this definition is that, when a bank has a large exposure to a non-viable firm (usually, its main bank), it is more likely to refinance its existing loans to that company if it is undercapitalised, as it has a low loss-absorbing capacity.

We gauge the magnitude of financially distressed and zombie firms in the Spanish economy, as well as its relationship with the business cycle, by computing three indicators: (i) the share of distressed firms, defined as the ratio of the number of distressed firms to the total number of firms that are least 5 years old; (ii) the zombie share, which is the ratio of the number of zombie firms to the total number of firms that are least 5 years old; (iii) the zombie share in terms of credit, which is the ratio of the total amount of credit in December of each year that belongs to zombie firms to the total amount of credit in December of each year that belongs to all firms that are least 5 years old. The three measures are lagging indicators of the business cycle. In particular, the share of distressed firms reached a maximum of 5.7% in 2013, at the end of the previous economic crisis.[6] This finding is consistent with other indicators of corporate financial distress such as the number of business bankruptcies, which peaked in 2013, exceeding 9,000 bankruptcy filings in that year.[7] The evolution of the zombie share and the zombie share in terms of credit is quite similar, as the former peaked at 2.1% in 2013 and the latter

[5] Provision of such liquidity has two positive externalities: (i) it avoids disruptions of supply chains (Giannetti and Saidi, 2019; Gourinchas et al., 2020) and (ii) preserves employment and, consequently, the income that workers use to spend on goods and services, which mitigates a decline in aggregate demand during a recession (Gagnon, 2020).

[6] As cited before, McGowan et al. (2018) find that the share of distressed firms in Spain was 10% in 2013. The reason for this discrepancy in figures is simple. McGowan et al. (2018) define those firms as companies with an interest coverage ratio (ICR) less than 1 during 3 consecutive years that are at least 10 years old. Our definition is more stringent, as a firm is distressed if its ICR is lower than 1 during at least 3 consecutive years, it also has negative equity during at least 3 consecutive years and it is at least 5 years old.

[7] Source: National Statistics Institute (INE).

reached a maximum of 16.4% in the same year. These figures indicate that, while the number of zombie firms is quite low even at the end of a deep recession, loans to those companies account for a sizeable share of the total stock of credit to non-financial corporations, which suggests substantial credit misallocation.

Our empirical analyses deliver the following findings. We document a negative relationship between the probability of receiving new credit and being distressed. This confirms that our proposed measure of financial distress is a valid one, since a priori distressed firms should have a lower probability of obtaining new credit because they are much riskier than solvent companies. More importantly, we also find that the main bank is the least reluctant bank to grant credit to a distressed firm, especially if it is poorly capitalised, followed by another bank that is not its main bank and then by a new bank that has no previous exposure to the company. This result indicates that the firm's main bank may have incentives to engage in loan evergreening to avoid an increase in their NPLs and loan loss provisions. This *suggestive* evidence is corroborated by an additional analysis based on bank-firm level data, which enables us to control for credit demand, and finds a positive correlation between the credit supply to distressed firms and their main bank. Importantly, this result holds even when we take into account the potential effect that relationship lending might exert on credit supply.

We also find that, during the whole sample period (1998-2019), 32% of the distressed firms recovered and became non-distressed the next year, 63.8% stayed in financial distress and 4.2% exited the market. These figures suggest that there is a sizeable proportion of distressed firms that are temporarily insolvent but viable in the long run. Hence, the typical definitions of zombie firms used in the literature may misclassify financially distressed firms as zombies. Moreover, when splitting the sample according to the business cycle, we find that the percentage of recoveries (exits) was lower (higher) during recessions than during expansions. This result provides further support to the validity of our definition of distressed firms.

In addition, De Martiis et al. (2021), using a large dataset of listed companies from Europe and the United States, show that zombie and distressed firms are not comparable types of companies, rather companies at a different stage of their financial unviability.[8] This finding highlights the need for constructing matched samples of zombie and distressed

[8] Acharya et al. (2022) compare the financial conditions and economic performance of distressed firms to those of zombie firms after the latter receive subsidised credit and find that zombie firms exhibit, on average, lower employment growth and investment and higher exit rates than distressed firms, as well as worse financials.

firms with similar financial conditions before studying whether these two categories of firms differ in their investment and employment decisions and their market exits, as we do in this paper. In particular, we first study whether distressed and zombie firms are ex-ante similar, i.e., whether their financial conditions differ or not before the latter obtain new credit. The rationale behind an ex-ante comparison is to examine whether observed differences in market exits and economic performance between distressed and zombie firms could be simply explained by one of these two categories of firms being, on average, financially weaker ex-ante. We document that zombie firms exhibit less deteriorated ex-ante financial conditions than distressed firms and they are significantly larger. But we also find that distressed firms hold a higher share of liquid assets and a higher share of tangible fixed assets –which can be pledged to obtain secured credit- than zombie firms. This evidence suggests that distressed firms engage in liquidity hoarding and also hold a higher share of pledgeable assets than zombie firms in order to reduce their probability of default and avoid the deadweight costs of bankruptcy and business failure. By contrast, zombie firms do not need to undertake those strategies because they receive external funding from their banks when they are on the verge of default.

After this exploratory analysis, we compare the business demography of zombie and distressed firms because the fact that the former obtain financial support such as loan refinancing may keep them artificially alive for a longer period than the latter. Therefore, it may occur that zombie firms have a lower propensity to leave the market than distressed firms, as measured by exit rates. This hypothesis is corroborated by two simple analyses. First, we compute the exit rates of zombie and distressed firms on three paired samples (one for each definition of zombie firm), which are constructed with propensity score matching to ensure that the two types of firms have very similar ex-post (i.e., after receiving credit) financial conditions, number of years in financial distress, size, age and length of the relationship with their main bank. This methodology enables us to rule out that our results are merely driven by the fact that we are comparing zombie and distressed firms in unmatched samples in which the former exhibit better financial conditions than the latter. In particular, we find that the percentage of market exits by firms that are classified as zombie firms is substantially lower than that of distressed firms. The difference between the two figures is both economically and statistically significant. Second, we use these three matched samples to estimate linear probability models (LPM) in which the dependent variable is a dummy that denotes a market exit and the key regressors are the three variables that identify zombie firms. The coefficients of interest are negative, sizeable and statistically significant, implying that a zombie firm has a

probability of exiting the market substantially lower than that of a distressed firm. These findings support the idea that we are actually capturing zombie firms with our measures, rather than distressed firms, as we explicitly control for relationship lending in those analyses. In addition, we assess the potential role of subsidised credit (e.g. Caballero et al., 2008; Acharya et al., 2019; Acharya et al., 2020; Acharya et al., 2022), but we only find weak evidence supporting the hypothesis that the provision of such credit amplifies the lower propensity of zombie firms to leave the market vis-à-vis distressed firms.[9]

In analogous fashion, regardless of the financial situation of zombie and distressed firms, the fact that the former receive financial support through loan refinancing or other means may be reflected in their decisions regarding investment in capital and hiring employees and, as a consequence, in their sales performance. In particular, using the three matched samples of the previous analyses, we find that both zombie and distressed firms exhibit negative and large average growth rates in these three dimensions. However, the contraction in capital, employment and sales is always much larger in distressed than in zombie firms. The differences between the two groups of firms are large (especially in capital) and highly significant. These conclusions are corroborated by multivariate regressions in which the dependent variable is the annual growth rate of capital, employment or sales and the key regressors are the three variables that identify zombie firms. The coefficients of interest are positive and significant in all the specifications and particularly large in the case of capital.

Our main contribution to the literature is to develop a *plausible* taxonomy of financially distressed and zombie firms that is consistent with stylised facts of business cycles (e.g., the temporal evolution of their shares), with intuitive transitions between different statuses and with the fundamental characteristics of the banks that grant them credit (i.e., whether it is their main bank or a new one and its capitalisation level). It is also plausible because our proposed definitions of distressed and zombie firms behave differently in terms of their business demography and economic performance. This is an essential methodological prerequisite for any study that attempts to estimate the effects of a high share of zombie firms on credit misallocation, aggregate productivity or long-term economic growth.

[9] This result may be due to a number of reasons. According to Caballero et al. (2008), the approach based on subsidised credit is not able to identify zombie firms if a bank makes new loans to a firm at normal interest rates that are then used to pay off past loans. Acharya et al. (2022) also state that lenders can subsidise their credit through amortisations or other concessions such as increasing loan maturity and relaxing the payment schedule.

## 2. Classification of firms; data sources; samples and descriptive evidence

In this subsection we introduce the key variables to measure firms' financial distress and zombie status.

### 2.1 Classification of firms

#### 2.1.1 Financially distressed firms

***Financially distressed firms***

We classify a firm as *financially distressed* (*distressed,* for short) if it is at least 5 years old and it has both an interest coverage ratio (ratio of a company's EBITDA to its interest expense) lower than 1 and negative equity during at least 3 consecutive years.[10] We require the firm to be at least 5 years old to avoid misclassifying startups with good business opportunities, which often incur losses in their first years of activity, as distressed firms. In addition, a firm with no debt is never distressed because it cannot default, regardless of its financial condition or age. Thus, our variable *distressed* is a dummy that equals 1 if the firm is classified as financially distressed based on these criteria and 0 otherwise.

***Non-distressed***

We consider that a firm is *non-distressed* if (a) it is at least 5 years old and its interest coverage ratio is not lower than 1 or it does not have negative equity during 3 consecutive years or (b) it is less than five years old. We also consider that a firm is *non-distressed* if it has no debt.

#### 2.1.2 Zombie firms, firm exits and subsidised credit

***Zombie firms***

We identify zombie status with three variables. Following our baseline definition, *zombie* is a dummy that equals 1 in year *t* if the firm is financially distressed in year *t* and it has received new credit (either term loans or credit lines[11]) from any bank in that year. In addition, we construct two fine-tuned definitions of zombie firms. *Zombie with main bank* is a dummy that equals 1 in year *t* if the firm is financially distressed in year *t* and it has

[10] The condition that the ICR is lower than 1 is usually called cash-flow insolvency, while having negative equity is generally referred as balance-sheet insolvency. A company is cash flow insolvent if it is unable to pay its debts as they fall due. Balance sheet insolvency occurs when the value of a company's assets is less than the amount of its liabilities, taking into account both contingent and prospective liabilities.

