Zombie firms – Evolution and main characteristics

A Eurozone Study

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Abstract

Zombie firms are defined as companies whose financial returns are insufficient to meet their liabilities to creditors, who continue to support them artificially to avoid recognizing losses. This study examines 3187 listed companies in the Eurozone over the period from 2010 to 2022. Two distinct definitions were employed to identify the presence of zombie firms and to analyze the differences in balance sheets between zombie and non-zombie firms. The findings indicate that, at an aggregate level, the proportion of zombie firms decreased following the Great Financial Crisis, only to surge dramatically during the global pandemic. On average, 7% of euro area firms can be classified as zombie firms according to the first definition and 20% according to the second. Additionally, the study reveals that zombie firms exhibit lower levels of investment, reduced asset bases, and higher levels of indebtedness. This research contributes to the existing literature by identifying the prevalence of zombification in the Eurozone and by highlighting the financial discrepancies between zombie and non-zombie firms. These insights may assist in identifying future predictors of zombification and help the creation of strategies that try to mitigate this issue through a deeper understanding of the phenomenon.

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Keywords: Zombie firms; Evergreening; Interest Coverage Ratio; Leverage; Non-performing loans

Resumo

As empresas zombie são definidas como empresas cujos retornos financeiros são insuficientes para satisfazer as suas responsabilidades para com os credores, que continuam a apoiá-las artificialmente para evitar o reconhecimento de perdas. Este estudo analisa as empresas listadas na Zona Euro durante o período de 2010 a 2022. Foram utilizadas duas definições distintas para identificar a presença de empresas zombie e para analisar as diferenças nos balanços entre empresas zombie e não zombie. As conclusões indicam que, a nível agregado, a proporção de deste tipo de empresas diminuiu após a Grande Crise Financeira, apenas para aumentar drasticamente durante a pandemia global. Em média, a Zona Euro registou 7% de empresas zombie de acordo com a primeira definição utilizada e 20% de acordo com a segunda. Além disso, o estudo revela que as empresas zombie apresentam níveis mais baixos de investimento, ativos reduzidos e níveis mais elevados de endividamento. Este estudo contribui para a literatura existente ao identificar a prevalência da zombificação na Zona Euro e ao destacar as discrepâncias financeiras entre empresas zombie e não zombie. Estes conhecimentos podem ajudar a identificar futuros fatores de previsão e auxiliar a criação de estratégias para mitigar este problema através de uma compreensão mais profunda do fenómeno.

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Contents

1. Introduction

Zombie firm existence is a theme that has been studied for some decades now, with increasing attention from countries and researchers. Since the economic downturn that happened during the Covid-19 crisis, there are growing concerns that this problem can become more prominent and undermine economies. Governments counteracted during this time by extending more support measures, as reported in (Lynch 2020), to find a way in which companies could survive with the negative economic outlook. The term zombie is used to classify these unhealthy firms just like the mythical zombie. Some businesses appear to live longer than they should thanks to a confluence of favorable lending terms, cheap interest rates, and other outside variables. Even if they might still be in business, their existence begs important concerns about the effectiveness and state of the economy.

Despite the recent trend and increased focus of researchers, this topic is still relatively new, even though the huge importance it possesses and the rising visibility in public discourse, as can be observed in the study by (Banerjee and Hofmann 2022), the steep increase in the number of times the word “zombie firms” or “zombie companies” started after 2015. The main reason for it, is that this theme only gained recognition in the aftermath of the Japanese banking crisis in the 1990s. Even then, only after the Great Financial Crisis, in which the banking industry once again took center stage, its acceptance and study became much broader. Numerous studies have been conducted on the interaction between banks and businesses, with particular attention to the existence of these businesses in the world economy and their effects on the grand scheme of things.

Several investigations have been carried out to assess the influence of zombie enterprises on the functioning of industries. Most people come to the conclusion that these organizations have a negative impact on the economy overall and that healthy businesses are especially vulnerable. According to (McGowan, Andrews and Millot 2018) research, funding zombie companies instead of more productive companies has a negative opportunity cost that limits employee expansion and reduces the ability of successful companies to make investments.

This topic was selected due to its recent emergence in academic research, which piqued my interest in exploring the existing work and identifying potential contributions I could make to the field. Additionally, the current environment of elevated interest rates, in contrast to the post-GFC period of stability, further motivated this choice. Given that zombie firms are often

characterized by non-performing loans, there is a heightened risk that the issue may exacerbate under such conditions. This potential escalation underscores the significance of the topic and its relevance to both current and future economic challenges.

