Lisbon School of Economics & Management
Universidade de Lisboa

# Master in

Finance

## MASTER FINAL WORK

Dissertation

# DETERMINANTS OF ZOMBIE FIRMS IN THE EUROZONE

MARINA SANTOS DIAS

DECEMBER - 2021

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**ORIENTATION:**

VICTOR BARROS

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# Resumo

Este trabalho pretende analisar os determinantes de empresas zombie. Empresas zombie são empresas que sobrevivem apesar de apresentarem resultados negativos continuamente. Este estudo utiliza uma definição principal (empresa deve ter mais de 10 anos e apresentar uma taxa de cobertura de juros inferior a 1 por três anos consecutivos) e uma definição alternativa (definição principal e apresentar um rácio Tobin's q e um ROE inferior à média do sector, por três anos consecutivos). Empresas zombie representam um fenómeno negativo, pois resultam em efeitos negativos sobre a produtividade e crescimento de outras empresas. Assim, a questão principal é: "Quais são os determinantes de empresas zombie na Zona Euro?". As conclusões poderão ajudar a identificar, prever e evitar empresas zombie. Concluímos que empresas zombie são frequentemente pequenas e médias empresas, com 40 anos e que laboram em Consumo, Indústria, Saúde e Tecnologia. A probabilidade de uma empresa ser zombie cresce com *corrupção, rácio de dívida* e *intangíveis* e decresce com *competitividade, ROA* e *rácio de liquidez*. Concluímos também que cerca de 11% e 5.5% das observações são empresas zombie, sob a definição principal e alternativa, respetivamente.

**JEL:** C55; D22; L22; E50; G28; G30; O52; P47.

**Palavras-chave:** Zombie firms; Negative equity firms; Zombie lending; Evergreening.

# Abstract

This paper aims to study zombie firms' determinants. Zombie firms are firms who manage to survive although they keep reporting negative equity. This paper uses a primary zombie definition (firm over 10 years old with an ICR below 1 for three years in a row) and an alternative definition (primary definition and a Tobin's q ratio and an ROE below-median within the sector, for three years in a row). Zombie firms are a negative phenomenon who result in negative effects on other firms' productivity and growth. Thus, the research question is: "What are the determinants of zombie firms in the Eurozone?". Conclusions can be used to identify, predict, and avoid zombie firms. We find that zombie firms are often SME, around 40 years old and mostly present in the Consumer Cyclicals, Industrials, Healthcare and Technology. The probability of a firm being a zombie grows with *corruption*, *debt ratio* and *intangibles* and decreases with *competitiveness*, *current ratio,* and *ROA*. We also find that zombie firms represent around 11% and 5.5% of our observations under the primary and alternative definitions, respectively.

**JEL:** C55; D22; L22; E50; G28; G30; O52; P47.

**Keywords:** Zombie firms; Negative equity firms; Zombie lending; Evergreening.

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To all of you, my deepest gratitude.

# Lista de Tabelas



# Abbreviation

EPS Earnings per share

ICR Interest Coverage Ratio

ROA Return on Assets

ROE Return on Equity

SME Small and Medium Enterprises

# Index

# 1 Introduction

This paper aims to provide a better understanding of zombie firms to avoid its formation and consequences. Zombie firms manage to survive in the creative-destruction process characteristic of a market economy that runs properly, although they keep reporting negative equity (Machek, 2018). These firms survive mainly due to increasing bank loans and leniency, government subsidies or weak regulation (Machek, 2018). Zombie firms are identified as having an interest coverage[1] ratio (ICR) below 1 for three years in a row (Adalet et al. 2018) or a Tobin's q[2] ratio below the median of the firms' sector for any year (Banerjee and Hofmann, 2018). Caballero et al. (2008) also define zombie firms as benefiting from subsidized credit with rates below those for the higher creditworthy companies.

Zombie firms are a negative phenomenon that should be studied and understood, since they result in high opportunity costs and adverse effects on other firms' productivity and growth. More specifically, they weigh on average productivity, holding back the potential growth of non-zombie firms. Due to market congestion (misallocation of resources to poorly performing firms), this misallocation negatively affects healthy firms' employment growth and investment. (Adalet et al. 2018). To further assist this motivation, in some countries, zombie firms might be a symptom of a weak policy structure, mainly on the insolvency regime levels, such as low barriers to restructuring or low entrepreneurial failure costs (Adalet et. al. 2017; Andrews & Petroulakis, 2019). Since, in 2018, according to Bank of America Merrill Lynch, zombie firms represented

[1] Calculated as the ratio of operating income to interest expenses.
[2] Calculated as the ratio of the assets' market value to their replacement cost or as market capitalization divided by total Assets.

13% of total worldwide firms (Egan & Horowitz, 2019), it is important to study this phenomenon to decrease its impact.

Most studies (Andrews & Petroulakis, 2019; Banerjee & Hofmann, 2018; Adalet et al. 2017 and 2018; Urionabarrenetxea et al. 2018) focus on the consequences of zombie firms. Understanding these consequences encourages policymakers to tackle these firms through their economic decisions and policies. Unlike those studies, this paper specifically focuses on the determinants of zombie firms. The main research question is: "What are the determinants of becoming a zombie firm in the Eurozone?". The conclusions can be used to identify, predict, and avoid the formation of zombie firms and henceforth, be helpful for government, banks, and firms' managers on decreasing the existence of zombie firms and consequent effects.

The previous literature on this topic is still mostly restricted to a set of variables to determine the causes of zombie firms (reviewed on the literature part of this paper) and/or focused on a consequence analysis. Additionally, most recent studies were related to Asia (Caballero et al. 2008; Hoshi, 2006; Peek & Rosengren, 2005; Zhang et al. 2020). In this paper, we will focus on the causes of the problem and extend the set of variables to include *corruption* and *competitiveness*, which, to the best of our knowledge, were never directly assessed. Our analysis identifies zombie firms in the Eurozone and compares their characteristics with non-zombie firms between 2011 and 2020 using two zombie definitions. The primary zombie definition follows Adalet et al. (2018) definition. The alternative zombie definition states that a firm is a zombie when cumulative it is older than 10 years old, it has an ICR below 1, a Tobin's q ratio below-median within the sector and an ROE below-median within the sector, both for three years in a row.

This paper finds that zombie firms are often identified as SME firms around 40 years old mostly present in the Consumer Cyclicals, Industrials, Healthcare and

Technology. The probability of a firm being a zombie grows with *debt ratio* and *intangibles* and decreases with *current ratio* and *ROA*. This paper also finds that zombie firms mainly come from corrupt and uncompetitive countries, being our database zombie observations mostly present in France, Greece, and Finland.

The main takeaway of this paper that distinguish it from other papers is that the probability of a firm being a zombie grows with *corruption* and decreases with *competitiveness*. This finding is of extreme relevance to decrease a country's zombie share – decreasing *corruption* and increasing *competitiveness* is needed.

Our paper contributes to existent literature on zombie firms and their determinants by analyzing how a firm's determinants affects a firm's likelihood of becoming a zombie. As a distinct feature, the paper used two definitions of zombie firms and compared their results – a main definition and an alternative definition (more restrictive than the previous one). Moreover, we verify the existence of zombie firms in a large number of countries over a long sample period, expanding recent literature (e.g., Binh et al. 2020; Blazkova & Dvoutely, 2020; De Martiis & Peter, 2021; Shivardi et al. 2021). Our results policy implications are based on providing information to avoid zombie firms' formation. By understanding that a firm who complies with most of our findings is highly likely to become a zombie, governments should review their regulations and banks should restrain from providing credit to these firms.

This study is organized as follows: Section 2 and 3 review previous literature on zombie firms and their determinants, respectively. Section 4 describes the underlying firm-level data and outlines variable definitions and empirical methodology used to estimate the determinants. We find that zombie firms represent 11% of our observations under the primary definition and 5.5% under the alternative definition. Section 5 shows

the incidence of zombie firms in our data and its determinants. Finally, the last section presents concluding remarks.

## 2 Literature Review

In 2020, after Covid-19 started affecting economies worldwide, the number of firms whose operating profits were not enough to pay the interests that the firms owed increased (Sandbu, 2020). However, Covid-19 was not the main reason of this increase. The last decade of low-interest rates that allowed firms to borrow at low costs is also to blame (Sandbu, 2020). Together with the central bank's policy return response to Covid-19, the result is an increase of companies that are neither dead nor alive (Rennison, 2020). These firms are often labelled as zombies.

Zombie firms are unproductive firms that should leave the market or go into a restructure but are kept alive with the help of their creditors and government (Machek, 2018). This help comes in the form of bank loans, bank forbearance, government subsidies, policies, or monetary stimulus (Machek, 2018). Quantitatively speaking, zombie firms present an ICR below 1 for three years in a row - i.e., the operating income is lower than interest expenses (Adalet et al. 2018). Alternatively, Banerjee & Hofmann (2018) define zombie firms as those that present low expected profitability - more specifically, zombie firms should have a Tobin's q ratio below the median of the firms' sector for any year or country. The economic condition of each country does not shape this result.

Another definition suggested by the literature is given by Caballero et al. (2008): zombie firms benefit from subsidized credit with rates below those for the higher creditworthy companies. It may be in the form of rate concessions, debt-equity swaps, debt forgiveness, moratoriums on loan principal or interest and others. However, this

definition is hard to apply since: *i)* identifying creditworthy companies is challenging; *ii)* banks might provide such credits for other reasons, like long-standing relationships; or *iii)* subsidized lending rates would have to be near zero or negative, when interest rates are low for a long period (Caballero et al. 2008). Consequently, with this definition, sometimes healthy firms are wrongly considered zombies since they borrow at lower interest rates than the prime rates (Caballero et al. 2008).