[11] We only include drawn credit facilities because undrawn credit lines are only available for very large companies, which would distort comparisons of the variable *zombie* between firms of different sizes.

obtained new credit from its main bank in that year, and 0 otherwise. The firm's main bank has the largest share of the company's outstanding credit balance as of December of the previous year. *Zombie with main low-capital bank* is a dummy that equals 1 if the firm is financially distressed, has received new credit from its main bank in that year and the bank is poorly capitalised, and 0 otherwise. We consider that a bank is poorly capitalized if its capital ratio - total capital plus reserves relative to total assets - is below the median of the distribution of capital ratios in a certain year.[12]

Therefore, to classify a company as a zombie firm, it must receive new credit from any bank or its main bank. For that purpose, we construct the following three variables: *new credit*, *new credit with main bank* and *new credit with main low-capital bank*. *New credit* is a dummy variable that equals 1 if the firm receives new credit from any bank in a certain year and 0 otherwise. Similarly, *new credit with main bank* is a dummy variable that equals 1 if the firm obtains new credit from its main bank in a certain year and 0 otherwise. Finally, *new credit with main low-capital bank* is a dummy variable that equals 1 if the firm obtains new credit from its main bank in a certain year and the bank is poorly capitalised, and 0 otherwise.

In addition, for several analyses we use other two variables, *new credit with new bank* and *new credit with another bank*. *New credit with new bank* is a dummy variable that equals 1 if the firm obtains new credit from a bank with no previous relationship with the company and 0 otherwise. *New credit with another bank* is a dummy variable that equals 1 if the firm receives new credit from another bank that is neither its main bank nor a new bank and 0 otherwise.

***Firm exit***

In order to study the business demography of distressed and zombie firms we create *exit*, which is a dummy variable that equals 1 if the firm exits the market in a certain year and 0 otherwise.

***Subsidised credit***

In some robustness analyses we use two dummy variables that denote whether a firm receives subsidised credit: *subsidised mean* and *subsided median*. To construct those variables, we first estimate the probability of default (PD) of each firm in our dataset and

[12] While a bank's capital buffer, i.e., the difference between a certain regulatory capital ratio and its capital requirement, should be a precise measure of loss-absorbing capacity (as in Peek and Rosengren, 2005; Giannetti and Simonov, 2013; and Schivardi et al., 2022), micro- and macro-prudential requirements have changed substantially during our long sample period (1995-2019), rendering very difficult to construct such a variable.

classify as "the safest" those firms in the first decile of the distribution of the PD.[13] We then compute, for each year and loan maturity[14], the mean and the median interest rates on the loans granted to the safest firms. Finally, *subsidised mean* (*subsided median*) equals 1 if the interest rate of at least one the firm's loans is lower than the average (median) interest rate of the loans granted to the safest firms in a certain year, and 0 otherwise.

### 2.1.3 Additional variables

For the analysis of real effects in the two categories of firms we use the variables *capital growth* (the annual growth rate of tangible fixed assets), *employment growth* (the annual growth rate of employees) and *sales growth* (the annual growth rate of real turnover[15]), all of them in percentage terms. To mitigate the effect of outliers, the three variables have been windsorised at the 5th and the 95th percentiles.

We use several control variables in our regressions and matching procedures. We compute firm *age* as the difference between the current year and its year of incorporation. To correct for right skewness, we compute the natural log of age plus 1. For the same reason, we measure firm *size* as the natural log of total assets. For some explanatory analyses we include other proxies of firm size, such as *micro*, a dummy variable that equals 1 if the company is a micro-firm[16] and the natural logs of employment and sales, in real terms. We also include several variables to account for the firm's legal and financial condition: *legal form* (e.g. public limited companies, private limited companies, partnerships, cooperatives, etc.), ROA (ratio of net income to total assets, in percentage terms), *interest coverage ratio*, *leverage* (ratio of total debt to total assets, in percentage terms), *current ratio* (current assets over current liabilities), *liquidity ratio* (cash, deposits and other current financial assets to total assets, in percentage terms) and *tangibility* (ratio of tangible fixed assets to total assets, in percentage terms). All firm financial ratios are windsorised at the 5th and 95th percentiles to mitigate the effect of outliers. We also compute *distress duration,* which equals the number of years in which a firm is classified

[13] The PD is based on the measure developed by Fernandez et al. (2022) for the Banco de España's internal credit assessment. This measure follows – and extends – the approach of Altman (1968) to Spanish firms. In particular, Fernandez et al. (2022) estimate the probability that a given firm will not be able to honour its debt and miss a payment. As such, this measure does not capture the risk of formal default (i.e., a firm filing for bankruptcy), but the risk of delinquent loans.

[14] Information on banks' interest rates at the loan level is only available between June 2018 and December 2019. We split loan maturity into 4 buckets: less than half a year, between half a year and 1 year, between 1 year and 5 years, more than 5 years.

[15] Real turnover is computed using the deflator of the value added at the 2-digit industry level. Source: OECD STAN Industrial Analysis.

[16] As we follow the European Commission definition, micro-firms must have less than 10 employees and a turnover of less than € 2 million or total assets less than € 2 million.

as financially distressed. In addition, we construct two variables to capture relationship lending (Berger and Udell, 1995; Petersen and Rajan, 1994). Following López-Espinosa et al. (2017) we define the duration of a lending relationship (*LR Duration*) as the number of months since the first loan was granted to a certain firm by a certain bank. Similarly, *LR Duration Main* is the number of months since the first loan was granted to a firm by its main bank. Finally, we use *industry,* which is the firm's sector of economic activity measured at a 2-digit level according to the NACE rev. 4 classification, and *region,* which is the company's location at the NUTS-3 level (i.e., provinces in Spain).

### 2.2 Data sources and initial sample selection

Our main data sources are the Banco de España's Central Balance Sheet Data Office (CBSDO) and the Credit Register of Banco de España (CIR). The CBSD contains the balance sheets and profit & loss accounts, as well as other non-financial characteristics such as industry, year of incorporation, location of the company's headquarters, demographic status (new firm, active firm, inactive firm or exit) and whether the firm is listed on a stock exchange, for a sample of an average of 767,860 non-financial corporations per year. The CIR contains monthly information on virtually all bank-firm relationships over a reporting threshold of € 6,000 for credit institutions operating in Spain. As loans to companies are normally much larger than the reporting threshold, we can claim that we have the whole population of loans to those firms. We use the CIR to construct the variables *new credit*, *new credit with main bank*, *new credit with main low-capital bank*, *new credit with new bank* and *new credit with another bank*.

We apply several filters to clean the data of the CBSDO. We exclude firms with financial ratios that may not be comparable with those of the rest of firms, as their goal is not profit maximisation: state-owned companies, local corporations, non-profit organisations, membership organisations, associations, foundations and religious congregations. We also exclude holding companies because their financials may not be comparable with those of the rest of firms. We remove foreign companies and permanent establishments of entities that do not reside in the country because they cannot be matched with the data on credit from the CIR. Financial firms and companies that do not belong to the market economy are also removed according to the NACE industry classification.[17] Following

[17] Financial service activities, except insurance and pension funding (64). Insurance, reinsurance and pension funding, except compulsory social security (65). Activities auxiliary to financial services and insurance activities (66). Public administration and defence; compulsory social security (84). Activities of membership organisations (94). Activities of households as employers of domestic personnel (97). Undifferentiated goods- and services-producing activities of private households for own use (98). Activities of extraterritorial organisations and bodies (99).

Nurmi et al. (2000), we also drop firms that belong to a business group because there is the possibility that a firm may show poor performance according to the ICR<1 condition due to financial arrangements between parent-daughter companies or foreign affiliates or due to intra-firm reasons (e.g. taxation and internal items). We also apply three filters provided by the CBSDO: (i) balance sheets with non-reliable monetary units; (ii) balance sheets with errors regarding positive/negative values; (iii) non-consistent employment. We delete observations with (i) or (ii) and impute the average number of employees in (iii).[18] Finally, we eliminate observations that violate basic accounting rules, which have impossible values (e.g. negative age) and firms whose turnover and production value are zero to avoid misclassifying inactive companies as zombie firms. These filters leave us with a sample of 8,765,778 observations, which correspond to 1,411,670 Spanish firms in the period 1995-2019.

Table 1 shows the descriptive statistics of all the firms in our sample. In particular, it reports the mean, median, standard deviation, the 5th percentile and the 95th percentile of the variables for the firms in our sample during the period 1995-2019. Focusing on the medians of the variables because some distributions are right skewed, we can observe that the total assets of the median firm are € 272,210, it has 3 employees and its sales are about € 225,210, which means that the median firm in our sample is a micro-firm. In fact, micro-firms account for 82% of the observations, which indicates that the sample is representative of the Spanish economy, which is characterised by a very atomised structure. The median firm is quite mature, as it is 10 years old. Regarding financial conditions, the median firm is not very profitable (its ROA is 1.3%) but it is cash-flow solvent, as its interest coverage ratio is 4.7, much greater than 1. However, it is quite indebted (its leverage ratio is 67.3%) and does not perform very well in terms of liquidity, as the current ratio is only slightly greater than 1 (1.3) and its liquid assets only account for 6.9% of its total assets. Tangible fixed assets, which proxy the assets that can be pledged as collateral to obtain secured credit, account for 19.3% of its total assets. Finally, the median duration of a lending relationship between a firm and its main bank is 71 months (5.9 years).[19] Looking at the last three columns of the table, the standard deviation and the 5th and the 95th percentiles, we can observe that there is substantial variability in the data. This is essential for our empirical analyses because we want to classify firms

[18] In particular, we use a Poisson regression in which the predictor variables are the log of total assets, the log of turnover, the log of firm age, legal form, industry at a 2-digit level, province and year dummies. The model's goodness of fit is quite good, as the Pseudo R2 is 0.65.

[19] We do not provide descriptive statistics of the variable *LR Duration* because it varies at the bank-firm level.

into different categories according to their financial condition and study their "real effects", i.e., their employment and investment decisions as well as their sales performance.