This study contributes to the existing body of literature by examining the presence of zombie firms within the Eurozone and identifying the balance sheet characteristics that distinguish them. A notable aspect of this research is the application of two distinct definitions of zombie firms, one of which, to the best of my knowledge, has not been previously employed in studies focusing on Eurozone data. The first definition identifies zombie firms according to 3 different conditions: an Interest Coverage Ratio (ICR) below 1; ii) sales growth being negative; iii) a leverage ratio above the average for companies in the same industry. All of these conditions have to be met for 2 consecutive years in order to a company to be deemed as a zombie firm. The second definition identifies zombie firms by those that have an ICR below 1 as in the first definition and a second condition of negative profits. Once again, these 2 conditions have to be met for 2 consecutive years.

Additionally, this study extends recent literature by analyzing the prevalence of zombie firms across different industries and countries within the Eurozone. Given that this issue has adversely affected several economies, my objective is to enhance the current understanding of the phenomenon. By quantifying the problem and identifying the characteristics of the firms contributing to it, this research aims to provide insights that can assist governments and relevant entities in developing targeted measures to mitigate the associated risks. The dataset utilized in this study is derived from information obtained from the Compustat database, covering the period from 2010 to 2022. It comprises 3187 companies, each with high-quality data available for a minimum duration of three years.

The main conclusions of this study are that the first definition applied in this study identifies an average of 7% of zombie companies in the Eurozone, while the second reports a figure of 20%. This discrepancy arises from the less restrictive criteria employed in the second definition for identifying zombie firms. Despite the differing results, the trends observed across both definitions are notably similar, thereby reinforcing the reliability of the findings. Furthermore, this study concludes that the countries with the highest percentages of zombie firms are Greece, Slovakia, and Portugal. It is also noteworthy that, while France and Ireland fall below the Eurozone average according to the first definition, they exceed it according to the second. The industries most affected by zombification are energy, consumer discretionary, and materials.

The remainder of this study is organized as follows: Section 2 refers to related literature, Section 3 describes the methodology and dataset used, Section 4 includes the summary statistics for the balance sheet characteristics present in this study, Section 5 reports the presence of zombie firms in the Eurozone, as an aggregate, in each country and industry. Section 6 presents the results for the linear regression used to determine the balance sheet characteristics differences between zombie firms and healthy ones and finally, Section 7 gives the concluding remarks and limitations of this paper.

2. Literature Review

The zombie lending problem has been a key theme for some decades now, being first documented in Japan following the real-estate boom during the 1990s, also known as the lost decade, when the country suffered a severe banking crisis that arose due to a large number of non-performing loans held by Japanese banks (Hoshi and Kashyap 2000).

Afterward, several academics expanded on the idea of credit misallocation. During the Japanese crisis, there was a tendency for banks to provide credit to companies that were financially distressed so that the banks would not have to recognize balance sheet losses (Rosengren and Peek 2005). The reluctance of banks to cut ties with companies due to their long-standing relationships was also documented. This led to the inefficient allocation of resources that resulted in Japan's stagnation in the 90s (Caballero, Hoshi and Kashyap 2008). It was also suggested that there should be policies that would facilitate the exit of struggling firms from the market and that banks needed to recognize bad loans instead of trying to protect themselves by allowing non-viable companies to continue to operate. Nearly two decades later the same argument could still be made.

As far as the European Union is concerned, it is argued that the inefficient allocation of resources by the banks has had a detrimental effect on the speed of the GFC's recovery (Schivardi, Sette and Tabellini 2017), when compared, for example, with the United States. One explanation for this phenomenon could be that a high proportion of zombie firms hampers the economic development of the country's other companies since more zombie lending translates to fewer firms defaulting (Acharya, et al. 2020). This occurrence can be detrimental because it is blunt with the crowding out effect, by not letting financially distressed firms go bankrupt there is no opportunity for new ones to appear or for existing ones to take their place and become more productive (Nieto-Carrillo, Carreira and Teixeira 2022).

Despite this, (Schivardi, Sette and Tabellini 2017) opposed current thinkin. When hen analyzing the relationship between banking and Italian companies, they concluded that the

existence of credit misallocation has a negligible effect on the growth of healthy companies when compared with zombies, even considering the existence of a link between weak banks and the existence of zombie firms.