These definitions capture firms that are not profitable enough to cover debt payments but whose creditors allow them to remain operational. In all definitions, firms must be 10 years or more, as start-ups are generally not expected to be profitable and may need more time to be profitable (Adalet et al. 2018). Some of the reasons these companies experience persistent negative profits can be: *i)* firms that just started their business; *ii)* firms that present current weak performance but expect high future profits; *iii)* state-owned firms whose primary reason to exist is not to be profitable (Adalet et al. 2018). Thus, a firm may be considered a zombie multiple times during their lifecycle – while they are start-ups or even during a decline stage that may be temporary or definitive.

It is important to note that zombie firms may represent a problem to society - they require long-term funding from governments (resulting in opportunity costs) and negatively affect the productivity and potential growth of other firms (Machek, 2018). Caballero et al. (2008) and Hoshi (2006) stated that industries with a high percentage of zombie firms exhibit more job destruction and depressed job creation, and lower productivity. A high zombie share also results in market congestion and distortions, and consequently, new firms consider that exist barriers to entry and investment and the natural market selection is weakened (Caballero et al. 2008).

Because these firms are protected and already have a negative equity, they take more risk, since they do not need to be concerned about bankruptcy and may not have

incentives aligned with profitability (Adalet et al. 2018). Thus, zombies hold on to their workers and financial resources making it difficult for new entrants to have access to these resources and even compete aggressively in the resource market (by decreasing prices or increasing salaries) (Adalet et al. 2018). Consequently, firm profits decrease, discouraging entry and investment and harming profitable firms' growth. (Hoshi, 2006). Hence, it is relevant to study the determinants of zombie firm to better understand and fight this phenomenon.

The study of zombie firms started in Japan in the early 21st century, because of the country's economic stagnation and the 90s financial system problems (Caballero et al, 2008; Hoshi, 2006; Peek & Rosengren, 2005). Most of these studies focused on bank behavior with these firms – "zombie lending" or "evergreening". Evergreening is when a bank provides additional credit to a distressed firm or allows the non-payment of existing loans (Peek & Rosengren, 2005). Caballero et al. (2008) referred that evergreening to insolvent firms in bankruptcy led to the survival of these unproductive firms and, consequently, prevented Japanese economic recovery in the long run. However, Adalet et al. (2018) stated that, in the short run, preventing these companies' unemployment creation and help to maintain market demand would lessen disturbances in the supply chain and maintain production capacity.

However, why do banks evergreen? Peek & Rosengren (2005) argued that evergreening was encouraged by the national duty of banks to support firms in trouble - to avoid unemployment, bankruptcies, and costly bailouts of the banking sector - and by the attempt of weak banks to avoid recognizing losses on their balance sheets. This way, banks dodged pressure to increase their loan loss reserves, further impairing their capital (Peek & Rosengren, 2005). Adalet et al. (2018) added that long-standing banking relationship was also a reason for continued bank lending to these unprofitable firms.

Hence, firms are more likely to receive credit if they are in poor financial conditions (Peek & Rosengren, 2005).

# 3 Determinants of zombie firms

Since zombie firms are a problem to the economy (Adalet et al 2018, Caballero et al. 2008, Hoshi, 2006 and Machek, 2018), we should find a solution for it. The first step in problem-solving is to understand the problem. Understanding the nature of such phenomena is key to address the issue and mitigate it. The remaining of this section details the existing literature on the determinants of zombie firms.

### *3.1.1 Bank health*

We should first start by studying what determines the existence of zombie firms – banks. Banks are one of the main reasons why zombie firms are born since they evergreen to these firms. Caballero et al. (2008), Hoshi (2006) and Peek & Rosengreen (2005) were among the first to study the determinants of zombie congestion. They found that the financial crisis caused damage in the banking sector by weakening the banks' ability only to provide credit to the most efficient uses. Undercapitalized banks whose balance sheets are impaired direct loans to zombie firms instead of writing them off, to avoid losses on their loan portfolios that arise from corporate insolvencies or loan impairments (Schivardi et al. 2021). Furthermore, these banks worry that they will not comply with the capital standards required by law and thus, they provide credit to insolvent borrowers, hoping that these firms will eventually recover or receive help from the government (Caballero et al. 2008).

Evergreening appears to be easier for smaller banks due to its higher flexibility and less constrained decision process. Banks with a capital ratio below-median provide

more credit to zombie firms than stronger banks. Additionally, low capital banks are less likely to classify their loans as bad. (Schivardi et al. 2021)

### *3.1.2 Interest rates*

A consequence of banks health and financial crisis are *interest rates* (nominal and real) downward trend. Lower rates push up the share of zombie companies since they reduce the firms' financial pressure to restructure or exit (De Martiis & Peter, 2021) and reduce the pressure on creditors to clean up their balance sheet and thus, encouraging them to evergreen (Banerjee & Hofmann, 2018). Reverse causality might also happen: the more zombie firms exist, the lower is the productivity growth and, consequently, the lower are the *interest rate* levels in the long run (Adalet et. al, 2018).

Moreover, *interest rates* are positively correlated with a firms' *age* and amount of fixed assets. Fixed assets are considered collateral, reducing the risk of bank loans, while *age* positively signals the firm's stability. (Zhang et al. 2020).

### *3.1.3 Regulation*

The second main reason zombie firms are born is regulation, more specifically, the consequence of regulation, such as subsidies, policies, monetary stimulus or simply regulation that allows firms to keep going on. Andrews and Petroulakis (2019, pp. 11), corroborates stating "The fact that zombies appear after large shocks in some countries but not others suggest that there is a potentially important role for structural policies." Adalet et. al. (2017) also concluded that countries with poorly designed national insolvency regimes frameworks that defer the market process to eliminate these firms are likely to connect with evergreening motives. The author state that those policy initiatives to help banks after financial crises are highly related with lower zombie congestion. Andrews and Petroulakis (2019) find that insolvency regimes that raise low barriers to

corporate restructuring or low personal costs associated with entrepreneurial failure can decrease the capital sunk in zombie firms. Consequently, capital reallocation productivity increases.

#### *3.1.4 Sector:*

On the other side, regulation influences all economic sectors. As such, Hoshi, 2006 found that highly regulated sectors' firms' probability of becoming zombies are low, due to the expected low volume of negative equity, especially in non-manufacturing sectors[3].

Caballero et al. (2008) reckon that the zombie problem is more significant in non-manufacturing sectors, mainly for real estate and construction sectors, which received more bank credit than the other sectors. Some reasons were: *i)* manufacturing firms face high international competition and thus protecting them requires large subsidies *ii)* the nature of the shocks that the sectors face is different - for example, real estate and construction frequently deal with scarcity and subsequent drops in land prices. Urionabarrenetxea et al. (2018) also found that the sectors more likely to become zombies are Information and Communication, followed by real estate; On the other side, companies less likely to become zombies are Agriculture, Forestry and Fishing, followed by Financial and Insurance, and Public Administration.

Thus, the more regulated or attached to the government a firm's sector is, the lower is the probability of the firm becoming a zombie.

[3] Both Caballero and Hoshi considered as non-manufacturing sectors: Construction, Wholesale and Retail, Services and Real Estate.

### *3.1.5 Location:*

The same way that a regulation affects the probability of a firm being a zombie, so does location since regulation changes according to location. Location has an impact on a firm's behavior, management, and strategy as they change with the local culture, resources, infrastructure, and government control.

Hoshi (2006) and Blazkova & Dvouletý (2020) state that zombies are more likely to be located outside large metropolitan areas. Hoshi (2006) believes this happens because of the location's reduced access to financial regulation system, lower visibility and reputation and less government control. Blazkova & Dvouletý (2020) refer to the potential of these areas as centers of innovation - they attract firms with high capital requirements and greater ability to take risk, leading to more probability of unexpected financial problems. Furthermore, Adalet et al. (2018)[4] state that, in 2013, zombie firms share was higher in Spain – at 10% – and lowest in France – at 2%; and Hallak et al. (2018) states that, between 2010 and 2013, zombie share was the highest in Greece (more than 25%) and Spain (around 20%).

### *3.1.6 Economic performance:*

Every firm has its own specificities, and therefore we cannot say for sure that a particular item of a balance sheet needs to be a certain value. However, Urionabarrenetxea et al. (2018) proved that firms with many off-balance-sheet *intangibles* could receive credit above the value of their book assets, since some of their resources are not presented on the firm's balance sheet. Additionally, some investments in *intangibles* like training and advertising are documented as operating costs, reducing a firm's earnings and equity.

[4] Based on a panel of 9 countries between 2003 and 2013: Belgium, Finland, France, Italy, Korea, Slovenia, Spain, Sweden, and the United Kingdom.

Thus, the author states that firms with many *intangibles* are highly likely to be considered zombie firms.

Additionally, it seems that capital structure, income and stock valuation are important zombie companies' determinants – specifically, a combination of low income, risky assets, and low *ROA* (De Martiis et al. 2021). In Europe, during turbulent times, companies with small operating income but high common stock are probably zombies; In non-crisis times, firms with high *ROA* usually do not require bank credit as they can finance themselves by retaining earnings (De Martiis et al. 2021). The same way, Binh et al. (2020) show that zombie firms have lower *ROA* and ROE than healthy firms.

### *3.1.7 Size:*

Some of a firm's specificities mentioned before are size and *age*. Firm size affects the type of management, financial policies, and capital structure decisions. All authors who studied this determinant (Andrews & Petroulakis, 2019; Urionabarrenetxea et al, 2018; Adalet et al, 2018; Hoshi, 2006; Banerjee & Hofmann, 2020; and Binh et al, 2020) agree that size influences the likelihood of becoming a zombie. However, the authors disagree on which size.