**Table 1: Descriptive statistics of firms (1995-2019)**

| Variable | Obs | Mean | Median | Std. Dev. | P5 | P95 |
|---|---|---|---|---|---|---|
| Total assets (,000 €) | 8,765,778 | 661.30 | 272.21 | 918.36 | 17.74 | 3,528.89 |
| Employment (#) | 8,765,778 | 5.29 | 3.00 | 6.56 | 0.00 | 24.76 |
| Sales (,000 €) | 8,765,778 | 606.22 | 225.21 | 892.47 | 0.00 | 3,410.26 |
| Micro (0/1) | 8,765,778 | 0.82 | 1.00 | 0.38 | 0.00 | 1.00 |
| Age (Years) | 8,765,778 | 12.09 | 10.00 | 8.68 | 2.00 | 28.00 |
| ROA (%) | 8,765,778 | 0.59 | 1.29 | 11.26 | -30.50 | 21.43 |
| Interest coverage ratio | 6,737,618 | 25.66 | 4.67 | 66.11 | -44.48 | 259.58 |
| Leverage (%) | 8,765,778 | 67.19 | 67.31 | 41.43 | 3.15 | 166.02 |
| Current ratio | 8,577,165 | 2.82 | 1.31 | 3.98 | 0.16 | 16.53 |
| Liquidity ratio (%) | 8,765,778 | 15.20 | 6.94 | 18.87 | 0.00 | 66.27 |
| Tangibility (%) | 8,765,778 | 29.26 | 19.33 | 28.81 | 0.00 | 89.94 |
| LR Duration Main (#) | 5,536,185 | 89.17 | 71.00 | 63.64 | 18.00 | 221.00 |

Notes: As the variable *interest coverage ratio* (ICR) is the ratio of a company's EBITDA to its interest expense, a missing value of ICR means that the company's interest expense is 0. *LR Duration Main* has a lower number of observations because many very small firms in Spain do not borrow from banks. We do not provide descriptive statistics of the variable *LR Duration* (the number of months since the first loan was granted to a certain firm by a certain bank) because it varies at the bank-firm level.

### 2.3 The evolution of distressed and zombie firms between 1997 and 2019

As a first approach to gauge the magnitude of financially distressed and zombie firms in the Spanish economy, as well as its relationship with the business cycle, we compute three indicators. First, the share of distressed firms, which is the ratio of the number of distressed firms to the total number of firms in the sample that are least 5 years old. Second, the zombie share, defined as the ratio of the number of zombie firms to the total number of firms in the sample that are least 5 years old. Third, the zombie share in terms of credit, which is the ratio of the total amount of credit in December of each year that belongs to zombie firms to the total amount of credit in December of each year that belongs to all firms that are least 5 years old. The three indicators are reported in percentage terms.

The three shares are lagging indicators of the business cycle. Figure 1 depicts the evolution of the share of distressed firms between 1997 and 2019. In particular, the share of distressed firms reached a maximum of 5.7% in 2013, at the end of the recession period 2008-2013. Figure 2 shows a similar evolution of the zombie share and the zombie share in terms of credit between 1997 and 2019, as the former peaked at 2.1% in 2013 and the latter reached a maximum of 16.4% in the same year. These figures suggest that, while

the number of zombie firms was quite low even at the end of a deep and long recession, loans to those companies accounted for a sizeable share of the total stock of credit to non-financial corporations.[20] Hence, the negative effects of credit misallocation may be substantial, although such analysis is beyond the scope of this paper.

Finally, another piece of descriptive evidence is the distribution of the share of distressed firms and the zombie share across industries for the whole sample period (1997-2019), as shown in Table 2. Both indicators display significant variation across productive sectors. In particular, the share of distressed firms ranges from 1.2% in "D. Electricity, gas, steam and air conditioning supply" to 5.5% in "S. Other service activities". The zombie share ranges from 0.3% in "D. Electricity, gas, steam and air conditioning supply" to 2.4% in

**Table 2: Share of distressed firms and zombie share across industries**

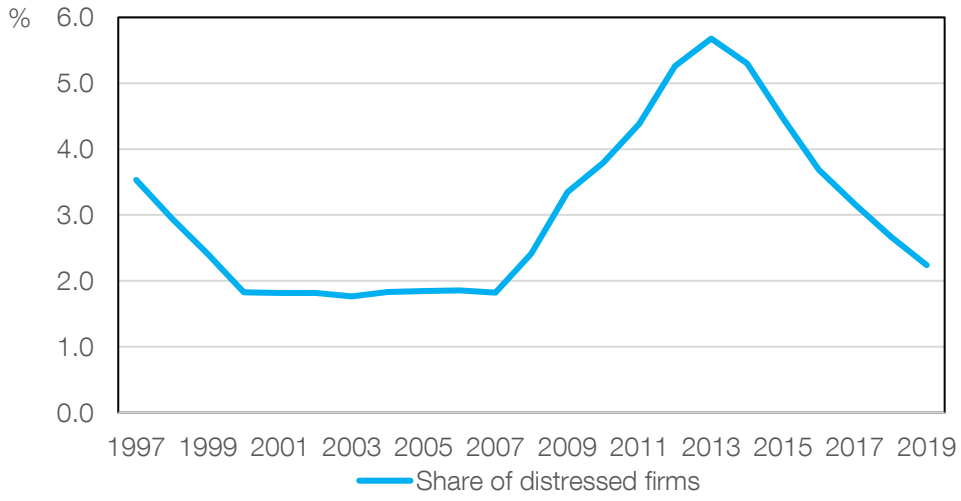
The share of distressed firms is the ratio of the number of distressed firms to the total number of firms in the sample, in percentage terms. The zombie share is the ratio of the number of zombie firms to the total number of firms in the sample, in percentage terms. By "total number of firms" we mean the number of firms in the sample that can be classified as distressed or non-distressed and zombie or non-zombie that are at least 5 years old. A firm is financially distressed if its interest coverage ratio is lower than 1 during at least 3 consecutive years, it has negative equity during at least 3 consecutive years and it is at least 5 years old, while a firm with no debt is never distressed. A firm is classified as a zombie firm in year *t* if it is financially distressed in year *t* and it has received new credit from any bank in that year. The sample period is 1997-2019. Industry is classified according to NACE Rev. 2.

| Industry | Share of distressed firms (%) | Zombie share (%) |
|---|---|---|
| A. Agriculture, forestry and fishing | 2.5 | 0.9 |
| B. Mining and quarrying | 5.2 | 2.4 |
| C. Manufacturing | 3.3 | 1.4 |
| D. Electricity, gas, steam and air conditioning supply | 1.2 | 0.3 |
| E. Water supply; sewerage, waste management and remediation activities | 2.8 | 1.3 |
| F. Construction | 4.7 | 1.9 |
| G. Wholesale and retail trade; repair of motor vehicles and motorcycles | 3.3 | 1.1 |
| H. Transportation and storage | 3.5 | 1.5 |
| I. Accommodation and food service activities | 4.4 | 1.2 |
| J. Information and communication | 2.4 | 0.8 |
| L. Real estate activities | 2.6 | 0.9 |
| M. Professional, scientific and technical activities | 1.9 | 0.6 |
| N. Administrative and support service activities | 3.1 | 1.1 |
| P. Education | 3.2 | 0.9 |
| Q. Human health and social work activities | 1.5 | 0.4 |
| R. Arts, entertainment and recreation | 3.7 | 1.1 |
| S. Other service activities | 5.5 | 1.0 |
| Total | 3.3 | 1.2 |

[20] The figures of the zombie share in terms of credit must be interpreted with caution, as our baseline definition of zombie firms requires that a distressed company receives new credit from any bank, which may lead to overestimate that share.

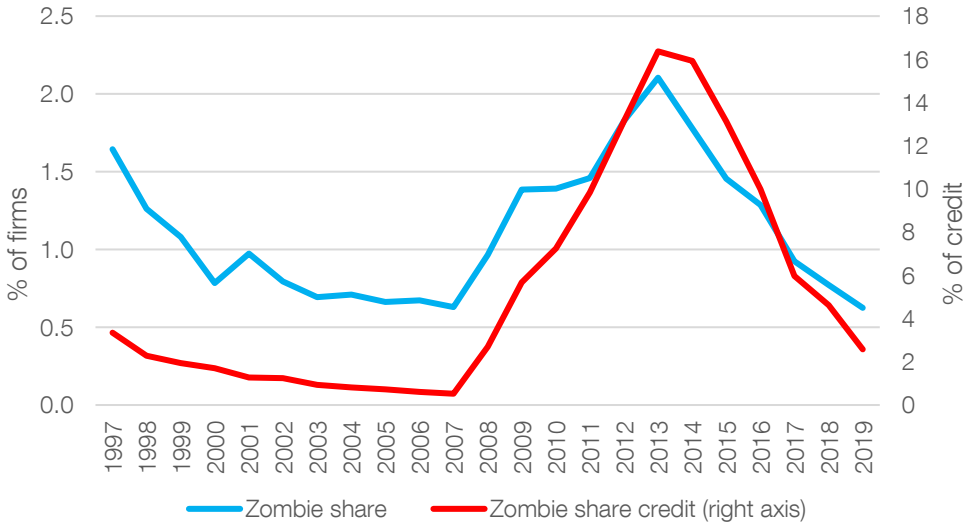
"B. Mining and quarrying". This observation highlights the importance of controlling for the firms' industry in all the paper's regression analyses.

Figure 1: Share of distressed firms between 1997 and 2019 in Spain




The share of distressed firms is the ratio of the number of distressed firms to the total number of firms, in percentage terms. By "total number of firms" we mean the number of firms in the sample that can be classified as distressed or non-distressed and are at least 5 years old. A firm is financially distressed if its interest coverage ratio is lower than 1 during at least 3 consecutive years, it has negative equity during at least 3 consecutive years and it is at least 5 years old, while a firm with no debt is never distressed.

Figure 2: Shares of zombie firms between 1997 and 2019 in Spain




The zombie share is the ratio of the number of zombie firms to the total number of firms in the sample, in percentage terms. By "total number of firms" we mean the number of firms in the sample that can be classified as distressed or non-distressed and zombie or non-zombie and are at least 5 years old. The zombie share in terms of credit is ratio of the total amount of credit in December of each year that belongs to zombie firms to the total amount of credit in December of each year that belongs to all firms. By "all firms" we mean the firms in the sample that can be classified as distressed or non-distressed and zombie or non-zombie and are at least 5 years old.

## 3. Relationship between new credit and being financially distressed (1998-2019)

### 3.1 Firm level analysis

A way to test whether our proposed measure of financial distress is a valid one is to the study the relationship between the probability of receiving new credit and being distressed. A priori, distressed firms should have a lower probability of obtaining new credit because banks estimate a higher probability of default by these companies than by non-distressed ones. However, the probability of granting credit to a distressed firm may differ between banks with previous exposure to the company, which may have incentives to engage in loan evergreening to avoid recording loan loss provisions and write-downs, and new banks, which do not have those incentives.