Having previously documented the harm caused by the existence of zombie firms, it is extremely important to understand how their share of the European Union's overall economy has evolved. Recent literature shows alarming signs regarding the evolution of the last few decades, especially in periods of crisis. As shown in (Banerjee and Hofmann 2022), there has been a step increase in the share of zombie firms, exacerbated after the period of the GFC, where the estimated percentage of zombie firms rose from 4 percent in 1980 to 15 percent in 2017. This could explain the period of greater stagnation experienced in the countries of the European Union, especially the slow recovery from the crisis when compared to other major economies such as the USA and China. This effect could be due to the zombie congestion, in which there is a discouragement for new companies to enter and young companies with upside are also constrained by the existing credit misallocation.

Since 2020, and especially since the start of the war in Ukraine, interest rates have been steadily rising for European Union countries. (Banerjee and Hofmann 2018) documented a link between low interest rates and an increase in the number of zombie firms. We are currently living in a period in the opposite direction to when this discovery was made, characterized by the highest interest rates in the eurozone since the GFC and as such we would expect a decrease in zombie firms. This is not documented in (Albuquerque and Iyer 2023) which estimated an increase in the share of zombie-firms in 2020 and 2021, going against the downward trend that started after 201. When we count for the fact that the spike in interest rates has yet to be accounted in this dataset the results become much more frightening.

Another aspect to take into account, verified by (Banerjee and Hofmann 2022), is the existence of a greater probability of remaining in zombie status. At the end of the 1980s the probability of persisting being a zombie was around 70% compared to the 85% recorded in 2017. This can be explained by the massive impact of the GFC which had global consequences and the monetary policy applied at the time (quantitative easing) also played a prominent role. It is interesting to note that in this study Japan stands out as a country with a very low share of zombie firms, around 3%. The country where the issue arose has recovered well due to the recapitalization of the banking system and the clean-up carried out on it. As far as the eurozone countries are concerned, they stand out because they are below the values registered in the Anglo-Saxon countries and have recovered by already being below the highs that occurred during the crisis. A limitation of this study is that it only takes into account listed companies, in

countries where the SMEs play a prominent role, as is the case in many eurozone countries. As such, these conclusions may be biased, as they do not have the full picture of the economy.

The zombie lending problem has been around for some time now and although it is more prominent in advanced economies it still exists throughout the whole world. (Albuquerque and Iyer 2023) carried out a study on zombie firms in emerging markets and advanced economies and concluded that the differences between the two are not marked; on the contrary, they are very similar. Looking at the balance sheets of the companies featured in the study shows that zombie firms present balance sheets with weaknesses in terms of profits, investment and risk of bankruptcy. Another conclusion to be drawn from this study is that the deterioration of the conditions of zombie companies began several quarters before they entered the status, which suggests that in the future there may be an effective way of predicting their entry into the zombie classification before they enter the status.

The presence of zombie firms in the economy is estimated in this study to have a negative effect in terms of investment, productivity and employment in companies that are not in this state. One of the explanations for this is the reduced supply of credit for healthy firms, suggesting the existence of evergreening motives, as already mentioned by (Rosengren and Peek 2005). Banks prefer to keep unhealthy firms alive rather than recognize credit losses.

As we saw earlier, there are solutions to solve the zombie lending problem. (Bonfim, et al. 2021) demonstrated that for the Portuguese banking sector, credit inspections can have beneficial effects, concluding that in the event of an inspection, banks are less likely to refinance companies in financially distressed situations. This is because inspections force banks to recognize the lower quality of their loans, so the cost of maintaining these loans becomes more expensive. To combat evergreening, the authors argue that there is a need to encourage banks to recognize losses early on and that only in this way will banks change their lending behaviors.

The conclusions of the previous study seem to clash with the evidence presented by (Blattner, Farinha and Rebelo 2019), while in the former inspections have a positive effect on mitigating zombie lending, the latter suggests that more restrictive credit policies have a harmful effect. Banks respond to higher capital requirements by reallocating credit to companies in financially distressed situations and with unreported loan losses. This study focused on Portugal during the GFC recovery period (2009-2016), where the Troika also had an influence, and it was estimated that in Portugal the country's total productivity was reduced by 20 percent due to credit misallocation.