Generally, it seems like big firms' probability of becoming zombies is higher (Andrews & Petroulakis, 2019; Urionabarrenetxea et al. 2018; Adalet et al. 2018; Hoshi, 2006; Hallak et al. 2018). This goes hand in hand with the bank health determinant, since its bank balance sheets are likely to be less sensitive to small firms' credit defaults and governments prefer to avoid a big bankruptcy (Andrews & Petroulakis, 2019). Additionally, Urionabarrenetxea et al. (2018) states that: *(i)* larger firms diversify more to decrease their bankruptcy chances and to afford higher borrowing level; *(ii)* information asymmetries are lower for these firms and, consequently, they have better

credit ratings enabling them to access non-bank credits; *(iii)* small firms' high rate of default dissuades financial institutions to grant them more credit. Adalet et al. (2018) also prove that the likelihood of becoming a zombie increases with size. This happens since large firms are more likely to receive government benefits to control employment loss. However, Hoshi (2006) adds that large firms are less likely to become zombie firms, since they are less likely to require financial assistance. However, if they do require more financial assistance than what it would be advisable, they have more access to borrowing and greater negotiation power.

The studies that disagree with the norm are Banerjee & Hofmann (2020), Binh et al. (2020) and De Martiis & Peter (2021) who state that zombie firms are much smaller than non-zombie firms. The first shows that assets, capital stock and employment of non-zombie firms are, on average, three times bigger than those of zombie companies.

### *3.1.8 Age:*

Concerning *age*, Adalet et al. (2018) and Hallak et al. (2018) find that the likelihood of being a zombie firm grows with *age*, as they are more likely to have many employees and benefit from subsidies from banks. Additionally, 5% of firms between 2 and 5 years old showed weak financial outcomes, but the author considered it due to the delay that start-ups face to strengthen their financial returns (Adalet et al. 2018).

Furthermore, Blazkova & Dvouletý (2020) found a nonlinear inverted U-shape pattern (with a turning point at around *age* 13 years), suggesting that zombie firms are likely middle-aged companies. They explain this finding with the fact that young firms face difficulties getting credit to open their business; As these firms age, their probability of becoming zombies increases. At the turning point, their start being considered stable and non-risky and thus, having easier access to credit (Blazkova & Dvouletý, 2020).

# 4 Empirical Investigation

## *4.1 Data*

This paper intends to study the determinants of zombie firms in the Eurozone. The results can be used to predict and avoid zombie firms and hence, be useful for government, banks, and firm's managers. Therefore, the main research question of this paper is "What are the determinants of becoming a zombie firm in the Eurozone?".

The firm-level data was gathered from the Refinitiv database and covers all active and listed firms located in the Eurozone between 2011 and 2020. The time frame allows avoiding possible selection bias issues from economic crisis, sector bubble bursts, election years, etc. Regarding the variable *corruption* and *competitiveness*, the data was retrieved from the Corruption Perception Index 2020 (Transparency International, 2021) and from the Global Competitiveness Report 2015-2016 (Schwab et al. 2016), respectively. Additionally, the final sample is driven by the data availability necessary to construct zombie firm measures[5]. Firms belonging to the financial business sector were also disregarded (958 observations).

Working with firms publicly listed has the disadvantages of not fully representing the word population of companies. This way, our conclusions will not fully fit all zombie firms and should be put into perspective.

As referred in Andrews & Petroulakis. (2019), before using the data, the same is cleaned commonly across all firms by: keeping accounts referring to the entire calendar year; using harmonized consolidation accounts; dropping observations with missing information on key variables.

[5] ICR (for at least 3 year), Age, Tobin's Q ratio and ROE.

## *4.2 Variable definition*

### *4.2.1 Measuring Zombie Firms*

In this paper, two zombie definitions will be used to ensure robustness of estimates. The main form of defining zombie firms will follow Adalet et al. (2018) definition (following points 1 and 2) – a zombie firms must be 10 years old or more and present an ICR below 1, for three years in a row. The alternative proxy for measuring zombie firms will combine the previous definition with Banerjee and Hofman (2018) and Binh et al. (2020) definitions – a zombie firm must be 10 years old or more and present an ICR below 1 (for three years in a row), a Tobin's q ratio below median of the firm's sector (for three years in a row) and a ROE below median of the firm's sector (also for three years in a row). In summary, in this paper, the primary definition of zombie firm will comply with points 1 and 2 and the alternative definition will comply with the following restrictions (cumulative).

1. Interest coverage ratio < 1, for three years in a row.
2. Age of 10 years or older – calculated as the current year less incorporation date.
3. Tobin's q ratio below median within the sector.
4. ROE[6] below median within the sector.

Point 1 is more suitable for cross-country comparisons as it is less endogenous to productivity than negative profits. This point also allows finding firms who lack profitability and who survive through methods different from subsidized credit. Point 2 is necessary to distinguish between zombie firms and start-ups. Point 3 is used since, comparatively, zombies should have low expected future growth potential. Point 4 will

[6] Calculated as Net Income After Taxes divided by Equity.

be used since zombie firms have low financial performance than healthy firms, which we will consider being the firms above the median ROE of the same sector.

Our zombie definition is applied to our data of listed non-financial corporates using Stata, covering 8 529 observations. The variables used in the study are described in detail in Table A10.

[Insert Table A10 here]

A dummy for zombie firms (either using the main or alternative definition) with value 1 if the firm is a zombie and 0 otherwise will be the dependent variable, which is directly linked to the research question. To analyze this variable, a Probit test will be done. Table 1 shows that, between 2011 and 2020, 11.08% of the observations were classified as zombies under the primary definition, and 5.53%% under the alternative definition. These results make sense since the alternative definition puts more requirements into a firm for it to be considered a zombie.

**Table 1:** Zombie observations percentage.

| | **Zombie dummy** | | **Alternative zombie dummy** | |
|---|---|---|---|---|
| | Freq. | Percent | Freq. | Percent |
| 0 | 7584 | 88.92 | 8057 | 94.47 |
| 1 | 945 | 11.08 | 472 | 5.53 |
| Total | 8529 | 100.00 | 8529 | 100.00 |

Notes: The table shows the age frequency and percentage for firms who are zombie and who are not for both Zombie and Alternative Zombie definition. The period studied is 2011 to 2020. *Zombie dummy* and *Alternative Zombie dummy* are dummy variables with value 1 when a firm is zombie, according to the primary and alternative zombie definitions, respectively.

### *4.2.2 Independent variables*

The selection of independent variables was based on the previous literature review. Regulation will not be spoken as it is relatively equal inside the Eurozone.

- *Size:* Firm size seems to be an important factor when distinguishing between zombie and non-zombie firms (Andrews & Petroulakis, 2019; Urionabarrenetxea et al. 2018; Adalet et al. 2018; Hallak et al. 2018; Hoshi, 2016; Banerjee & Hofmann, 2020). Our model distinguishes between two size categories, according to the European Commission Regulation (EU) No 651/2014 of 17 June 2014 Annex I, Article 2, as shown in Table A11 – Small and Medium Enterprises (SME), which compilates micro, small and medium-sized firms or Large. To determine the firm size, the variable must comply with at least two of the three criteriums. The staff headcount is the variable employees, the turnover is the variable revenue, and the balance sheet is the logarithm of the variable assets (to normalize the variable). Since the literature review was no unanimous on the variable, we have no expectations.

[Insert Table A11 here]

According to Table 2, zombie observations tend to be SME under both definitions - around ¾ of the zombie observations. This result goes against most studies (Adalet et al. 2018; Andrews & Petroulakis, 2019; Hallak et al. 2018; Urionabarrenetxea et al. 2018) and agrees with Banerjee & Hofmann (2020), Binh et al. (2020) and with Hoshi (2006) who states that large firms are less likely to require financial assistance.

**Table 2:** Size of observations.

| | **Database** | | **Zombie dummy** | | **Alternative Zombie dummy** | |
|---|---|---|---|---|---|---|
| Firm Size | Freq. | Percent | Freq. | Percent | Freq. | Percent |
| SME | 3273 | 38.37 | 720 | 76.19 | 335 | 70.97 |
| Large | 5256 | 61.63 | 225 | 23.81 | 137 | 29.03 |
| Total | 8529 | 100.00 | 945 | 100.00 | 472 | 100.00 |

Notes: The period studied is 2011 to 2020.

- *Sector:* Our sample is distributed across 10 sectors. Consequently, it seems appropriate to analyze in which sectors the presence of zombie observations is higher[7]. Due to the literature review, we expect this variable to show that zombie firms tend to be more present in non-manufacturing sectors.

  According to Table 3, it seems that zombie observations tend to be more present in Consumer Cyclicals, Industrials, Healthcare and Technology sectors under both definitions. However, it should be mentioned that the sectors most present in the database are also Consumer Cyclicals, Industrials and Technology, which influences our results.