To test these hypotheses, we estimate LPMs in which we use several dependent dummy variables, which denote whether the firms receive new credit and the type of bank from which they obtain it, for the period 1998-2019[21]:

$$D.NewCredit_{ft} = \alpha_f + \mu_{ilt} + \beta Distressed_{ft-1} + \gamma X_{ft-1} + \varepsilon_{ft} \quad (1)$$

More specifically, we estimate five separate regressions in which the dependent variable $D.NewCredit_{ft}$ refers to each of the following credit-related dummy variables defined in Section 2: *new credit*, *new credit with main bank*, *new credit with main low-capital bank, new credit with another bank* and *new credit with new bank.* For a cleaner identification, the second, third, fourth and fifth regressions are run on different subsamples. For instance, when using *new credit with main bank* we drop all the observations of firms that have obtained new credit from another bank or from a new bank. This implies that *new credit with main bank* becomes a dummy that equals 1 if the firm obtains new credit *only* from its main bank and 0 if it does not receive new credit from *any bank*.

The key independent variable is *Distressed*, which is lagged one period to mitigate concerns about reverse causality. $X_{ft-1}$ is a vector of control variables, which consists of several firm characteristics that are likely to be correlated with the probability of obtaining new credit: *age* (there are less information asymmetries in the case of firms with a long track record), *size* (large companies generally have more diversified business models that makes them less risky, while small firms are informationally opaque - see, inter alia, Berger et al., 2001) and *tangibility* (a proxy for the amount of collateral that a company

[21] Note that, according to our definition of distressed firms (Section 2.1.1) we can compute the variable *distressed* since 1997, but equation (1) includes this variable, as well as all the controls, lagged one year.

can pledge to obtain secured credit). In addition, we include several variables that measure the financial condition of a firm: ROA, *interest coverage ratio*, *leverage*, *current ratio* and *liquidity ratio*. All these variables are also lagged one period. We also add firm fixed effects ($\alpha_f$), which absorb all time-invariant (observed and unobserved) heterogeneity (e.g. industry, legal form, business model, managerial skills) that may affect the probability of obtaining a loan. Finally, we include region-industry-time fixed effects ($\mu_{ilt}$) to take into account the business cycle at a disaggregated level because of the strong correlation between business cycles and credit cycles (e.g. Rünstle and Vlekke, 2018). *Industry* is measured at a 2-digit level and *region* at NUTS-3 level (i.e., Spanish provinces).

The estimation results are presented in Table 3. In all columns, the coefficient is negative and highly significant, suggesting that, ceteris paribus, when a firm enters financial distress it has less chances to obtain new credit than when it is non-distressed. In particular, column (1) shows that, when a firm enters financial distress, there is a reduction in the probability of receiving new credit by any bank by 5.5 pp., which is a sizeable effect with a semielasticity of -0.17 from its unconditional probability[22] (32.3%). But the most interesting part comes from the inspection of the remaining columns. According to column (2), when a firm becomes financially distressed, there is a decrease in the probability of obtaining new credit from its main bank by only 0.9 pp., which is a relatively small effect with a semielasticity of -0.08 from its unconditional probability (11.7%). In addition, according to column (3), when a firm enters financial distress, there is a decline in the probability of receiving new credit from its main bank by only 0.7 pp. if the bank is poorly capitalised. This is a smaller effect with a semielasticity of -0.06 from its unconditional probability (11.6%). By contrast, column (4) shows that, when a firm becomes financially distressed, there is a decrease in the probability of receiving new credit from another bank that is not its main bank by 1.1 pp, which is a fairly large effect with a semielasticity of -0.15 from its unconditional probability (7.3%). In analogous fashion, column (5) shows that, when a firm enters financial distress, there is a reduction in the probability of obtaining new credit from a new bank by 2.2 pp., which is quite a large effect with a semielasticity of -0.17 from its unconditional probability (12.6%).

Therefore, the main bank is the least reluctant bank to grant credit to a distressed firm, especially if it is poorly capitalised, followed by a bank that is not its main bank but is

[22] The unconditional probability is percentage of observations in which *new credit* equals 1. Note that the unconditional probability equals the unconditional mean in the case of Bernoulli random variables such as our dependent variables.

exposed to the company and then by a new bank with no previous exposure. These results provide *suggestive* evidence that banks with a previous relationship with a distressed firm, especially the firm's main bank, may have incentives to engage in loan evergreening to avoid recognising loan losses that reduce their capital buffers.

**Table 3: Relationship between the probability of obtaining new credit and being distressed**

This table shows the coefficient of the lagged variable "Distressed", which is a dummy variable that equals 1 if the firm is financially distressed. A firm is financially distressed if its interest coverage ratio is lower than 1 during at least 3 consecutive years, it has negative equity during at least 3 consecutive years and it is at least 5 years old, while a firm with no debt is never distressed. The dependent variables are "New credit", "New credit with main bank", "New credit with main low-capital", "New credit with another bank" and "New credit with new bank". "New credit" is a dummy that equals 1 if the firm obtains new bank credit from any bank and 0 otherwise. "New credit with main bank" is a dummy that equals 1 if the firm obtains new credit *only* from its main bank and 0 if it does not receive new credit from *any* bank. "New credit with main low-capital bank" is a dummy variable that equals 1 if the firm *only* obtains new credit from its main bank and the bank is poorly capitalised, and 0 if it does not receive new credit from *any* bank. "New credit with another bank" is a dummy that equals 1 if the firm *only* receives new credit from another bank that is not its main bank nor a new bank and 0 if it does not receive new credit from *any* bank. "New credit with new bank" is a dummy that equals 1 if the firm *only* obtains new credit from a bank with no previous relationship and 0 if it does not receive new credit from *any* bank. All specifications include the following lagged firm controls: age, size, return on assets, interest coverage ratio, leverage, current ratio, liquidity ratio and tangibility. All specifications also include firm fixed effects and region-industry-time fixed effects, where industry is measured at a 2-digit level and region at NUTS-3 level (i.e., Spanish provinces). The estimation period is 1998-2019. Robust standard errors in parenthesis are clustered at the firm-level. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

| VARIABLES | (1) New credit | (2) New credit with main bank | (3) New credit with main low-capital bank | (4) New credit with another bank | (5) New credit with new bank |
|---|---|---|---|---|---|
| Distressed (t-1) | -0.055*** | -0.009*** | -0.007*** | -0.011*** | -0.022*** |
| | (0.002) | (0.001) | (0.002) | (0.001) | (0.001) |
| Unconditional probability | 32.3% | 11.7% | 11.6% | 7.3% | 12.6% |
| Lagged firm controls | YES | YES | YES | YES | YES |
| Firm fixed effects | YES | YES | YES | YES | YES |
| Region-industry-time fixed effects | YES | YES | YES | YES | YES |
| Observations | 5,341,759 | 3,034,981 | 2,550,397 | 2,575,211 | 3,060,657 |
| R-squared | 0.442 | 0.360 | 0.361 | 0.506 | 0.290 |

Nevertheless, we cannot rule out an alternative explanation: the existence of relationship lending, which can mitigate temporary financial difficulties of firms (e.g. during an economic crisis) better than transaction lending thanks to the use of soft information (Bolton et al., 2016). In that case, the relationship lender is likely to be the firm's main bank, which may have acquired soft information on the distressed firm during several years of interactions with the company. To discard this alternative hypothesis, we next conduct an analysis based on bank-firm level data that allows us to control for the effect associated with the length of the lending relationship and by any unobserved characteristics within each specific bank-firm lending relationship. Hence, this analysis also enables us to estimate the correlation between being financially distressed and the

credit supplied by the firm's main bank over and above the effect of any other aspect of relationship lending. In this new analysis we also control for credit demand and focus on the supply of credit of the main bank.

### 3.2 Bank-firm level analysis

In this subsection, we undertake a more granular analysis by using disaggregated bank-firm level data from the Banco de España's Credit Register. In particular, we estimate OLS regressions in which the dependent variable is the annual growth rate of the (log) volume of total credit granted by bank *b* to firm *f* (*Credit growth)* and the key independent variable is the interaction between the variable *Distressed* and the dummy variable *Main Bank*, which equals 1 when bank *b* is firm's *f* main bank and 0 otherwise:

$$CreditGrowth_{fbt} = \alpha_{ft} + \mu_{bt} + \beta Distressed_{ft-1} x MainBank_{fbt-1} + \gamma_1 MainBank_{fbt-1} + \gamma_2 LRDuration_{fbt-1} + \varepsilon_{fbt} \quad (2)$$

Where we measure the duration of a lending relationship with *LR Duration,* which is the number of months since the first loan was granted to firm *f* by bank *b.* In order to achieve a clean identification of banks' credit supply, we implement the Khwaja and Mian (2008) methodology and include firm-time fixed effects ($\alpha_{ft}$) to control for firm-specific shocks to credit demand.[23] In addition, we saturate the specifications with bank-time fixed effects ($\mu_{bt}$) to rule out an omitted-variable bias in our estimations.

The results are presented in column (1) of Table 4. The coefficient of interest is positive and statistically significant, which implies that, consistent with previous evidence, there is a positive relationship between the credit supply to distressed firms and their main bank. Next we augment the specification in equation (2) by including firm-bank fixed effects ($\theta_{fb}$) to control for any unobserved characteristics within each specific bank-firm lending relationship. The results, displayed in column (2) of Table 4, are very similar. Thus, our findings indicate that a firm's main bank may have strong incentives to roll over its existing loans to the distressed company to avoid loan loss recognition. This result holds even when we take into account the potential effect that relationship lending might exert on credit supply.

[23] This methodology exploits the fact that many firms simultaneously borrow from several banks, which allows to compare credit growth across different lenders for the same firm in the same period. This within-firm comparison controls for all observable and unobservable, time-invariant and time-varying firm characteristics, including firm-specific shocks to credit demand.