Finally, addressing the fact that the European Union has tightened monetary policy as a response to inflation, there is the study by (Albuquerque and Mao 2023), in which it would be expected that companies in financially distressed situations would suffer the greatest consequences. The results from Albuquerque's study suggest the opposite, zombie firms are the ones that have the least consequences when compared to healthy firms, zombie lending allows them to remain afloat. This phenomenon is explained by evergreening (Rosengren and Peek 2005), where banks prefer to offer new credit instead of recognizing a non-performing loan or a default. The countries that are most wary of this phenomenon are those that combine highly capitalized banks with efficient resolution of bankruptcy cases, resulting in fewer incentives to keep zombie firms alive.

3. Methodology

Throughout this research project, there will be an investigation of two different approaches to determining if a business is in financial distress. The lack of a clear consensus in the literature regarding the exact elements that define such a circumstance is the driving force for this choice. As such, it seems to be extremely necessary to include both definitions in order to fully assess the validity and robustness of the results. The purpose of applying different criteria to the data is to determine whether the outcomes from different methods are consistent with one another and whether it is possible to verify a correlation between them. This methodology not only reinforces the findings of this research but also expands the possibility of its replication and confirmation in other academic studies, bringing an element of novelty compared to what had already been used in studies with similar purposes, i.e. measuring the level of zombification present in the eurozone.

The first method to identify zombie firms is the same one as presented by (Albuquerque and Iyer 2023) in which, they take into account 3 different balance sheet components: i) an Interest Coverage Ratio (ICR) below 1; ii) sales growth being negative; iii) a leverage ratio above the average for companies in the same industry. To conclude that a company is categorized as a zombie firm, all these conditions must be present for 2 consecutive years, thus preventing the study from short-term shocks that would end up skewing the results.

The first point being the Interest Coverage Ratio above 1 is extremely necessary to draw conclusions about a company's financial health by studying its ability to pay interest on its debt. The second one it is not as popular in the literature, but its importance is undeniable as referred by (Vidhan and Takeshi 2004) revenue growth is a good predictor of future expected

productivity. The last one is the leverage ratio being above the industry median for the time period, being computed as Total Debt/Total Assets, which informs us about financially distressed companies, companies with higher leverages compared to their peers typically have credit constraints and therefore find it difficult to finance new projects, thus translating in more difficult for them to remain in the market without restructuring and reducing their activity.

The second one is based on the study by (Binh, Huong and Loan 2020) in which the first assumption is the same as in the previous, ICR must be below one, the second is having negative profits for two consecutive years. This method is less restrictive in conditions and can add a different perspective on what the number of zombies present in the Eurozone could be, by looking at negative profits we can arrive at a more approximate number of companies that aren't generating money and are having trouble paying their interest expenses, so we get a more comprehensive result and get a clearer sense of the dimension that this problematic is having in the Eurozone.

In order to get those results I used *Compustat* to retrieve data from companies from all of the countries members of the Eurozone, excluding financial companies like banks and insurance companies because of the extensive regulations that are present in this sector. I also excluded companies with less than 3 years of available data, as well as those who do not consistently report their data and had gaps during some years in important variables such as Revenue, Interest Expense, Total Assets and Total Debt.

Another fact to bear in mind is that a company that has entered zombie status can only leave it provided that any of the conditions needed are not met for 2 consecutive years. The assumption behind this methodology is that zombie firms are not expected to recover in a short-period of time and those that do is because they were mostly listed as zombies-firms due to cyclical-fluctuations. As reported in (Banerjee and Hofmann 2022) the probability of staying as a zombie in the following year was 85% in 2017 for OCDE countries, a higher number when compared with the data of the late 1980s when it was 70%. Therefore recovery from zombie status is not an expectation for the short-term and should be taken with serious concern, because according to (Banerjee and Hofmann 2018) 25% of companies deemed as zombies have left the market. A positive note is that in this study of the total number companies that have entered the zombie status since 1980, 60% have managed to recover.

One limitation of this method is that *Compustat* only takes into account listed firms. Translating into private firms not being represented in this study, since they represent a high

proportion of the economy the full picture may not be totally represented. The reason behind this methodology is such that *Compustat* gives extremely detailed Balance Sheet data that is not present in other databases and allows to draw more reliable conclusions when compared with other options, plus has presented in (Albuquerque and Iyer 2023) listed companies were more likely to be in zombie status when compared with private ones, present in the ORBIS database. Therefore, to the best of my knowledge, this method, for the countries present in the study, this method can be considered the upper bound for zombie firms identification, even though the ideal would be a dataset that considers the entire economy, this is not feasible and the ones included are the most representative of the economy and more relevant for this issue of zombification in the Eurozone.