  **Table 3:** Sector of observations.

| | **Database** | | **Zombie dummy** | | **Alternative Zombie dummy** | |
|---|---|---|---|---|---|---|
| Sector | Freq. | Percent | Freq. | Percent | Freq. | Percent |
| Academic & Educational Services | 5 | 0.06 | | | | |
| Basic Materials | 852 | 9.99 | 68 | 7.20 | 51 | 10.81 |
| Consumer Cyclicals | 1902 | 22.30 | 262 | 27.72 | 150 | 31.78 |
| Consumer Non-Cyclicals | 821 | 9.63 | 48 | 5.08 | 39 | 8.26 |
| Energy | 285 | 3.34 | 24 | 2.54 | 11 | 2.33 |
| Healthcare | 617 | 7.23 | 172 | 18.20 | 53 | 11.23 |
| Industrials | 1718 | 20.14 | 181 | 19.15 | 90 | 19.07 |
| Real Estate | 715 | 8.38 | 48 | 5.08 | 12 | 2.54 |
| Technology | 1381 | 16.19 | 136 | 14.39 | 64 | 13.56 |
| Utilities | 233 | 2.73 | 6 | 0.63 | 2 | 0.42 |
| Total | 8529 | 100.00 | 945 | 100.00 | 472 | 100.00 |

Notes: The period studied is 2011 to 2020.

  This result only agrees with the literature review to some extent since some of the zombie observations' sectors, such as Consumer cyclicals, Industrials and Technology can have some manufacturing activities, although most of them are not.

- *Country:* In this study, location will not be considered. Instead, we will talk about the countries where the headquarters of the firms are located. As in the previous variable, our sample is distributed across 24 countries. Therefore, this variable will also be analyzed.

[7] According to Caballero et al. (2008), Hoshi (2016) and Urionabarrenetxea et al. (2018).

According to Table 4, it seems that 77% of the zombie observations were present in France, Greece and Finland, under both definitions. This result completely disagrees with Adalet et al. (2018) who found that France had 2% of zombie share, while we found it to have 44.44% and 35.59% under main and alternative zombie definition, respectively. However, the result agrees with Hallak et al. (2018) on that Greece has a high share of zombie firms. The reason may be that, as it happens with *sector*, this result is influenced by the fact that these countries represent 64% of the database observations - more specifically, France represents 44.18%. Since these countries are, respectively, center, south and north Eurozone, this result seems quite random. A possible reason may be worse technology access, worse production structures or others.

**Table 4:** Country of observations.

| | **Database** | | **Zombie dummy** | | **Alternative Zombie dummy** | |
|---|---|---|---|---|---|---|
| Country | Freq. | Percent | Freq. | Percent | Freq. | Percent |
| Austria | 377 | 4.42 | 33 | 3.49 | 7 | 1.48 |
| Belgium | 569 | 6.67 | 34 | 3.60 | 10 | 2.12 |
| Cyprus | 127 | 1.49 | 25 | 2.65 | 25 | 5.30 |
| Estonia | 109 | 1.28 | 15 | 1.59 | 9 | 1.91 |
| Finland | 917 | 10.75 | 67 | 7.09 | 32 | 6.78 |
| France | 3768 | 44.18 | 420 | 44.44 | 168 | 35.59 |
| Germany | 311 | 3.65 | 10 | 1.06 | 1 | 0.21 |
| Greece | 785 | 9.20 | 240 | 25.40 | 168 | 35.59 |
| Italy | 146 | 1.71 | 17 | 1.80 | 8 | 1.69 |
| Latvia | 85 | 1.00 | 7 | 0.74 | 5 | 1.06 |
| Lithuania | 148 | 1.74 | 3 | 0.32 | 3 | 0.64 |
| Luxembourg | 180 | 2.11 | - | - | - | - |
| Malta | 16 | 0.19 | - | - | - | - |
| Netherlands | 267 | 3.13 | 11 | 1.16 | 3 | 0.64 |
| Portugal | 154 | 1.81 | 15 | 1.59 | 6 | 1.27 |
| Slovak Republic | 55 | 0.64 | 2 | 0.21 | - | - |
| Slovenia | 139 | 1.63 | 11 | 1.16 | 7 | 1.48 |
| Spain | 376 | 4.41 | 35 | 3.70 | 20 | 4.24 |
| Total | 8529 | 100.00 | 945 | 100.00 | 472 | 100.00 |

Notes: The period studied is 2011 to 2020.

- *Corruption:* According to the Transparency International Corruption Perceptions Index of 2020, there seems to be no relationship between the countries with more zombie observations and its level of *corruption*. The index scores of the countries with more

zombie observations (as seen previously) are Finland with 87 points (low *corruption*), France with 69 points, and Greece with 50 points (high *corruption*).

- *Competitiveness*: From the Global Competitiveness Report 2015-2016, we can see that Finland had a score of 80.2 points (high *competitiveness*), France of 78.8 points and Greece of 62.6 points (low *competitiveness).* Therefore, again, we find no relation between the countries with more zombie observations and its level of *competitiveness*.
- *Age:* Calculated as the year minus the company's incorporation year, this variable will be analyzed to see if it influences in a firm being a zombie. Literature shows that the probability of being a zombie grows with *age*. Table 5 shows that zombie observations under both definitions are around 40 years old. Hallak et al. (2018) explains this result saying that older firms are more transparent in their financial reports and have long-term relationships with banks.

**Table 5:** Age of Database observations and zombie observations.

| **Age** | N | Mean | Std. Dev. | p25 | Median | p75 |
|---|---|---|---|---|---|---|
| Database | 8529 | 48.734 | 42.867 | 20 | 32 | 64 |
| Zombie dummy | 945 | 39.945 | 33.971 | 19 | 28 | 49 |
| Alternative Zombie dummy | 472 | 43.735 | 34.271 | 23 | 31.5 | 56 |

Notes: The table shows the summary statistics for the variable age. *Age* is calculated as the year minus the company's incorporation year. The period studied is 2011 to 2020.

- *Interest rate:* Calculated as interest expenses divided by total debt, this variable will inform us about the banks and country financials' health. We expect to find that, the lower the *interest rates* are, the higher is the probability of a firm being a zombie (Banerjee & Hofmann, 2018 and Adalet et. al, 2018).
- Economic performance: To analyze zombie firms' economic performance and to confirm the conclusions found in the previous literature review, the following variables will also be studied in the probability tests:
    - Profitability ratios - *Return on Assets (ROA):* calculated as operating income divided by assets.

- Liquidity ratios - *Current ratio:* calculated as current assets divided by current liabilities.
- Financial leverage - *Debt ratio:* calculated as liabilities divided by assets.
- *Intangibles:* According to Urionabarrenetxea et al. (2018), industries that are intensive in *intangibles* - particularly, in knowledge – are mainly technology, services and health, which we have previously seen, have a high percentage of zombie observations. Thus, we expect to find that firms with higher intensity of *intangibles* are likely to be zombies.

### *4.3 Methodology*

This section provides supporting evidence on the determinants of zombie firms, especially for those determinants whose previous results seemed random, such as *competitiveness* and *corruption*. Therefore, this paper will focus on the probability of a firm being considered a zombie, as a function of some determinants: *(i) corruption; (ii) competitiveness; (iii) age; (iv) interest rate (v) ROA (vi) current ratio (vii) debt ratio* and *(vii) intangibles.*

Countries belonging to the Eurozone were analyzed by other papers such as Andrews & Petroulakis (2019), De Martiis et al (2021) and Adalet et al. (2017) before. However, our study differs from other studies in that all Eurozone was never studied. Studying all Eurozone allows the variable regulation not to be studied since the same regulation is applied in all countries. Additionally, *corruption* and *competitiveness* will be analyzed for the first time.

Table A12 shows the descriptive statistics of the variables used in the study. Multicollinearity, Wald test and omitted variables tests were also performed to test heteroscedasticity (not presented for the sake of parsimony).

[Insert Table A12 here]

Table A13 presents the coefficients for the Pearson correlation. This table shows an almost perfect negative correlation between *corruption* and *competitiveness*, presenting potential problems of multicollinearity. *Age* is negatively correlated with *interest rates* confirming Zhang et al. (2020) finding that older firms usually receive lower *interest rates*.

[Insert Table A13 here]

### *4.3.1* Pooled Probit Model

A Probit regression that estimates the probability of a dummy dependent variable (*d_zombie* and *d_zombie_alt*) being 1 if the firm i in year t is a zombie and 0 otherwise, according to the independent variables, will be used. On the left part of the model is the probability of a firm being a zombie in the period studied. The right side includes the independent variables.

The Probit regression is the following:

$$(1)\ \Pr(d\_zombie_{it}) = \alpha_0 + \beta_1 corruption_{it} + \beta_2 competitiveness_{it} + \beta_3 age_{it} + \beta_4 int\_r_{it} + \beta_5 ROA_{it} + \beta_6 current\_r_{it} + \beta_7 debt\_r_{it} + \beta_8 intangibles_{it} + \delta_e + \epsilon_{it}$$

The variable $\delta_e$ is the fixed effect specification for the year. The index of observation is i and the time index is t. The regression model will be used for both the primary and alternative definition of zombie. Additionally, because there is high correlation between *corruption* and *competitiveness*, the models will not have both variables simultaneously.

### *4.3.2* Pooled Logit Model

A Logit regression that will model the binary dependent variable (*d_zombie* and *d_zombie_alt*) with value 1 if the firm I in year t is a zombie and 0 otherwise will be used to conduct a robust analysis of the Probit model. The Logit regression will estimate the variables that affect the probability of a firm being a zombie and is the following:

(2) $$d\_zombie_{it} = \alpha_0 + \beta_1 corruption_{it} + \beta_2 competitiveness_{it} + \beta_3 age_{it} + \beta_4 int\_r_{it} + \beta_5 ROA_{it} + \beta_6 current\_r_{it} + \beta_7 debt\_r_{it} + \beta_8 intangibles_{it} + \delta_e + \epsilon_{it}$$

## 5 Result Analysis

### *5.1 Differences between variables analysis*

Differences between zombie and non-zombie firms' determinants, according to the primary definition, are shown in Table 6. This analysis enables to see the mean variable differences between these firms. To start, we can see that *corruption* is higher for zombie observations than for non-zombie observations and that *competitiveness* is lower. This means that zombie observations are mainly located in corrupt and uncompetitive countries. Regarding *age* and *ROA*, we can see that zombie observations have negative *ROA and* are around 10 years younger than non-zombie observations who present positive *ROA*, on average. De Martiis et al (2021) confirms this finding when saying that firms with high *ROA* do not usually need bank credit as they can finance themselves with retaining earnings. On the other side, d*ebt ratio* is higher for zombie observations, due to their higher percentage of debt and/or low amount of assets to pay its debt. Furthermore, as appointed by Urionabarrenetxea et al. (2018) and proved by this table, firms with higher intensity of *intangibles* are more likely zombies.