**Table 4: Credit supply of the main bank to distressed firms**

This table shows the results obtained from a regression analysis in which the dependent variable is the annual growth rate of the (log) volume of total credit granted by bank *b* to firm *f* (Credit growth) and the key independent variable is the interaction between the variable "Distressed*"* (lagged one year) and the dummy variable "Main Bank". "Distressed" is a dummy variable that equals 1 if the firm is financially distressed. A firm is financially distressed at year *t* if its interest coverage ratio is lower than 1 during at least 3 consecutive years, it has negative equity during at least 3 consecutive years and it is at least 5 years old, while a firm with no debt is never distressed. "Main Bank" equals 1 when bank *b* has the largest share of the firm's *f* outstanding credit balance, as of December of year *t-1*. Column (1) includes the variables "Main Bank"*,* "RL Duration" (the number of months plus one since the first loan was granted to the firm *f* by bank *b*) and firm-time plus bank-time fixed effects. Column (2) also includes firm-bank fixed effects. The estimation period is 1998-2019. Two-way cluster-robust standard errors at the firm-level and at the bank-level in parenthesis. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

| | (1) | (2) |
|---|---|---|
| Distressed (t-1) x Main Bank (t-1) | 0.181*** | 0.119*** |
| | (0.016) | (0.017) |
| Main bank (t-1) and RL Duration (t-1) | YES | YES |
| Firm-Time FE | YES | YES |
| Bank-Time FE | YES | YES |
| Firm-Bank FE | NO | YES |
| Observations | 7,556,135 | 6,929,808 |
| R-squared | 0.447 | 0.584 |

## 4. Identifying distressed firms, zombie firms and their properties

### 4.1 Transition matrices of distressed firms, non-distressed firms and market exits: the role of the business cycle

As a second test of the validity of our definition of distressed firms, we construct a transition matrix in which firms are classified as distressed, non-distressed or a market exit between two consecutive years, *t-1* and *t*. The results are presented in Table 5. According to Panel A of Table 5, during the whole sample period (1998-2019)[24], 32% of the distressed firms in year *t-1* recovered and became non-distressed in the next year *t*, 63.8% stayed in financial distress and 4.2% exited the market. These figures suggest that there is a sizeable proportion of distressed firms that are temporarily insolvent but viable after an improvement in the macroeconomic environment or measures that strengthen their balance sheets such as a debt restructuring (private workouts, pre-insolvency arrangements and formal bankruptcy procedures) or recapitalisations. Hence, this result is consistent with the main findings of Nurmi et al. (2020), who show that the typical

[24] Note that, according to our definition of distressed firms (Section 2.1.1) we can compute the variable *distressed* since 1997, but the transition matrix includes this variable lagged one year.

**Table 5: Transition matrix of distressed firms, non-distressed firms and market exits during the whole sample period (1998-2019) and several subperiods**

This table shows a transition matrix in which firms are classified as distressed, non-distressed or a market exit between two consecutive years, *t-1* and *t*. "Distressed" is a dummy variable that equals 1 if the firm is financially distressed. A firm is financially distressed if its interest coverage ratio is lower than 1 during at least 3 consecutive years, it has negative equity during at least 3 consecutive years and it is at least 5 years old, while a firm with no debt is never distressed. In each cell the top figure is the number of observations and the bottom figure is the relative frequency of observations within its row, in percentage terms. Panel A contains the transition matrix for the whole sample period 1998-2019. Panel B reports the transition matrix for the expansionary period (1998-2007) and Panels C and D contain the matrices for the recession period (2008-2013) and the recovery period (2014-2019), respectively.

**Panel A: 1998-2019**

| | | Year t | | | |
|---|---|---|---|---|---|
| | | Non-distressed | Distressed | Exit | Total |
| Year t-1 | Non-distressed | 6,753,134<br>97.7 | 46,480<br>0.7 | 113,226<br>1.6 | 6,912,840<br>100 |
| | Distressed | 31,187<br>32.0 | 62,089<br>63.8 | 4,106<br>4.2 | 97,382<br>100 |
| | Total | 6,784,321<br>96.8 | 108,569<br>1.6 | 117,332<br>1.7 | 7,010,222<br>100 |

**Panel B: 1998-2007**

| | | Year t | | | |
|---|---|---|---|---|---|
| | | Non-distressed | Distressed | Exit | Total |
| Year t-1 | Non-distressed | 2,073,574<br>98.3 | 10,468<br>0.5 | 25,803<br>1.2 | 2,109,845<br>100 |
| | Distressed | 6,299<br>36.6 | 10,256<br>59.6 | 660<br>3.8 | 17,215<br>100 |
| | Total | 2,079,873<br>97.8 | 20,724<br>1.0 | 26,463<br>1.2 | 2,127,060<br>100 |

**Panel C: 2008-2013**

| | | Year t | | | |
|---|---|---|---|---|---|
| | | Non-distressed | Distressed | Exit | Total |
| Year t-1 | Non-distressed | 2,133,262<br>96.7 | 21,392<br>1.0 | 51,759<br>2.4 | 2,206,413<br>100 |
| | Distressed | 9,794<br>27.7 | 23,716<br>67.0 | 1,910<br>5.4 | 35,420<br>100 |
| | Total | 2,143,056<br>95.6 | 45,108<br>2.0 | 53,669<br>2.4 | 2,241,833<br>100 |

**Panel D: 2014-2019**

| | | Year t | | | |
|---|---|---|---|---|---|
| | | Non-distressed | Distressed | Exit | Total |
| Year t-1 | Non-distressed | 2,546,298<br>98.1 | 14,620<br>0.6 | 35,664<br>1.4 | 2,596,582<br>100 |
| | Distressed | 15,094<br>33.7 | 28,117<br>62.8 | 1,536<br>3.4 | 44,747<br>100 |
| | Total | 2,561,392<br>97.0 | 42,737<br>1.6 | 37,200<br>1.4 | 2,641,329<br>100 |

definitions of zombie firms used in the literature (such as an interest coverage ratio lower than 1 for at least three consecutive years) often misclassify financially distressed firms as zombies.

These figures change in an intuitive way when we split the whole sample period in the expansion period of the Spanish economy (1998-2007), the recession period due to the global financial crisis and the European sovereign debt crisis (2008-2013) and the recovery period of the Spanish economy before the outbreak of the Covid-19 pandemic (2014-2019). In particular, according to Panel B of Table 5, during the expansion period (1998-2007), 36.6% of the distressed firms re-emerged and became non-distressed the next year, 59.6% stayed distressed and 3.8% exited the market. By contrast, as shown in Panel C of Table 5, during the recession period 2008-2013 the percentage of recoveries was substantially lower (27.7%) and the percentage of exits was much higher (5.4%). During the recovery period before the Covid-19 crisis, as displayed in Panel D of Table 5, the percentage of recoveries was much higher (33.7%) and the percentage of exits was much lower (3.4%) than during the previous crisis period. These results provide further support to the validity of our definition of distressed firms, as the proportion of recoveries (exits) is expected to be higher (lower) during economic expansions than during recessions.

### 4.2 Are zombie and distressed firms ex-ante similar?

A question that naturally arises before continuing with our empirical analyses is whether zombie and distressed firms are ex-ante similar, i.e., whether their financial conditions differ or not before being classified as zombie or distressed. In particular, the differences between zombie and distressed firms in their market exits and in their investment and employment decisions will be illustrated later. But the rationale behind an ex-ante comparison is to examine whether these differences could be simply explained by one of

these two categories of firms being, on average, financially weaker ex-ante (i.e., before zombie firms obtain new credit). Hence, if we find meaningful ex-ante differences between zombie and distressed firms, we will need to make use of matching techniques to construct subsamples in which the two categories of firms exhibit very similar financials.

Therefore, we conduct the following analysis in order to compare the ex-ante financial conditions of the two types of firms. First, we construct a subsample that only comprises the first 3 or more consecutive years of observations of each firm (e.g. periods $t$=1, 2, 3). This means that all the companies in that subsample can be labelled as non-distressed, distressed or zombie firms. Second, we identify, for each firm, the first year in which firms can be classified as zombie or distressed according to our definitions (i.e., period $t$=3). Third, we compute the financial ratios and the rest of characteristics of each firm 1 year before that period (i.e., period $t$=2), which measure its ex-ante financial conditions. Fourth, we only keep companies that are classified as distressed or zombie firms at $t$=3. Fifth, we only retain the observations at $t$=2, so that we can compare the firms' ex-ante financial conditions of distressed and zombie firms. Finally, we compute the means of those ex-ante financial ratios (e.g. ROA, *interest coverage ratio*, *leverage*, etc.) and the rest of characteristics (*size*, *age*) of distressed and zombie firms, together with two-sample t tests on the equality of means, where the null hypothesis is no difference between the means of the two groups.

The results are presented in Table 6. Unsurprisingly, most differences in means are statistically significant because of the large sample size, so we need to focus on economic significance. Zombie firms exhibit somewhat less deteriorated financial conditions than distressed firms in terms of profitability (an average ROA of -17.2% vs. -18.6%) and indebtedness (an average *leverage* of 141.6% vs. 145.7%). Accordingly, the average *interest coverage ratio* of zombie firms is substantially larger than that of distressed firms (-10.1 and -16.2, respectively). This difference could also be due to zombie firms receiving credit at subsidised rates, but we have no firm-level information on the interest rates of loans, credit lines or bonds.

In addition, distressed firms have, on average, a higher share of liquid assets than that of zombie firms (6.7% vs. 4.9%) and a higher share of tangible fixed assets that can be pledged as collateral to obtain additional secured credit (33.1% vs. 30.4%), arguably because the former do not obtain additional financial support such as loan refinancing to stay afloat. This evidence suggests that distressed firms engage in liquidity hoarding and

also hold a higher share of pledgeable assets than zombie firms in order to reduce their probability of default and avoid the deadweight costs of bankruptcy and business failure. By contrast, zombie firms do not need to undertake those strategies because they receive external funding from their banks or their contractual parties when they are on the verge of default.

Table 6 also shows that zombie firms are larger (as measured in terms of total assets) than distressed firms. The difference in size is quite meaningful. In the case of zombie firms, their average total assets are € 245,200 while, for distressed firms, their average total assets are € 160,500. This finding is quite intuitive, as large firms usually have large loans to repay, which means that banks have more incentives to refinance loans granted to large unviable firms in order to avoid recording massive provisions and write-downs.