The following regression will be used to study the differences in balance sheet characteristics from zombies to non-zombies:

$$Y_{i,c,d,t} = \beta \text{Zombie}_{i,c,d,t} + \zeta_{c,d,t} + \epsilon_{i,c,d,t} \quad (1)$$

The Y refers to the different balance sheet characteristics that will be measured in the study, as we can see in Table 5 and Table 6, later in the study.

To assess the impact of zombification there will be a use of a dummy variable (Zombie) that will assume the value 1 if the company is classified as a zombie in a period and 0 if the conditions are not met. β measures the difference between balance sheet characteristics between healthy companies and zombie ones.

This study will include control variables in addition to the primary analysis to take company, country, industry and time-specific factors into consideration, captured in (1) by $\zeta_{c,d,t.}$ It is essential to take these differences into consideration because of the heterogeneous economic environment that exists inside the Eurozone, which is marked by significant differences between its member nations. Ignoring these small details could inject biases into the analysis, which could undermine the validity of further findings obtained and threaten the precision and validity of the results. This research seeks to ensure a more thorough and nuanced knowledge of the relationships under examination by methodically controlling for these characteristics, which will increase the robustness and reliability of its conclusions.

4. Summary Statistics

The final database used for this study includes data for companies listed on the stock exchange for the Eurozone countries and covers all the years from 2010 to 2022. The frequency

used is annualized, resulting in 30805 observations after the cleaned dataset. This cleaning process was based on the one followed by (Banerjee and Hofmann 2022), thus eliminating companies with holes in key variables such as assets or sales, and disregarding companies with less than 3 years of data.

Dealing with outliers is still a problem after removing companies with gaps and inconsistent data. According to Wooldridge, some observations have a tendency to skew results since they are not typical of the community. The winsorization technique, which replaces outliers - observations with extreme values – above a defined threshold with the threshold value itself, was used in this investigation. In this case, the percentile used was 2.5 and 97.5. By limiting the maximum and minimum numbers, this method makes the data used more robust and the inferences that follow from it more reliable. Although not perfect, this method is one of the most popular throughout existing literature to deal with outliers.

The summary statistics of the total data set can be seen in the following table:

	All Firms				*Zombie Firms*			
Variable	N	mean	sd	median	N	mean	sd	median
ROA	30805	0.07	0.15	0.07	2174	-0.08	0.14	-0.04
Debt Ratio	30805	0.28	0.22	0.25	2174	1.27	21.92	0.46
ICR	30805	48.58	200.21	7	2174	-7.99	23.59	-1.54
Δ Intangibles	27618	3.12	6.68	0.02	2174	1.75	5.4	-0.06
Log Assets	30805	5.52	2.33	5.33	2174	4.7	1.99	4.54
Δ PPE	27618	0.77	1.74	0.03	2174	0.03	0.71	-0.06
Δ Debt	27618	2.46	5.25	0.05	2174	0.25	1.4	0.01
Interest Rate	30805	0.16	0.41	0.04	2174	0.06	0.05	0.05
Log Debt	30805	4.22	2.94	4.06	2174	4.03	2.01	3.92
Δ Assets	27618	0.31	0.68	0.05	2174	-0.07	0.26	-0.07

Table 1 – Summary statistics for all firms and zombie firms from 2010 until 2022. [1]

Table 1 shows the summary statistics for the database used as well as for just the companies with zombie status in a given year. Analyzing it allows us to gauge the differences in anatomy between companies with zombie status and healthy ones in a more generalized way. By making this distinction for the main variables being studied that define the financial health of companies, we can see how they behave differently due to the distress that led them to the status in the first place.

As expected, the differences exist and can be verified by analyzing the mean column for the variables, also taking into account the percentiles and median (which can be observed in the annex), because only looking at a mean of a variable does not represent the full picture.

[1] Definition of the variables in annex – Figure 1.

Starting with a profitability index - Return on Assets - as one might expect zombie firms have a lower value for the mean and median. Another fact to bear in mind is that the 90th percentile for zombie firms has a lower value than the mean for all the data. The conclusion that the return on assets is negative for companies with this status is in line with (Storz, et al. 2017) who identifies zombies by firms that have negative ROA. Even though this study does not follow this method, the results presented here make it possible to make this correlation between the two methodologies, in which the average return on assets is negative for zombie firms.