**Table 6:** Differences between Zombie and Non-zombie observations - Primary definition.

| | N | Treated (Zombie) | Control (Non-Zombie) | Difference (Non-Zombie – Zombie) |
|---|---|---|---|---|
| Corruption | 8529 | -64.912 | -69.934 | -5.022*** |
| | | (0.349) | (0.109) | (0.333) |
| Competitiveness | 8529 | 73.598 | 76.438 | +2.840*** |
| | | (0.231) | (0.590) | (0.186) |
| Age | 8529 | 39.945 | 49.829 | +9.884*** |
| | | (1.105) | (0.502) | (1.475) |
| Interest rate | 8529 | 0.258 | 0.601 | +0.344 |
| | | (0.116) | (0.227) | (0.643) |
| ROA | 8529 | -0.141 | 0.039 | +0.180*** |
| | | (0.009) | (0.001) | (0.005) |
| Current ratio | 8529 | 1.790 | 1.720 | -0.070 |
| | | (0.064) | (0.023) | (0.069) |
| Debt ratio | 8529 | 0.765 | 0.586 | -0.179*** |
| | | (0.022) | (0.003) | (0.011) |
| Intangibles | 8529 | 0.081 | 0.066 | -0.014*** |
| | | (0.004) | (0.001) | (0.004) |

Notes: The period studied is 2011 to 2020. The symbols ** and *** represent significance level of 5% and 1%, respectively, for a one-tailed test.

The same table was made with the alternative zombie definition (not presented for the sake of parsimony) and its findings are mainly the same, except for *current ratio* which is higher for non-zombie observations than for zombie observations and whose mean difference is statistically significant. Moreover, under this definition, *intangibles* mean difference is not statistically significant and almost null.

The same way, Table 7 compares the zombie determinants for both SME and large companies. We conclude that SME are more present in corrupt and uncompetitive countries and have higher *current ratio* and *intangibles* and lower *debt ratio*. The lower *debt ratio* is explained since SME high rate of default dissuades financial institutions to grant them more credit (Urionabarrenetxea et al. 2018). Additionally, *ROA* is negative for SME and positive for large firms, which can be explained by the fact that SME are younger (24 years) than large firms. Table 7 also shows that zombie firms, under both definitions, are SME. This finding goes hand in hand with Table 2 and Table 6.

**Table 7:** Differences between Small and Medium Enterprises and Large Enterprises.

| | N | Treated (SME) | Control (Large) | Difference (SME-Large) |
|---|---|---|---|---|
| Corruption | 8529 | -66.569 | -71.127 | +4.558*** |
| | | (0.175) | (0.127) | (0.212) |
| Competitiveness | 8529 | 74.783 | 76.958 | -2.175*** |
| | | (0.112) | (0.063) | (0.120) |
| Age | 8529 | 33.717 | 58.085 | -24.368*** |
| | | (0.508) | (0.651) | (0.917) |
| Interest rate | 8529 | 0.923 | 0.339 | +0.583 |
| | | (0.410) | (0.205) | (0.415) |
| ROA | 8529 | -0.040 | 0.056 | -0.096*** |
| | | (0.004) | (0.001) | (0.003) |
| Current ratio | 8529 | 2.048 | 1.528 | +0.520*** |
| | | (0.052) | (0.013) | (0.044) |
| Debt ratio | 8529 | 0.588 | 0.617 | -0.030*** |
| | | (0.008) | (0.003) | (0.007) |
| Intangibles | 8529 | 0.070 | 0.066 | +0.004* |
| | | (0.002) | (0.001) | (0.002) |
| Zombie dummy | 8529 | 0.220 | 0.043 | +0.177*** |
| | | (0.007) | (0.003) | (0.007) |
| Alternative Zombie dummy | 8529 | 0.102 | 0.026 | +0.076*** |
| | | (0.005) | (0.002) | (0.005) |

Notes: The period studied is 2011 to 2020.

### *5.2 Probit Regression Model*

Table 8 shows the estimation results of the Probit model mentioned in the methodology section, and each column shows the coefficient estimates and respective standard errors. Model (1) shows the Probit model without the variable *competitiveness* and model (2) the same model without the variable *corruption*, since these two variables are highly correlated. Model (3) and (4) show the same Probit model only with the variable *corruption* and *competitiveness*, respectively. Model (5), (6), (7) and (8) follow models (1), (2), (3) and (4), respectively, but under the alternative zombie definition.

**Table 8:** Probit Regression Models.

| | (1) d_zombie | (2) d_zombie | (3) d_zombie | (4) d_zombie | (5) d_zombie_alt | (6) d_zombie_alt | (7) d_zombie_alt | (8) d_zombie_ |
|---|---|---|---|---|---|---|---|---|
| Corruption | 0.0298*** | | 0.0273*** | | 0.0378*** | | 0.0361*** | |
| | (0.00212) | | (0.00194) | | (0.00266) | | (0.00257) | |
| Competitiveness | | -0.0538*** | | -0.0432*** | | -0.0632*** | | -0.0585** |
| | | (0.00318) | | (0.00307) | | (0.00373) | | (0.00361 |
| Age | 0.000115 | -0.00006.27 | | | 0.000533 | 0.000248 | | |
| | (0.000512) | (0.000509) | | | (0.000615) | (0.000610) | | |
| Interest rate | -0.00143 | -0.00146 | | | -0.00221 | -0.00218 | | |
| | (0.00144) | (0.00133) | | | (0.00250) | (0.00197) | | |
| ROA | -2.872*** | -3.000*** | | | -1.474*** | -1.577*** | | |
| | (0.270) | (0.280) | | | (0.162) | (0.168) | | |
| Current ratio | 0.0151 | 0.0185* | | | -0.0930*** | -0.0849*** | | |
| | (0.0101) | (0.0104) | | | (0.0346) | (0.0317) | | |
| Debt ratio | 0.363** | 0.371** | | | -0.298*** | -0.308*** | | |
| | (0.152) | (0.153) | | | (0.105) | (0.105) | | |
| Intangibles | 0.489** | 0.595*** | | | 0.0716 | 0.234 | | |
| | (0.197) | (0.199) | | | (0.224) | (0.220) | | |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 8,529 | 8,529 | 8,529 | 8,529 | 8,529 | 8,529 | 8,529 | 8,529 |
| Adjusted R-Squared | 0.203 | 0.211 | 0.061 | 0.058 | 0.133 | 0.143 | 0.094 | 0.099 |

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: Each column shows the coefficient estimates and their standards errors (in parentheses) of a Probit regression models. The period studied is 2011 to 2020.

The *corruption* coefficient is positive, meaning that the higher is a country's *corruption*, the higher is the probability of a firm being a zombie in that same country. This conclusion can be seen in the corrupt bankers who provide credit when they should not or in the politicians who provide subsidies for those who do not deserve it (Andrews & Petroulakis, 2019; Banerjee & Hofmann, 2018; Machek, 2018). Similarly, *intangibles* are also positive under the main definition, meaning that the probability of a firm becoming a zombie grows with *intangibles*, confirming Urionabarrenetxea et al. (2018).

Contrary to *corruption*, *competitiveness* is negative for all models, meaning that the higher is a country's *competitiveness* score, the lower is the probability of a firm being a zombie, in that same country. Thus, Hoshi (2006) statement that zombie firms are less productive, and therefore less competitive is confirmed. The same way, *ROA* also has a negative coefficient, meaning that the higher a firm's *ROA* is, the lower its probability of being a zombie firm is. Of course, when a firm's business is going well, its *ROA* increases, allowing the firm to finance itself and lowering its risk of becoming a zombie (De Martiis et al. 2021).

*Current ratio* is negative and statistically significant in all models that used the alternative zombie definition. Thus, the higher is a firm's *current ratio*, the lower is its probability of becoming a zombie. The *current ratio* can increase due to an increase in current assets and/or a decrease in current liabilities – both are signs of healthy firms. When using the primary definition, this variable is not statistically significant[8]. The same way, d*ebt ratio* is statistically significant in all models and negative under the alternative zombie definition and positive otherwise. Under the main zombie definition, a firm is more likely to become a zombie when its *debt ratio* is higher. The *debt ratio* increases with increases in liabilities and/or decreases in assets, which can ben signs of financial problems. Under the alternative zombie definition, a firm is more likely to become a zombie when its *debt ratio* is lower. This puzzling result may come from the definition's criterium.

*Age* and *interest rate* are not statistically significant in any model. However, we can still see that i*nterest rate* is negative for all models proving Banerjee & Hofmann (2018) and Adalet et. al, (2018) findings that the lower the *interest rates* are, the higher is the probability of a firm being a zombie.

A logistic model was run to control and robust the results - Table 9. This table presented the same values and results, certifying, this way, Table 8.