**Table 6: Ex-ante descriptive statistics of zombie firms and financially distressed firms**

This table shows the means of variables measured 1 year before a firm is first classified as "Zombie" or "Distressed". "Zombie" is a dummy that equals 1 if the firm is financially distressed and it has received new credit from any bank. "Distressed" is a dummy variable that equals 1 if the firm is financially distressed. A firm is financially distressed if its interest coverage ratio is lower than 1 during at least 3 consecutive years, it has negative equity during at least 3 consecutive years and it is at least 5 years old, while a firm with no debt is never distressed. The sample only comprises firms with at least 3 consecutive years of observations that are either zombie firms or distressed firms. The statistical significance of the difference between the means of the two groups has been evaluated according to two-sample t tests on the equality of means, in which the population variances are not assumed to be equal, where the null hypothesis is no difference. The sample period is 1997-2019. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

| | (1) Zombie firms | | (2) Distressed firms | | | |
|---|---|---|---|---|---|---|
| Variable | Obs | Mean | Obs | Mean | Difference between means (1)-(2) | P-values of two-sample t tests |
| Log (total assets) | 2,835 | 5.50 | 8,243 | 5.08 | 0.42 | 0.00 |
| Log (age+1) | 2,835 | 2.14 | 8,243 | 2.13 | 0.01 | 0.39 |
| ROA | 2,835 | -17.19 | 8,243 | -18.61 | 1.43 | 0.00 |
| Interest coverage ratio | 2,835 | -10.11 | 8,243 | -16.18 | 6.07 | 0.00 |
| Leverage | 2,835 | 141.56 | 8,243 | 145.71 | -4.15 | 0.00 |
| Current ratio | 2,823 | 1.30 | 8,189 | 1.24 | 0.07 | 0.30 |
| Liquidity ratio | 2,835 | 4.92 | 8,243 | 6.70 | -1.78 | 0.00 |
| Tangibility | 2,835 | 30.39 | 8,243 | 33.13 | -2.73 | 0.03 |

Note: by taking the antilog one can find that the average total assets of zombie firms and distressed firms are € 245,000 and €160,500, respectively.

Therefore, we may conclude that zombie firms exhibit less deteriorated ex-ante financial conditions than distressed firms, they are significantly larger and hold a lower share of liquid assets and tangible fixed assets. Hence, in our following analyses we will use matching techniques to rule out that observed differences in the market exits and investment and employment decisions between distressed and zombie firms are not merely driven by differences in the financial viability between these two categories of firms, as also found by De Martiis et al. (2021).

### 4.3. Market exits, distressed firms and zombie firms

Regardless of the financial situation of distressed firms and zombie firms, the fact that the latter obtain financial support such as loan refinancing may keep them artificially alive for a longer period than distressed firms. Therefore, it may occur that zombie firms have a lower propensity to leave the market than distressed firms, as measured by exit rates.

To test this hypothesis, we conduct the following analysis to construct a subsample of firms as homogeneous as possible in terms of their financial conditions and key characteristics. First, we make a subsample that only comprises distressed and zombie firms. Second, we construct a paired sample by means of propensity score matching[25] by selecting zombie and distressed firms with similar values of *size*, *age, distress duration,* ROA, *interest coverage ratio*, *leverage*, *current ratio*, *liquidity ratio* and *tangibility*.

We also follow a similar procedure to construct two other paired samples of firms classified as "distressed" or "zombie with main bank" and classified as "distressed" or "zombie with main low-capital bank", respectively. These two samples include an additional variable, *LR Duration Main,* which is the number of months since the first loan was granted to a firm by its main bank. The rationale is that the main bank might provide credit to a distressed firm not only because of "perverse incentives", but also because it has an information advantage thanks to the soft information on the distressed firm that has acquired during several years of interactions with the company (i.e., relationship lending). Under this alternative hypothesis, the distressed firms that receive credit might actually be better than the distressed firms that do not obtain it. Therefore, the former would exhibit lower exit rates than the latter not only because of the additional financial support, but also because of their better economic performance.

[25] In particular, 1:1 nearest neighbour matching without replacement, caliper equal to 0.001 and imposing the common support condition.

We then use these three matched subsamples to test the aforementioned hypothesis, i.e., whether zombie firms have a lower propensity to leave the market than distressed firms, as measured by exit rates. We carry out two simple analyses. First, we compute the percentage of market exits for the variables *zombie, zombie with main bank* and *zombie with main low-capital bank.* The results are reported in Table 7. In the first subsample, the percentage of market exits by firms that are classified as zombie firms (*zombie*=1) is 2.3%, while the exit rate of distressed firms (*zombie*=0) is substantially higher, 4.6%. The difference between the two figures (2.3%) is both economically and statistically significant according to a two-sample test of proportions. In the second subsample, the percentage of market exits by firms that are classified as "zombie firms with their main bank" (*zombie with main bank*=1) is 2.5%, while the exit rate of distressed firms (*zombie*=0) is much higher, 5.3%. The difference between the two figures (2.9%) is also both economically and statistically significant. In the third subsample, the percentage of

**Table 7: Percentage of market exits in financially distressed firms by zombie status**

This table studies whether zombie firms ("Zombie"=1, "Zombie with main bank"=1 or "Zombie with main low-capital bank"=1) exit the market less frequently than financially distressed firms ("Zombie"=0). The statistical significance of the difference between the percentage of market exits in the two groups has been evaluated according to two-sample tests of proportions, where the null hypothesis is no difference. There are three samples. The first sample (top panel) comprises distressed firms and zombie firms that have received new credit from any bank ("Zombie"=1). The second sample (medium panel) comprises distressed firms and zombie firms that have obtained new credit from its main bank ("Zombie with main bank"=1). The third sample (bottom panel) comprises distressed firms and zombie firms that have received new credit from its main bank, whose capital ratio is below the median ("Zombie with main low-capital bank"=1). In the second and third samples we delete those distressed firms that have received new credit from a new bank or from other bank that is not their main bank but have not obtained new credit from their main bank. The three samples have been constructed with a propensity score matching estimator to select zombie and distressed firms with similar values of size, age, distress duration, return on assets, interest coverage ratio, leverage, current ratio, liquidity ratio and tangibility. The second and third samples include an additional variable, "LR Duration Main", which is the number of months since the first loan was granted to a firm by its main bank. The sample period is 1997-2019.

| | Proportions (%) | P-value* |
|---|---|---|
| Zombie=0 | 4.6 | |
| Zombie=1 | 2.3 | |
| **Difference** | **2.3** | **0.00** |
| Observations | 56,060 | |
| Zombie=0 | 5.3 | |
| Zombie with main bank=1 | 2.5 | |
| **Difference** | **2.9** | **0.00** |
| Observations | 30,078 | |
| Zombie=0 | 5.3 | |
| Zombie with main low-capital bank=1 | 2.6 | |
| **Difference** | 2.6 | |
| Observations | 22,780 | **0.00** |

market exits by firms that are classified as "zombie with main low-capital bank" (*zombie with main low-capital bank*=1) is 2.6%, while the exit rate of distressed firms (*zombie*=0) is much higher, 5.3%. Again, the difference between the two figures (2.6%) is both economically and statistically significant.

Second, we estimate LPMs in which the dependent variable is *exit*, a dummy that equals 1 if the firm exits the market in a certain year and 0 otherwise (Table 8). The key regressors are *zombie* in column (1), *zombie with main bank* in column (2) and *zombie with main low-capital bank* in column (3). In the three cases, we include region-industry-time fixed effects to take into account regional and industry-specific shocks. By contrast, we do not use firm fixed effects in order to exploit the cross-section variation of the data. We also add *legal form* as an additional control, but we do not include other variables such as financial ratios, age and size because we have constructed the three paired subsamples by means of propensity score matching on those variables, as previously explained. The key coefficients are negative and statistically significant in the three regressions. According to column (1), a zombie firm has, on average, a probability of exiting the market that is 2.4 pp. lower than that of a distressed company. In similar fashion, column (2) shows that a zombie firm that obtains new credit from its main bank has, on average, a probability of leaving the market that is 2.5 pp. lower than that of a distressed company. Finally, column (3) shows that a zombie firm that receives new credit from its main bank has, on average, a probability of leaving the market that is 2.6 pp. lower than that of a distressed company if the bank is poorly capitalised (i.e., its capital ratio is below the median of the distribution of that variable). These effects are also sizeable, given that the unconditional probability of a market exit in each subsample is 3.5%, 3.9% and 3.9%, respectively. Therefore, the results of the two analyses indicate that we are actually capturing zombie firms with our measures, rather than distressed firms, as the former have a lower propensity to leave the market than the latter and this phenomenon cannot be attributed to relationship lending.[26]

In addition, we wish to know whether the lower propensity to leave the market by zombie firms vis-à-vis distressed firms depends on the business cycle. For that purpose, we run

[26] In a robustness test, we also construct a variation of the variable *zombie* only based on unsecured credit to replicate the two analyses of this section. In particular, *zombie* is a dummy that equals 1 in year *t* if the firm is financially distressed in year *t* and it has received unsecured new credit from any bank in that year. The rationale behind is that zombie lending requires that the new credit is not collateralised, so that banks' recovery rates are very low if they do not roll over their existing loans to unviable firms and let them default instead. The results of these analyses (available upon request) are very similar. In addition, the share of secured credit in total credit is substantially lower in zombie than in distressed firms, regardless of the definition of zombie firm that is employed.

**Table 8: Relationship between the probability of a market exit and being a zombie firm**
**Matched sample of distressed and zombie firms**

This table shows the coefficients of "Zombie", "Zombie with main bank" and "Zombie with main low-capital bank" in OLS regressions in which the dependent variable ("Exit") is a dummy that equals 1 if the firm exits the market in a certain year. "Zombie" is a dummy that equals 1 if the firm is financially distressed and it has received new credit from any bank. "Zombie with main bank" is a dummy that equals 1 if the firm is financially distressed and it has received new credit from its main bank. "Zombie with main low-capital bank" is a dummy that equals 1 if the firm is financially distressed and it has received new credit from its main bank, whose capital ratio is below the median. A firm is financially distressed if its interest coverage ratio is lower than 1 during at least 3 consecutive years, it has negative equity during at least 3 consecutive years and it is at least 5 years old, while a firm with no debt is never distressed. There are three samples, which are used to run the regressions displayed in columns (1), (2) and (3), respectively. The first sample comprises distressed firms and zombie firms that have received new credit from any bank ("Zombie"=1). The second sample comprises distressed firms and zombie firms that have obtained new credit from its main bank ("Zombie with main bank"=1). The third sample comprises distressed firms and zombie firms that have obtained new credit from its main bank, whose capital ratio is below the median ("Zombie with main low-capital bank"=1). In the second and third samples we delete those distressed firms that have received new credit from a new bank or from other bank that is not their main bank but have not obtained new credit from their main bank. The three samples have been constructed with a propensity score matching estimator to select zombie and distressed firms with similar values of size, age, distress duration, return on assets, interest coverage ratio, leverage, current ratio, liquidity ratio and tangibility. The second and third samples include an additional variable, "LR Duration Main", which is the number of months since the first loan was granted to a firm by its main bank. The specifications also include region-industry-time fixed effects, where industry is measured at a 2-digit level and region at NUTS-3 level (i.e., provinces), and legal form. The estimation period is 1997-2019. Robust standard errors in parenthesis are clustered at the firm-level. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

| | (1) Exit | (2) Exit | (3) Exit |
|---|---|---|---|
| Zombie | -0.024*** | | |
| | (0.002) | | |
| Zombie with main bank | | -0.025*** | |
| | | (0.003) | |
| Zombie with main low-capital bank | | | -0.026*** |
| | | | (0.004) |
| % Exits | 3.5 | 3.9 | 3.9 |
| Firm controls | Legal form | Legal form | Legal form |
| Region-industry-time fixed effects | YES | YES | YES |
| Observations | 46,769 | 22,832 | 16,556 |
| R-squared | 0.182 | 0.226 | 0.247 |

the previous regressions in three subsamples: (i) the expansionary period of the Spanish economy (1997-2007); (ii) the recession period due to the global financial crisis and the European sovereign debt crisis (2008-2013); (iii) the recovery period of the Spanish economy before the outbreak of the Covid-19 pandemic (2014-2019). According to the estimation results (Table 9), the lower probability associated to exits by zombie firms holds in the three subperiods, but it is larger during economic expansions than during recessions. In the case of our baseline definition of zombie firm, according to columns (1) and (3), a zombie firm had a probability of exiting the market that was 3.8 pp. and 2.3 pp. lower than that of a distressed firm during the periods 1997-2007 and 2014-2019, respectively. These are sizeable effects, given that the unconditional probability is 2.7% and 2.8%, respectively. By contrast, according to column (2), a zombie firm had a