The other profitability ratio studied is the Interest Coverage Ratio, which is also used as a method of identifying zombie firms, so the differences would be expected, but it is nonetheless pertinent to note that for the entire dataset, a mean ICR of 48.58 and a median of 7 was presented, while for the zombies a mean of -7.99 and median of -1.54 With the identification criterion being an ICR below 1, the fact that there are tangible differences is to be expected although the number of observations/companies with negative earnings before interest and taxes is still overwhelming.

To test the differences in size between healthy and non-healthy, we use of two different variables: log assets and log debt. Healthy companies are larger in terms of assets in this data, similarly to (Albuquerque and Iyer 2023). However, this particular result differs from (McGowan, Andrews and Millot 2018), who concluded that zombie firms tend to be larger. One possible explanation for this difference could be the fact that they only took into account companies with more than 10 years of data, and 3 consecutive years with an ICR below 1. Older firms are more likely to be bigger in size, so the difference may not be in the anatomy of zombie firms but in the different conditions used to determine this zombification.

When talking about debt it is important to not only look at log debt but also at the debt ratio. In the first case, the differences are not tangible, but by the logic that healthy firms are larger in this data set and by analyzing the percentiles in the annex, it can be seen that zombie firms have higher debt ratios and lower returns and sizes to support them, thus becoming in a problematic situation regarding the sustainability of companies.

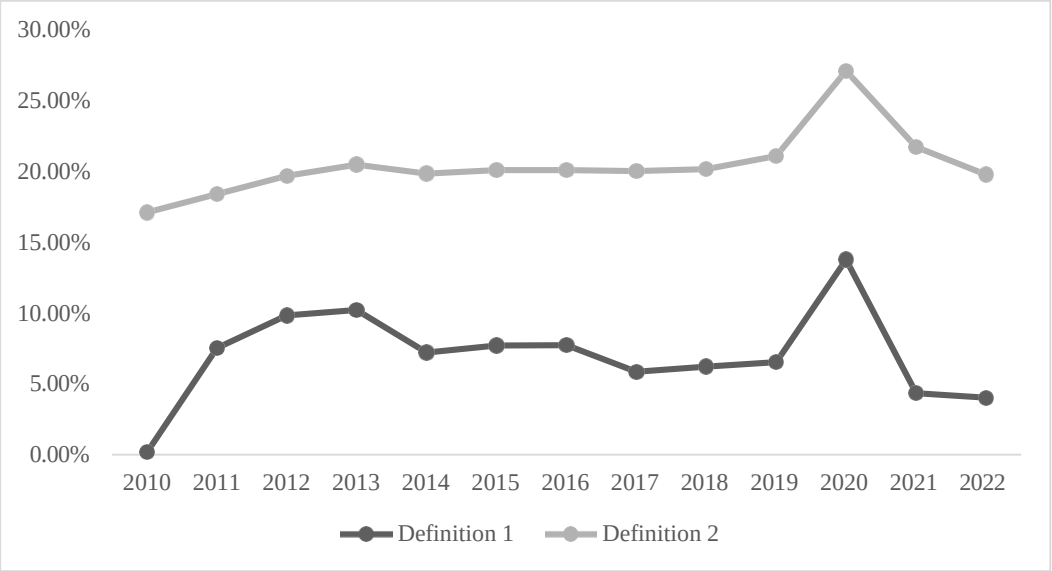
Finally, two investment variables were used: the first in Table 1 is the change in intangible assets, whose values were taken directly from *Compustat*. As documented by (Albuquerque and Mao 2023) the investment of zombie firms is lower in this category of assets when compared to their healthy peers, and the summary statistics capture exactly the same

phenom. In this study, I used the change in PPE as the definition of tangible assets following the previous studies on the theme. Once again, the investment of unhealthy companies is lower, which translates into a problem that encompasses a company that is already struggling in relation to its competitors, and lacking the capacity and availability to invest, ends up falling even further behind.

5. Zombie firms' presence

5.1. Eurozone Evolution

In Graph 1, there is an overview of the zombie firms share evolution throughout the period of the study. The following conclusions can be drawn from the subsequent analysis. By the 1st definition, which considers an ICR below 1, a leverage level above the industry median and a negative evolution in the level of sales for 2 consecutive years, there was a zombification boom following the Great Financial Crisis, peaking in 2013.