[8] Ignoring the 10% confidence level p-value

**Table 9:** Logit Regression Models.

| | (1) d_zombie | (2) d_zombie | (3) d_zombie | (4) d_zombie | (5) d_zombie_alt | (6) d_zombie_alt | (7) d_zombie_alt | (8) d_zombie_alt |
|---|---|---|---|---|---|---|---|---|
| Corruption | 0.0298*** | | 0.0273*** | | 0.0378*** | | 0.0361*** | |
| | (0.00212) | | (0.00194) | | (0.00266) | | (0.00257) | |
| Competitiveness | | -0.0538*** | | -0.0432*** | | -0.0632*** | | -0.0585*** |
| | | (0.00318) | | (0.00307) | | (0.00373) | | (0.00361) |
| Age | 0.000115 | -0.00006.2 | | | 0.000533 | 0.000248 | | |
| | (0.000512) | (0.000509) | | | (0.000615) | (0.000610) | | |
| Interest rate | -0.00143 | -0.00146 | | | -0.00221 | -0.00218 | | |
| | (0.00144) | (0.00133) | | | (0.00250) | (0.00197) | | |
| ROA | -2.872*** | -3.000*** | | | -1.474*** | -1.577*** | | |
| | (0.270) | (0.280) | | | (0.162) | (0.168) | | |
| Current ratio | 0.0151 | 0.0185* | | | -0.0930*** | -0.0849*** | | |
| | (0.0101) | (0.0104) | | | (0.0346) | (0.0317) | | |
| Debt ratio | 0.363** | 0.371** | | | -0.298*** | -0.308*** | | |
| | (0.152) | (0.153) | | | (0.105) | (0.105) | | |
| Intangibles | 0.489** | 0.595*** | | | 0.0716 | 0.234 | | |
| | (0.197) | (0.199) | | | (0.224) | (0.220) | | |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 8,529 | 8,529 | 8,529 | 8,529 | 8,529 | 8,529 | 8,529 | 8,529 |
| Adjusted R-Squared | 0.203 | 0.211 | 0.061 | 0.058 | 0.133 | 0.143 | 0.094 | 0.099 |

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: Each column shows the coefficient estimates and their standards errors (in parentheses) of a Probit regression models. The period studied is 2011 to 2020.

Through the analysis of the independent variables on the empirical investigation part of this paper and the result analysis, this paper reaches some conclusions: Zombie firms tend to labor on Consumer Cyclicals, Industrial, Healthcare and Technology *sector* and/or be located in France, Greece, or Finland and in corrupt and/or uncompetitive countries. Zombie firms also tend to be SME (3/4 of the observations) around 40 years old. Moreover, the probability of a firm being a zombie grows with *debt ratio* (main definition) and *intangibles* (confirming Urionabarrenetxea et al. 2008) and decreases with *current ratio* and *ROA* (confirming De Martiis et al. 2021).

The main finding of this paper, aside from analyzing the determinants previously studied are the results of the *corruption* and *competitiveness* variable. Model (3), (4), (7) and (8) of Table 8 were calculated to analyze the probability of a firm being a zombie with no other variables to discard any possible influences from other determinants. Although the coefficients slightly decrease, the findings remain the same – The probability of a firm being a zombie grows in corrupt and uncompetitive countries. Thus,

a possible measure for governments to decrease a country's zombie share is by decreasing corruption and increasing competitiveness.

## 6 Conclusion

This study analyzed the determinants of the listed zombie observations in the Eurozone in the period 2011-2020. Zombie firms are firms with negative equity that survive with the help of their creditors. They have more than 10 years old and present, for three years in a row an ICR less than 1 and a Tobin's Q ratio lower than their sector average. This paper also used a zombie firm alternative definition to make comparisons. The alternative definition states that a firm is zombie when it is older than 10 years old, it has an ICR below 1, a Tobin's q ratio below-median within the sector and an ROE below-median within the sector. Between 2011 and 2020, 11.08% of the Eurozone listed firms were classified as zombies under the primary definition and 5.53% under the alternative definition. Therefore, the study of this phenomenon is of major relevance since zombie firms represent negative consequences to society because of zombie congestion decreasing productivity and contributing to inefficient firms' survival (due to easy access to debt) (Machek, 2018). This way, the available credit for efficient firms decreases, creating barriers to market entry (Machek, 2018 and Caballero et al. 2008). Moreover, zombie firms hold on to their workers and financial resources making it difficult for new entrants to have access to these resources (Hoshi, 2006).

This paper intends to study the probability of a firm being a zombie through a Probit model. The results can be used to predict and avoid zombie firms and hence, be useful for government, banks, and firm's managers. The period studied is 2011 to 2020.

The research found that, zombie firms: (i) are SME, representing ¾ of this study's observations; (ii) are mostly present in Consumer Cyclicals, Industrials, Healthcare and

Technology *sector*; (iii) are mostly present in France, Greece and Finland; (iv) are mostly present in corrupt countries; (v) are mostly present in uncompetitive countries; (vi) are around 40 years old; (vii) present low *ROA*; (viii) present high *debt ratios;* (ix) have high intensity of *intangibles* (x) present low *current ratio.*

Moreover, the main finding of this paper (aside from analyzing the determinants previously studied in other papers) is that zombie firms are in corrupt and uncompetitive countries. This finding is extremely important as it provides guidance to fight the zombie phenomena – governments must fight corruption and increase competitiveness.

Our paper contributes to existent literature on zombie firms and their determinants by analyzing how a firm's determinants affect a firm's likelihood of becoming a zombie and by extending recent literature on this subject. As a distinct feature, the paper used two definitions of zombie firms and compared their results – a main definition and an alternative definition, more restrictive than the previous one. Our results policy implications are based on providing information to avoid zombie firms' formation. By understanding that a firm who complies with most of our findings is highly likely to become zombies, governments should review their regulations and banks should restrain from providing credit to these firms. One limitation of our study is the zombie firms' definitions, since there is not an universal definition that can be used. Another limitation is the set of variables, who is still very limited and focused on Asia or Europe. Future research should focus on studying other geographical areas and other zombie firms' determinants. For example: which stock exchange are the firms on; liabilities; revenue; or even the main sex of the employees. Future research could also try to understand why France and Greece, two countries completely different (economically, culturally, etc), show the same trend of zombie share.

## 7 References

Adalet McGowan, M., Andrews, D., & Millot, V. (2017). Insolvency Regimes, Zombie Firms and Capital Reallocation. *OECD Economics Department* Working Paper, No. 1399.

Adalet McGowan, M, Andrews, D., & Millot, V. (2018). The Walking Dead: Zombie Firms and Productivity Performance in OECD Countries, *Economic Policy*, 33(96), 685-736.

Andrews, D., & Petroulakis, F. (2019). Breaking the Shackles: Zombie Firms, Weak Banks, and Depressed Restructuring in Europe. *ECB* Working Paper, Nº 2240.

Blažková, I., & Dvouletý, O. (2020). Zombies: Who Are They and How Do Firms Become Zombies? *Journal of Small Business Management,* forthcoming, 1-27.

Banerjee, R., & Hofmann, B. (2018). The Rise of Zombie Firms: Causes and Consequences. *BIS Quarterly Review,* September, 23(3), 67-78.

Banerjee, R., & Hofmann, B. (2020). Corporate Zombies: Anatomy and Life Cycle. *Bank for International Settlements* Working Paper. No. 882.

Binh, T., Huong, V., & Loan, N. (2020). Zombie Companies: Experimental Research from Real Estate Listed Sectors. *Revista Argentina de Clínica Psicológica*, 29(5), 1360-1369.

Caballero, R., Hoshi, T., & Kashyap, A. (2008). Zombie Lending and Depressed Restructuring in Japan. *American Economic Review*, *98*(5), 1943-77.

De Martiis, A., Heil, T., and Peter, F. (2021). *Are you a Zombie? A Supervised Learning Method to Classify Unviable Firms and Identify the Determinants.* SSRN Electronic Journal, forthcoming, January.

De Martiis, A., & Peter, F. J. (2021). *When Companies Don't Die: Analyzing Zombie and Distressed Firms in a Low Interest Rate Environment.* SSRN Electronic Journal, forthcoming, July.

Dudley L. Poston Jr. (2021), *Ordinary Least Square Regressions.* Encyclopedia.com

Egan, M., & Horowitz, J., (2019). *13% of the world's companies are "zombies". That's not healthy.* CNN Business. 2019, 31st March.

European Commission Regulation (2014) No 651/2014 of 17 June 2014 declaring certain categories of aid compatible with the internal market in application of Articles 107 and 108 of the Treaty. *Official Journal of the European Union.*

Hallak, I., Harasztosi, P., & Schich, S. (2018). Fear the Walking Dead? Incidence and Effects of Zombie Firms in Europe. *Journal of Economic Science Research*, 1(1).

Hoshi, T. (2006). Economics of the living dead. *The Japanese Economic Review*, *57*(1), 30-49.

Machek, O. (2018). Determinants of Becoming a Zombie Firm: A Pitch. *Journal of Accounting and Management Information Systems*, *17*(4), 677-684.

Peek, J., & Rosengren, E. (2005). Unnatural Selection: Perverse Incentives and the Misallocation of Credit in Japan. *American Economic Review*, *95*(4), 1144-1166.

Rennison J. (2020), Pandemic debt binge creates new generation of "zombie" companies. *Financial Times.* 2020, 14th September.

Sandbu M. (2020), *The corporate zombies stalking Europe.* Financial Times. 2020, 8th September.

Schawb, K. (2019). The Global Competitiveness Report 2019. *World Economic Forum* Insight Report.

Schivardi, F., Sette, E., & Tabellini, G. (2021). Credit Misallocation During the European Financial Crisis. *The Economic Journal*. forthcoming

Selfin, Y., (2019). *Zombies in our midst.* KPMG. 2019, 15th May.