**Table 9: Relationship between the probability of a market exit and being a zombie firm depending on the business cycle. Matched sample of distressed and zombie firms**

This table is similar to Table 8, but splitting the sample into 3 subperiods: the expansionary period (1997-2007), the recession period (2008-2013) and the recovery period (2014-2019).

| | 1997-2007 | 2008-2013 | 2014-2019 | 1997-2007 | 2008-2013 | 2014-2019 | 1997-2007 | 2008-2013 | 2014-2019 |
|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| Zombie | -0.038*** | -0.019*** | -0.023*** | | | | | | |
| | (0.004) | (0.003) | (0.003) | | | | | | |
| Zombie with main bank | | | | -0.032*** | -0.022*** | -0.025*** | | | |
| | | | | (0.006) | (0.005) | (0.005) | | | |
| Zombie with main low-capital bank | | | | | | | -0.039*** | -0.021*** | -0.026*** |
| | | | | | | | (0.008) | (0.005) | (0.006) |
| % Exits | 2.7 | 4.4 | 2.8 | 2.6 | 5.0 | 3.3 | 2.8 | 4.9 | 3.3 |
| Firm controls | Legal form | Legal form | Legal form | Legal form | Legal form | Legal form | Legal form | Legal form | Legal form |
| Region-industry-time fixed effects | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| Observations | 10,677 | 20,586 | 15,505 | 4,994 | 10,779 | 7,059 | 3,591 | 8,303 | 4,662 |
| R-squared | 0.229 | 0.163 | 0.184 | 0.269 | 0.205 | 0.242 | 0.306 | 0.226 | 0.258 |

probability of exiting the market that was only 1.9 pp. lower than that of a distressed firm during 2008-2013, and the unconditional probability during this period is much higher, 4.4%. We document very similar patterns when using the two fine-tuned definitions of zombie firm: "zombie with main bank", as shown in columns (4), (5) and (6), and "zombie with main low-capital bank", as displayed in columns (7), (8) and (9). These findings imply that granting new credit to distressed firms during economic downturns increases their chances of survival, but less than that during expansionary periods, arguably because the financial condition of some of those firms during recessions is so deteriorated that they do not manage to stay afloat even with additional financial support.

Finally, we examine the potential role of subsidised credit (e.g. Caballero et al., 2008; Acharya et al., 2019; Acharya et al., 2020; Acharya et al., 2022). For that purpose, we use our first matched sample of distressed and zombie firms (the one with the baseline definition of zombie firm) to estimate two LPMs in which the dependent variable is *exit.*

**Table 10: Relationship between the probability of a market exit and being a zombie firm. The role of subsidised credit**

The table shows the coefficients of "Zombie" and the interaction between "Zombie" and "Subsidised mean" (column (1)) and of "Zombie" and the interaction between "Zombie" and "Subsidised median" (column (2)) in OLS regressions in which the dependent variable ("Exit") is a dummy that equals 1 if the firm exits the market in a certain year. "Zombie" is a dummy that equals 1 if the firm is financially distressed and it has received new credit from any bank. A firm is financially distressed if its interest coverage ratio is lower than 1 during at least 3 consecutive years, it has negative equity during at least 3 consecutive years and it is at least 5 years old, while a firm with no debt is never distressed. "Subsidised mean" ("subsided median") equals 1 if the interest rate of at least one the firm's loans is lower than the average (median) interest rate of the loans granted to the safest firms in a certain year, defined as those whose probability of default is in the first decile of the distribution of that variable. The sample comprises distressed firms and zombie firms. It has been constructed with a propensity score matching estimator to select zombie and distressed firms with similar values of size, age, distress duration, return on assets, interest coverage ratio, leverage, current ratio, liquidity ratio and tangibility. The specifications also include region-industry-time fixed effects, where industry is measured at a 2-digit level and region at NUTS-3 level (i.e., provinces), and legal form. The estimation period is 2018-2019. Robust standard errors in parenthesis are clustered at the firm-level. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

| | (1)<br>Exit | (2)<br>Exit |
|---|---|---|
| Zombie | -0.040*** | -0.041*** |
| | (0.010) | (0.010) |
| Zombie*Subsidised mean | -0.021* | |
| | (0.012) | |
| Zombie*Subsidised median | | -0.017 |
| | | (0.015) |
| % Exits | 3.0 | 3.0 |
| Firm controls | Legal form | Legal form |
| Region-industry-time fixed effects | YES | YES |
| Observations | 2,488 | 2,488 |
| R-squared | 0.242 | 0.242 |

In the first LPM, the key regressors are *zombie* and the interaction between *zombie* and *subsidised mean*. In the second LPM, the key regressors are *zombie* and the interaction between *zombie* and *subsided median*. As explained in Section 2.1.2, *subsidised mean* and *subsided median* are dummy variables that denote whether a firm obtains subsidised credit.[27] In both regressions we also include region-industry-time fixed effects and *legal form* as control variables. Table 10 displays the results. The coefficients of *zombie* are negative, statistically significant and of similar size in the two columns, in line with previous exercises. However, the interaction term is only marginally significant in column (1) and insignificant in column (2), which suggests that the provision of subsidised credit does not substantially influence the propensity of zombie firms to exit the market vis-à-vis distressed firms.

## 5. Real effects in distressed and zombie firms

In analogous fashion to the case of exit rates, regardless of the financial condition of distressed and zombie firms, the fact that zombie firms obtain financial support through loan refinancing or other means may be reflected in their decisions regarding capital investment, hiring employees and, as consequence, in their sales performance. Therefore, in this section we study the potential differences between the two types of companies in those dimensions.

For that purpose, we conduct the following analyses using the same three matched subsamples of distressed and zombie firms employed in the previous Section 4.3, so that these two categories of firms have very similar financial conditions, years in financial distress, size, age and duration of the lending relationship with their main bank. First, we compute average annual growth rates in physical capital (i.e., tangible fixed assets), employment and sales (measured as real turnover) of distressed and zombie firms. Table 11 shows these values for zombie firms (i.e., *zombie*, *zombie with main bank* or *zombie with main low-capital bank* equals 1) and distressed firms (*zombie* equals 0). Both zombie and distressed firms exhibit negative and large average growth rates of the three variables. However, the contraction in capital, employment and sales is always much larger in distressed firms than in zombie firms, regardless of the selected definition of zombie firm.

[27] In the first LPM we cannot include *subsidised mean* alone as a third explanatory variable because there is perfect multicollinearity between *zombie* and the interaction term *zombie*subsidised mean.* The reason is that there are no distressed firms (i.e., those for which *zombie*=0) that receive subsidised credit (i.e., *subsidised mean*=1); in fact, they do not receive any new credit by definition. To put it differently, there are no observations for which *zombie*=0 and *subsidised mean*=1, which is the only case where *subsidised mean* would be different from *zombie*subsidised mean.* Because of the same reason, we cannot include *subsidised median* alone as a third explanatory variable in the second LPM.

The differences between the two groups of firms are large (especially in capital) and highly significant according to two-sample t tests on the equality of means.

**Table 11: Real effects: average annual growth rates (%) by zombie status**

This table studies the dynamics of capital investment, employment decisions and sales performance of zombie firms ("Zombie"=1, "Zombie with main bank"=1 or "Zombie with main low-capital bank"=1) as compared to the one experienced by distressed firms ("Zombie"=0). The statistical significance of the difference between the means of the two groups has been evaluated according to two-sample t tests on the equality of means in which the population variances are not assumed to be equal, where the null hypothesis is no difference. There are three samples. The first sample (top panel) comprises distressed firms and zombie firms that have received new credit from any bank ("Zombie"=1). The second sample (medium panel) comprises distressed firms and zombie firms that have obtained new credit from its main bank ("Zombie with main bank"=1). The third sample (bottom panel) comprises distressed firms and zombie firms that have received new credit from its main bank, whose capital ratio is below the median ("Zombie with main low-capital bank"=1). In the second and third samples we delete those distressed firms that have received new credit from a new bank or from other bank that is not their main bank but have not obtained new credit from their main bank. The three samples have been constructed with a propensity score matching estimator to select zombie and distressed firms with similar values of size, age, distress duration, return on assets, interest coverage ratio, leverage, current ratio, liquidity ratio and tangibility. The second and third samples include an additional variable, "LR Duration Main", which is the number of months since the first loan was granted to a firm by its main bank. The sample period is 1997-2019.

| | Capital | Employment | Sales |
|---|---|---|---|
| Zombie=0 | -8.6 | -6.0 | -11.9 |
| Zombie=1 | -1.2 | -4.3 | -7.9 |
| **Difference (0-1)** | **-7.4** | **-1.7** | **-4.0** |
| P-value* | 0.00 | 0.00 | 0.00 |
| Observations | 56,022 | 56,022 | 56,022 |
| Zombie=0 | -10.1 | -7.2 | -13.6 |
| Zombie with main bank=1 | -2.9 | -4.5 | -9.0 |
| **Difference (0-1)** | **-7.2** | **-2.8** | **-4.6** |
| P-value* | 0.00 | 0.00 | 0.00 |
| Observations | 30,078 | 30,078 | 30,078 |
| Zombie=0 | -9.5 | -7.6 | -13.6 |
| Zombie with main low-capital bank=1 | -3.6 | -4.8 | -9.8 |
| **Difference (0-1)** | **-5.9** | **-2.8** | **-3.8** |
| P-value* | 0.00 | 0.00 | 0.00 |
| Observations | 22,780 | 22,780 | 22,780 |

We then turn to multivariate analyses using the same three matched subsamples of distressed and zombie firms. In particular, we run OLS regressions in which the dependent variable is *capital growth* in columns (1), (2) and (3), *employment growth* in columns (4), (5) and (6) and *sales growth* in columns (7), (8) and (9). The key regressors are *zombie* in (1), (4) and (7), *zombie with main bank* in (2), (5) and (8) and *zombie with main low-capital bank* in (3), (6) and (9). In all cases, we include region-industry-time fixed effects and the variable *legal form*, but we do not include firm fixed effects in order to exploit the cross-section variation of the data. The results are presented in Table 12.