Graph 1– Zombie firm share evolution in the Eurozone through 2010 until 2022

Since then, there has been a stabilization/reduction of this phenomenon, combined with a favorable macroeconomic climate and relative world peace. This trend was reversed in 2020 with the covid-19 crisis, where there was a sharp drop in consumption combined with easier credit conditions, both prime conditions for the creation and intensification of the zombification phenomenon. It is also possible to see a reversal of this trend as early as 2022. The literature argues that this may be the effect of the economy's installed capacity and the rebound effect following a fall in consumption that did not exactly result in a recession in the world economy. However, these figures may not be a true representation of what the future trend could be. The

current climate of geopolitical instability, inflation and the end of the rebound effect could result in a reversal of the decline in zombification and a return to intensification.

Another important note is the analysis of the evolution of the trend using the 2nd definition of zombie in this study. This uses an ICR below 1 and negative profits for 2 consecutive years. What can be seen is that these values are fairly stable throughout the period at around 20%. This stability at an aggregate level is not visible when we look at the evolution by country - Graph 2 in the annex - where we can see countries like France and Greece, two of the main contributors to zombification in this sample, moving in opposite directions. The former was close to 20% in 2010 (the average value for the eurozone) but ends 2022 with values close to 30% in this definition. Greece, on the other hand, reached its peak in 2012 and has since seen a regression in its zombie firm values, over time, converging with the eurozone. Even if the nation's zombification levels have decreased, it is important to understand that it has to be a continuous work and if proper measures and regulations are not taken this problem can arise once again.

There are several causes other than only the economic recovery that can be responsible for the decline in zombification levels. For example, the phenomena might have its roots in the closing or bankruptcy of businesses that were once labeled as zombies, as well as in the possibility of their privatization, which would cause them to leave open markets. Furthermore, the macroeconomic environment—which was marked by an extended period of stability—probably had a big impact. This ongoing stability may have helped businesses become more financially stable, which would have reduced the number of zombie corporations. However, it is crucial to approach this decline with cautious optimism, as the persistence of underlying structural issues necessitates ongoing vigilance and proactive measures to ensure sustained economic resilience.

5.2. Country Analysis

In this next section, I propose a brief analysis of the different values of zombie companies present in the European Union, which vary greatly from country to country. As we know, despite the fact that we are dealing with a political and monetary union, there is still a great divergence between the economies of the countries represented in this study, as we can see illustrated in Table 2 and Table 3, which take into account the 2 definitions of zombie firms that were defined earlier.

Zombie Definition 1			
Country	0	1	Percentage
AUT	712	20	2.73%
BEL	1123	70	5.87%
CYP	650	77	10.59%
DEU	6373	164	2.51%
ESP	1728	100	5.47%
EST	179	17	8.67%
FIN	1770	58	3.17%
FRA	6283	401	6.00%
GRC	1620	483	22.97%
HRV	819	116	12.41%
IRL	513	20	3.75%
ITA	3332	320	8.76%
LTU	366	25	6.39%
LUX	474	49	9.37%
LVA	204	17	7.69%
MLT	177	10	5.35%
NLD	1533	66	4.13%
PRT	450	101	18.33%
SVK	63	18	22.22%
SVN	262	42	13.82%
Total	28631	2174	7.06%

Table 2– Average Zombie Percentage by country (Def1)

An analysis of Table 2 - which has to do with the definition of zombie firm 1 - shows the countries with the highest incidence of this problem, including Greece (the highest number of observations in terms of both percentage and absolute value), Portugal and Slovakia, what could possibly be an explanation is these countries are known for having a relatively poorer business fabric compared to the other countries in the study, companies, in this case those listed, resulting in greater precariousness, thus giving rise to a greater incidence of this issue. Another fact to bear in mind is that in terms of absolute value, Greece, France and Italy make up around 54.7% of all the observations categorized as zombie firms, it should be noted that this is not only a consequence of the higher incidence of these countries, such as Greece, but also of the large total number of observations from Italy and France.