Transparency International (2021), *Corruption Perceptions Index 2020.* Retrieved August 2nd, 2021, from: https://www.transparency.org/en/cpi/2020/index/nzl

Urionabarrenetxea, S., Garcia-Merino, J., San-Jose, L., & Retolaza, J. (2018). Living With Zombie Companies: Do We Know Where the Threat Lies. *European Management Journal*, *36*(3), 408-420.

Zhang, C., Chen, Y., & Zhou, H. (2020). Zombie Firms and Soft Budget Constraints in the Chinese Stock Market. *Asian Economic Journal*, *34*(1), 51-77.

# 8 Appendix

**Table A10:** Variable's Definitions.

| Variable name | Variable definition |
|---|---|
| Zombie dummy | Dummy variable with value 1 if the firm is a zombie company, according to the main zombie definition. |
| Alternative zombie dummy | Dummy variable with value 1 if the firm is a zombie company, according to the alternative zombie definition. |
| Firm Size | Defines a zombie as micro, small, medium, or large according to the European Commission Regulation (EU) No 651/2014 of 17 June 2014 Annex I, Article 2. The variable must follow at least two of the three criterium. The staff headcount is the variable employees, the turnover is the variable revenue, and the balance sheet is the variable logarithm of total assets. |
| Sector | Represents the sector in which the firm belongs. |
| Country | Represents the country where the headquarters of the company is located. |
| Corruption index score | Shows the firm's country corruption score according to the Transparency International Corruption Perceptions Index of 2020. |
| Competitiveness index score | Shows the firm's country competitiveness score according to the Global Competitiveness Report 2015-2016. |
| Age of the company | Calculated as the year minus the company's incorporation year. |
| Interest rate | Calculated as interest expenses divided by total debt. |
| Return on assets | Calculated as operating income divided by total assets. |
| Current ratio | Calculated as current assets divided by total current liabilities. |
| Debt ratio | Calculated as liabilities divided by total assets. |
| Intangibles | Shows the amount of net intangibles that each firm has in a certain year. |

Notes: The table shows the name and respective definition of the dependent and independent variables used in the regression models. The zombie definition states that a firm is a zombie when it is older than 10 years old and it has an ICR<1, for three years in a row. The alternative zombie definition states that a firm is a zombie when it is older than 10 years old, it has an ICR<1, a Tobin's q ratio below median within the sector and an ROE below median within the sector, for three years in a row.

**Table A11:** Size categories, according to the European Commission Regulation (EU) No 651/2014 of 17 June 2014.

| Enterprises | Staff headcount | Turnover | Balance sheet total |
|---|---|---|---|
| **Micro enterprises** | < 10 | ≤ € 2 million | ≤ € 2 million |
| **Small enterprises** | < 50 | ≤ € 10 million | ≤ € 10 million |
| **Medium-sized enterprises** | < 250 | ≤ € 50 million | ≤ € 43 million |
| **Large enterprises** | > 250 | > € 50 million | > € 43 million |

Notes: The table shows the size criterium to define on which category a firm, according to the European Commission Regulation (EU) No 651/2014 of 17 June 2014 Annex I, Article 2. To determine the firm size, the variable must follow at least two of the three criterium.

**Table A12:** Descriptive Statistics.

| | N | Mean | Std. Dev. | p25 | Median | p75 |
|---|---|---|---|---|---|---|
| Zombie dummy | 8529 | .111 | .314 | 0 | 0 | 0 |
| Alternative Zombie dummy | 8529 | .055 | .229 | 0 | 0 | 0 |
| Corruption Index Score | 8529 | -69.378 | 9.789 | -76 | -69 | -69 |
| Competitiveness Index Score | 8529 | 76.124 | 5.472 | 75.3 | 78.8 | 78.8 |
| Age | 8529 | 48.734 | 42.867 | 20 | 32 | 65 |
| Interest rate | 8529 | .563 | 18.641 | .022 | .035 | .055 |
| ROA | 8529 | .019 | .156 | .006 | .043 | .078 |
| Current ratio | 8529 | 1.728 | 2.01 | .971 | 1.358 | 1.946 |
| Debt ratio | 8529 | .606 | .328 | .454 | .592 | .72 |
| Intangibles | 8529 | .068 | .102 | .005 | .028 | .088 |

Notes: The period studied is 2011 to 2020. *Interest rate* is calculated as interest expenses divided by total debt. *ROA* is calculated as operating income divided by assets. *Current ratio* is calculated as current assets divided by current liabilities. *Debt ratio* is calculated as liabilities divided by assets.

**Table A13:** Correlations.

| Variables | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| (1) Corruption | 1.000 | | | | | | |
| (2) Competitiveness | -0.824* | 1.000 | | | | | |
| (3) Age | -0.116* | 0.083* | 1.000 | | | | |
| (4) Interest rate | 0.013 | -0.008 | -0.012 | 1.000 | | | |
| (5) ROA | -0.054* | -0.012 | 0.136* | 0.000 | 1.000 | | |
| (6) Current ratio | -0.001 | 0.022* | -0.061* | 0.017 | -0.030* | 1.000 | |
| (7) Debt ratio | 0.036* | -0.015 | -0.007 | -0.019 | -0.298* | -0.272* | 1.000 |
| (8) Intangibles | -0.041* | 0.093* | -0.079* | 0.033* | -0.075* | -0.055* | 0.029* |

**** p<0.01, ** p<0.05, * p<0.1*

Notes: The period studied is 2011 to 2020. The symbol * represents significance level of 10% for a one-tailed test.

# 9 Literature Theoretical Review Table

| Author | Topic paper | Type of analyze | Main conclusions |
|---|---|---|---|
| **Banerjee & Hofmann (2018)** | "The rise of zombie firms causes and consequences" | Explore the rise of zombie companies and its causes and consequences. | • Zombie firms present low expected profitability.<br>• Lower rates tend to push up zombie shares.<br>• Zombie firms are firms that for three years in a row present: *i*) low debt service capacity; and *ii*) either negative return on assets or negative investment.<br>• Causes of the rise of zombie firms: Weak banks that roll over loans rather than writing them off; Low-interest rates that reduce the financial pressure on zombies to restructure or exit.<br>• Median Tobin's q of zombie firms is higher than that of non-zombies.<br>• Lower rates boost aggregate demand and raise employment and investment in the short run. But the higher prevalence of zombies they leave behind misallocate resources and weigh on productivity growth. Should this effect be strong enough to reduce growth, it could even depress interest rates further. |
| **Banerjee & Hofmann (2020)** | "Corporate zombies: Anatomy and life cycle" | Explore the anatomy and life cycle of zombie companies using firm-level data. | • Zombie companies are smaller than non-zombie firms, less productive, and grow less in terms of assets and employment, while spending less on physical and intangible capital. They are also more leveraged. |
| **Caballero et al. (2008)** | "Zombie lending and depressed restructuring in Japan" | Explore the role that misdirected bank lending played in prolonging the Japanese macroeconomic stagnation.<br>Document the prevalence of evergreening and show its effects on healthy firms. | • Zombie-dominated industries exhibit more depressed job creation and destruction, and lower productivity.<br>• Zombie firms are firms who receive subsidized credit at rates below those for the most creditworthy companies.<br>• Zombie problem is more serious for non-manufacturing firms (construction sector). |
| **De Martiis et al. (2021)** | "Are you a Zombie? A supervised learning method to classify unviable firms and identify the determinants" | Apply decision trees to identify the firm-specific determinants of zombie companies across countries and time. | • Companies with small operating income but high common stock are probably zombie firms.<br>• ROA is the main variable to find zombie firms. |

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|---|---|---|---|
| **Machek (2018)** | "Determinants of becoming a zombie firm: a pitch" | Use the pitching research template to develop the research idea of "What are the determinants of becoming a zombie firm?" | • "Zombie firms" describes firms that: should go out of the market or be forced to restructure but are still alive and operate normally; only generate enough cash to pay off the interest on their debt.<br>• These firms receive subsidies and loans from governments.<br>• Zombie firms represent a problem to society as they require long-term funding from governments and affect productivity and growth potential of other firms negatively. |
| **Zhang et al. (2020)** | "Zombie Firms and Soft Budget Constraints in the Chinese Stock Market" | Analyze zombie firms' characteristics after using Fukuda and Nakamura method to identify zombie firms in China. | • Interest rates are positively correlated with a firms' age and amount of fixed assets. |

# 10 Literature Empirical Review Table

| Author | Region | Period | Methodology | Dependent variable | Independent variables | Main conclusions |
|---|---|---|---|---|---|---|
| **Adalet et al. (2017)** | Austria, Belgium, Finland, France, Germany, Greece, Italy, Japan, Korea, Portugal, Slovenia, Spain, Sweden and the United Kingdom | 2013 | Cross-country econometric framework to study the link between insolvency regimes and zombie capital share at the industry level. | Share of industry capital sunk in zombie firms. | *Insol.*<br>*Exp.*<br>Control variables.<br>*Pol.* | • Poorly designed national insolvency regimes frameworks are likely to connect with evergreening motives.<br>• Raising barriers to corporate restructuring and creating personal costs associated with entrepreneurial failure can reduce the capital sunk in zombie firms.<br>• High barriers to restructuring lowers the likelihood of zombie recovering. |
| **Adalet et al. (2018)** | Austria, Belgium, Finland, France, Germany, Italy, Korea, | 2003-2013 | Pooled cross-country micro data to explore the distortionary effects of | *Y:* Measure of activity (the investment rate, the percentage change in | *nonZ.*<br>*Z.*<br>*Firm controls.*<br>Interacted country, industry, and | • Zombie" firms: old firms with persistent problems meeting their interest payments.<br>• A high share of industry capital sunk in zombie firms tends to congest markets and to crowd-out the growth of non-zombie firms. |