**Table 12: Real effects: average annual growth rates (%) by zombie status**

This table shows the coefficients of "Zombie", "Zombie with main bank" and "Zombie with main low-capital bank" in OLS regressions in which the dependent variables are annual capital growth, annual employment growth and annual sales growth (all in percentage terms). "Zombie" is a dummy that equals 1 if the firm is financially distressed and it has received new credit from any bank. "Zombie with main bank" is a dummy that equals 1 if the firm is financially distressed and it has obtained new credit from its main bank. "Zombie with main low-capital bank" is a dummy that equals 1 if the firm is financially distressed and it has received new credit from its main bank, whose capital ratio is below the median. A firm is financially distressed if its interest coverage ratio is lower than 1 during at least 3 consecutive years, it has negative equity during at least 3 consecutive years and it is at least 5 years old, while a firm with no debt is never distressed. There are three samples. The first sample comprises distressed firms and zombie firms that have received new credit from any bank ("Zombie"=1), and it is used to run the regressions displayed in columns (1), (4) and (7). The second sample comprises distressed firms and zombie firms that have obtained new credit from its main bank ("Zombie with main bank"=1), and it is used to run the regressions presented in columns (2), (5) and (8). The third sample comprises distressed firms and zombie firms that have obtained new credit from its main bank, whose capital ratio is below the median ("Zombie with main low-capital bank"=1), and it is used to run the regressions presented in columns (3), (6) and (9). In the second and third samples we delete those distressed firms that have received new credit from a new bank or from other bank that is not their main bank but have not obtained new credit from their main bank. The three samples have been constructed with a propensity score matching estimator to select zombie and distressed firms with similar values of size, age, distress duration, return on assets, interest coverage ratio, leverage, current ratio, liquidity ratio and tangibility. The second and third samples include an additional variable, "LR Duration Main", which is the number of months since the first loan was granted to a firm by its main bank. The specifications also include region-industry-time fixed effects, where industry is measured at a 2-digit level and region at NUTS-3 level (i.e., provinces), and legal form. The estimation period is 1997-2019. Robust standard errors in parenthesis are clustered at the firm-level. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---|---|---|---|---|---|---|---|---|---|
| | Capital growth (%) | Capital growth (%) | Capital growth (%) | Employment growth (%) | Employment growth (%) | Employment growth (%) | Sales growth (%) | Sales growth (%) | Sales growth (%) |
| Zombie | 6.737*** | | | 1.466*** | | | 3.758*** | | |
| | (0.337) | | | (0.274) | | | (0.424) | | |
| Zombie with main bank | | 6.050*** | | | 2.146*** | | | 3.107*** | |
| | | (0.469) | | | (0.404) | | | (0.633) | |
| Zombie with main low-capital bank | | | 4.819*** | | | 2.353*** | | | 3.709*** |
| | | | (0.557) | | | (0.475) | | | (0.758) |
| Average growth (%) | -4.9 | -6.5 | -6.5 | -5.1 | -5.8 | -6.2 | -9.9 | -11.3 | -11.7 |
| Firm controls | Legal form | Legal form | Legal form | Legal form | Legal form | Legal form | Legal form | Legal form | Legal form |
| Region-industry-time fixed effects | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| Observations | 46,884 | 22,832 | 16,556 | 46,884 | 22,832 | 16,556 | 46,884 | 22,832 | 16,556 |
| R-squared | 0.216 | 0.253 | 0.259 | 0.201 | 0.243 | 0.257 | 0.206 | 0.241 | 0.256 |

The coefficients are positive and significant in all columns. They are particularly large in the case of capital. According to columns (1), (2) and (3), the annual growth rate of capital in zombie firms is between 4.8 pp. and 6.7 pp. higher than that of distressed firms. These are sizeable effects, as the average capital growth ranges between -6.5% and -4.9% in the three matched subsamples. The effects are more moderate, but still fairly large, in the case of employment and sales. According to (4), (5) and (6), the annual growth rate of employment in zombie firms is between 1.5 pp. and 2.4 pp. higher than that of distressed firms (the average employment growth is between -6.2% and -5.1% in the three matched subsamples). According to (7), (8) and (9), the annual growth rate of sales in zombie firms is between 3.1 pp. and 4.2 pp. higher than that of distressed firms (the average sales growth is between -11.7% and -9.9% in the three matched subsamples).[28]

These findings cannot be attributed to differences in the financial condition, size, age or length of the lending relationship with their main bank between distressed and zombie firms because the analyses have been implemented in three subsamples in which these two categories of firms have very similar values of *size, age,* ROA, *interest coverage ratio*, *leverage*, *current ratio*, *liquidity ratio*, *tangibility, distress duration and LR Duration Main* (see Section 4.3 for more details). Hence, the results of the two analyses indicate that we are actually identifying zombie firms with our measures, rather than distressed firms, as the former exhibit less deteriorated real effects than the latter thanks to the financial support they receive through loan refinancing or other means. As in the previous section, this phenomenon cannot be explained by the information advantage of the firms' main bank, which would only provide additional credit to the "best" distressed companies, as we control for the potential effect of relationship lending in our empirical exercises.

## 6. Conclusions

There is a never-ending debate among academics and policy-makers on the economic effects of zombie lending and zombie firms, which has been renewed by the wide array of extraordinary measures implemented by governments and central banks to mitigate the severe impact of the Covid-19 crisis on the financial conditions of many firms around the world.

[28] As in Section 4.3, we also replicate the two analyses of this section using a variation of the variable *zombie* only based on unsecured credit. In particular, *zombie* is a dummy that equals 1 in year *t* if the firm is financially distressed in year *t* and it has received unsecured new credit from any bank in that year. Results (available upon request) are very similar.

However, a recent strand of the literature shows that the typical definitions of zombie firms, which rely exclusively on firm-level data, often misclassify financially distressed firms as zombies. This methodological shortcoming arises because of two reasons: (i) financial distress is a necessary but not sufficient condition for a company to become a zombie firm; (ii) there are no zombie firms in the absence of zombie lending. Therefore, in order to distinguish between financially distressed and zombie firms, a researcher needs both firm-level data to measure companies' financial soundness and bank-firm level data on lending relationships. To identify zombie firms correctly has important policy implications because a potentially high number of temporarily distressed firms may be viable in long run, so that they may recover and become solvent again after debt restructuring, recapitalisation or an improvement in the macroeconomic environment that raises the demand for their products and services. By contrast, zombie firms should be liquidated and exit the market to allow for the reallocation of credit and factors of production to profitable firms.

Against this backdrop, we construct a rich dataset that combines the balance sheets of a very large sample of Spanish companies and the comprehensive Credit Register of Banco de España, which contains information on virtually all bank-firm relationships for credit institutions operating in Spain. We use these data to develop a plausible taxonomy of financially distressed and zombie firms. We then perform several analyses to test the validity of our definitions. First, we document, as expected, a negative relationship between the probability of receiving new credit and being financially distressed, arguably because those firms are much riskier than solvent companies. However, we also find that the main bank is less reluctant to grant credit to a distressed firm than a new bank that with no previous exposure to the company, especially if it is poorly capitalised, which suggests that the former may have incentives to engage in the evergreening of existing loans to avoid loan loss recognition. This finding is corroborated by a further analysis with bank-firm level data, which enables us to control for credit demand and relationship lending, ruling out an alternative explanation, i.e., that the main bank is more willing to provide new credit to the distressed firm because it has superior information on its creditworthiness compared to a new bank.

Second, we find that a sizeable proportion of financially distressed firms in a certain year recover and become non-distressed the next year, which confirms that our proposed definition identifies distressed firms rather than zombies. In addition, when splitting the sample according to the business cycle, the percentage of recoveries (exits) is lower

(higher) during recessions than during expansions, which provides further support to the validity of our measure of distressed firms.

Third, we study the business demography of zombie and distressed firms because the fact that the former obtain financial support such as loan refinancing may keep them afloat for a longer period than the latter. This hypothesis is supported by our analyses, as we find that the probability of exiting the market of zombie firms is substantially lower than that of distressed firms in three subsamples of companies with similar financial conditions, number of years in financial distress, size, age and, crucially, length of the lending relationship with their main bank. By contrast, previous studies that compare the market exits of distressed and zombie firms make use of unmatched samples in which the two categories of firms do not exhibit similar financials. In addition, our analyses also allow us to reject an alternative hypothesis, namely that the lower exit rates of zombie firms are due to relationship lending by their main banks, which grant them new credit based on the soft information they have acquired during several years of interactions with the company.

Similarly, the new credit provided to zombie firms may be reflected in different decisions regarding investment in capital, hiring employees and, as a consequence, in their sales performance, as compared to distressed firms. This hypothesis is also verified by our analyses. In particular, using the same three subsamples of companies with similar financial conditions, number of years in financial distress, size, age and length of the lending relationship with their main bank, we find that, while both zombie and distressed firms exhibit negative and large average growth rates in these three dimensions, the contraction in capital, employment and sales is much larger in distressed than in zombie firms. Therefore, this result provides further evidence that we are actually identifying zombie firms with our measures, rather than distressed firms.

This research suggests that a careful validation of any proposed definition of zombie firm may be worth it before conducting a study on the effects of a high share of zombie firms on credit dynamics, aggregate productivity or long-term economic growth. Needless to say, there may not be a "one-size-fits-all" definition that is applicable for all firms across jurisdictions, as it may depend on factors such as the sectoral composition of an economy, firm size distribution, and the institutional and legal framework of each country.

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