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|---|---|---|---|---|---|---|
| | Luxembourg, Portugal, Slovenia, Spain, Sweden, and the United Kingdom | | zombie firms on the performance of non-zombie firms and on the extent of productivity-enhancing capital reallocation. | employment or the level of multi-factor productivity) in firm *i*, in industry *s*, in country *c*, at time *t*. | year fixed effects. | • Helping distressed firms during recessions prevents massive layoffs and helps maintaining aggregate demand in the short run.<br>• Firms with 250 employees or more are nearly twice as more likely to be zombie firms than firms with less than 20 employees.<br>• More than one out of ten firms over 40 years old are zombie firms.<br>• Zombie congestion inflates wages relative to productivity and depresses market prices and (non-zombie) market shares.<br>• Employment growth of young non-zombie firms is particularly sensitive to zombie congestion. |
| **Andrews & Petroulakis (2019)** | Austria; Denmark; Estonia; France; Germany; Greece; Latvia; Slovenia; Spain; Portugal; United Kingdom | 2001-2014 | OLS regression to analyze the connection between zombie firms and banks health. | Dummy variable: 1 if the company is zombie | *Bank health.* firm level controls (such as firm age, size, and labor productivity) Insolvency framework indicators; | • The damage in banking sector caused by financial crisis weakened its ability to only provide credit to the most efficient uses.<br>• Zombie firms' main sectors are manufacturing, services, and construction.<br>• Bank balance sheets are more sensitive to large firms in distress than smaller firms. |
| **Binh et al. (2020)** | Vietnam | 2008-2016 | Probit regression to determine factors affecting the probability of a firm being a zombie in the real estate industry. | Dummy variable equal to 1 if a firm is a zombie firm. | *ROA. ROE. Size. Revenue growth rate. Financial leverage. Change in total assets. Cash payment ratio. Current ratio. Asset turnover ratio.* | • Zombie firms have lower ROA, ROE, and total assets turnover.<br>• Zombie firms are smaller. |

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|---|---|---|---|---|---|---|
| **Blazkova & Dvoulety (2020)** | Czech Republic | 2003-2015 | Logistic regression to determine zombie characteristics. Panel data approach to investigate over time the dynamics of the process of becoming a zombie. | Dummy variable equal to 1 if a firm is a zombie firm. | *Legal form. Size. Sector. Location. Region. Age* | • Zombies are more concentrated in larger cities.<br>• Nonlinear reversed U-shape pattern, indicating that zombie firms are most likely middle-age companies. |
| **De Martiis & Peter (2021)** | Italy; Spain; Greece; France; Germany; Austria; Netherlands; Belgium. | 1990-2018 | Logistic regressions focusing on the financial structure of the company, the profitability, and its size. | *Status* | Firm-level explanatory variables (profitability, size, and leverage). | • High short-term interest rates are linked with a decrease in zombie status.<br>• Zombie firms are smaller in size. |
| **Hoshi (2006)** | Japan | 1993-2001 | Identify zombie firms in Japan. Compare the characteristics of zombie firms with other firms using a Probit regression | Zombie dummy variable that takes 1 when the interest payment during the period is below the minimum required interest payment, *R**; | *Profit rate. Negative income. Operating profit rate. Main bank dependence. Total debt/Total assets. Log (Total assets). Log (Employment) Location.* | • Zombie firms are insolvent and have little hope of recovery but avoid failure thanks to support from their banks who give interest concessions or outright debt forgiveness.<br>• The net cost of saving zombies may be smaller, because the benefit of protecting incumbent jobs is subtracted from all these costs.<br>• Larger size makes the firm less likely to be a zombie, but among small firms, relatively larger firms are more likely to be protected and become zombies.<br>• When the proportion of zombie firms in an industry increases, job creation declines, and job destruction increases.<br>• If the lenders' support for zombies is large enough, they may decide to expand, gambling for resurrection. |

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|---|---|---|---|---|---|---|
| | | | | | *Industry dummies.* | |
| **Peek & Rosengren (2005)** | Japan | 1993-1999 | Hypothesis test to test the "affiliation" hypothesis. | Dummy variable:1 if loans to firm i by bank j increased from year t-1 to year t, and 0 otherwise. | *Firm. Bank. CapreQ. Affil.* | • Firms are more likely to receive additional credit if they are in poor financial condition and continue to perform poorly after receiving additional bank financing.<br>• Evergreening was encouraged by the national duty of banks to support firms in trouble and by the attempt of weak banks to maintain required capital ratios on their balance sheets.<br>• Evergreening: when a bank extends additional credit to a troubled firm to enable the firm to make interest payments on outstanding loans and avoid or delay bankruptcy. |
| **Schivardi et al. (2021)** | Italy | 2004-2013 | Regression model to determine whether banks with low capital ratios are more likely to extend credit to zombie firms. | Log difference in total lending of bank j to firm i between year t and t+1 | *Zit*; *LowCapjt*. *Crisist*. *Xijt*. Dummies: different sets of dummy variables used in different specifications. | • Evergreening appears to be easier for smaller banks.<br>• During the Eurozone financial crisis: (i) undercapitalized banks were less likely to cut credit to non-viable firms. (ii) Credit misallocation increased the failure rate of healthy firms and reduced the failure rate of non-viable firms. |
| **Urionabarrenetxea et al. (2018).** | Spain | 2010-2014 | Analyze the presence of zombie firms in the Spanish economy by applying EZIndex and identifying the sources of greatest risk using: Kolmogorov-Smirnov test; | EZIndex | *Industry Location Size Intangibles Regulation* | • Industry more likely to have zombies: Information and Communication; Real Estate.<br>• Industry less likely to have zombies: Agriculture, forestry, and fishing industry; Financial and Insurance; Public Administration.<br>• The more regulated or the more attached to the government a firm is, the lower is its probability of becoming a zombie.<br>• Larger firms diversify more to decrease their bankruptcy chances and to afford higher borrowing level.<br>• Firms with many off-balance-sheet intangibles can receive credit over and above the value of their book assets. |

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|---|---|---|
| | | log-linear analysis. |

# 11 Literature review summary table of independent variables

| Independent variable | Studies | Conclusions |
|---|---|---|
| **Bank Health** | Andrews & Petroulakis (2019) | Financial crisis weakens banks' ability to only provide credit to the most efficient uses.<br>One-third of the negative effects of zombie congestion on the efficiency of reallocations is attributed to weak banks. |
| | Schivardi et al. (2021) | Evergreening is easier for smaller banks due to its higher flexibility and less constrained decision process.<br>Low capital banks are less likely to classify their loans as bad. |
| **Interest Rates** | Banerjee & Hofmann, (2018) | The interest rates drop since the 80s has reduced the firms' financial pressure to restructure or exit.<br>Lower rates tend to push up zombie shares, since they reduce the pressure on creditors to clean up their balance sheet. |
| | De Martiis & Peter (2021) | High short-term interest rates are linked with a decrease in zombie status. |
| | Zhang et al. (2020) | Interest rates are positively correlated with a firms' age and amount of fixed assets. |
| **Sector** | Hoshi, (2006) | Highly regulated sectors' firms' probability of becoming zombies is low. |
| | Caballero et al. (2008) | Non-manufacturing firms are more likely to become zombie firms, especially, wholesale and retail, services, and Real estate. |
| | Urionabarrenetxea et al. (2018) | The industry:<br>• more likely to have zombies: Information and Communication; Real Estate.<br>• less likely to have zombies: Agriculture, forestry, and fishing; Financial and Insurance; Public Administration. |
| **Economic Performance** | Urionabarrenetxea et al. (2018) | Firms with higher intensity of intangibles are more likely zombie. |
| | De Martiis et al. (2021) | Companies with small operating income but high common stock are probably zombies.<br>Firms with high ROA do not usually need bank credit as they can finance themselves with retaining earnings. |
| | Binh et al. (2020) | Zombie firms have smaller ROA, ROE and Total asset turnover. |
| **Country** | Hallak et al. (2018) | Zombie shares are higher in Greece and Spain. |
| | Hoshi, (2006) | Zombies are more likely to be located outside large metropolitan areas. |
| | Blazkova & Dvouletý, (2020) | Zombies are more likely to be located outside large metropolitan areas. |

| | | |
|---|---|---|
| **Size** | Andrews & Petroulakis, (2019) | Big firms' probability of becoming zombies is higher. |
| | Urionabarrenetxea et al. (2018) | Larger firms diversify more to decrease their bankruptcy chances and to afford higher borrowing level.<br>Information asymmetries are lower for these firms and, consequently, they have better credit ratings enabling them to access non-bank credits.<br>Small firms' high rate of default dissuades financial institutions to grant them more credit. |
| | Adalet et al. (2018) | The likelihood of becoming a zombie increases with size.<br>Large firms are more likely to receive government benefits. |
| | Hallak et al. (2018) | Larger firms are more likely to be zombies. |
| | Hoshi (2006) | Large firms are less likely to become zombie firms. |
| | Banerjee & Hofmann (2020) | Zombie firms are smaller than non-zombie firms. |
| | Binh et al. (2020) | Zombie firms are smaller in scale. |
| | De Martiis & Peter (2021) | Zombie companies are smaller in size. |
| **Age** | Adalet et al. (2018) | The likelihood of being a zombie firm grows with age. |
| | Blazkova & Dvouletý (2020) | Nonlinear reversed U-shape pattern, indicating that zombie firms are most likely middle-age companies. |
| | Hallak et al. (2018) | Older firm are more likely to be zombies. |