Zombie Definition 2			
Country	0	1	Percentage
AUT	673	59	8.06%
BEL	938	255	21.37%
CYP	532	195	26.82%
DEU	5685	852	13.03%
ESP	1626	202	11.05%
EST	162	34	17.35%
FIN	1626	202	11.05%
FRA	4892	1792	26.81%
GRC	1310	793	37.71%
HRV	735	200	21.39%
IRL	390	143	26.83%
ITA	2819	833	22.81%
LTU	331	60	15.35%
LUX	447	76	14.53%
LVA	152	69	31.22%
MLT	164	23	12.30%
NLD	1357	242	15.13%
PRT	378	173	31.40%
SVK	54	27	33.33%
SVN	247	57	18.75%
Total	24518	6287	20.41%

Table 3– Average Zombie Percentage by country (Def2)

Now looking at table 3, and also taking into account the differences between the definitions used, in the latter there is a probability of around 20% of companies being considered zombies in a given year, representing an increase of 13% when compared with the first definition. This can be explained by the lower complexity of the conditions used, only ICR and profits. When the estimated difference in percentage is above 13% there is an indication that in these countries there are companies that are less profitable in percentage and thus becoming more likely to become zombies by the first criterion. I'd like to highlight France, Ireland, Latvia and Cyprus as countries where the difference between definitions exceeds what would be expected on average, revealing a business fabric that, although it may not be as zombified as in other countries, when compared with others can be identified as less profitable, which could lead to future problems.

5.3. Sectorial Analysis

As (Caballero, Hoshi and Kashyap 2008) identified, the occurrence of zombie firms ends up being more evident in non-manufacturing sectors such as real-estate companies. This can happen for a couple of reasons such as:

- Regulations that are different from each sector play an important role in the possibility of a firm becoming a zombie: companies in high-leverage industries, like construction, or in lightly regulated industries, are expected to be more likely to become zombie firms. A priori, highly regulated industries, like finance, insurance, and public administration itself, can be expected to have a residual effect due to the expected low volume of negative equity (Hoshi, 2006).
- Shocks: Variations in the nature and timing of shocks exert disparate effects on sectors, thereby influencing cash flow dynamics and growth cycles across diverse industries. These impacts manifest in differential magnitudes, temporal durations, and temporal alignments, thereby delineating distinctive trajectories for companies within each sector.

	Zombie Definition 1				Zombie Definition 2		
Sector	0	1	Total %	Zombie %	0	1	Zombie %
Energy	774	98	3%	11.24%	660	212	24.20%
Materials	2343	186	8%	7.35%	2051	478	18.88%
Industrials	7100	527	25%	6.91%	6325	1302	17.00%
Consumer Discretionary	5104	471	18%	8.45%	4365	1210	21.63%
Consumer Staples	2799	215	10%	7.13%	2581	433	14.32%
Health Care	2413	162	8%	6.29%	1584	1009	38.61%
Information Technology	4545	278	16%	5.76%	3908	915	18.91%
Communication Services	2339	197	8%	7.77%	1935	601	23.60%
Utilities	1182	38	4%	3.11%	1107	113	9.23%
Real Estate	14	2	0%	12.50%	2	14	87.50%
Total	28631	2174	100%	7.06%	24518	6287	20.41%

Table 4–Zombie Percentage by Sector

From Table 4, which shows the observations from the dataset that have been identified as zombie firms by the two definitions used, we can begin to distinguish the sectors that stand out as having the highest number of observations categorized as zombies. We can see that the highest percentage of real estate companies, even though they have a very small number of observations, are still classified as zombies, in line with existing literature.

Taking into account the first definition used to classify zombie firms, one can see that within the dataset under review, the energy sector stands out, with 11% of its observations classified as zombies. Furthermore, companies in the consumer discretionary and materials perform worse than their counterparts in other sectors. Given the greater sample numbers connected with these sectors, the conclusions drawn from their data have a more sustainable foundation.

In contrast, based on the first definition of zombie enterprises, it is clear that the industries with the lowest zombification rates are utilities, information technology, and healthcare. A common thread connecting these sectors is their generally steady demand dynamics, which make them less subject to the swings inherent in business cycles. This tolerance to major demand fluctuations emerges as a critical feature in preventing the establishment of zombie firms in these industries.

An analysis of the second definition used is consistent with expectations, as the higher overall number of zombies due to the simpler criterion naturally results in a higher number for each sector. For the most part, sectors previously identified with greater levels continue to show negative prominence here, but positive outliers remain apparent. However, a significant departure is noted in the Health Care sector, which moves from below-average status in the first definition to 18% over average in the second, contradicting earlier findings made by (Albuquerque and Mao 2023) but going in line with finds made by (Banerjee and Hofmann 2022), who estimated high levels of zombification in the healthcare sector, leaving the possibility that this trend could be reversed in the aftermath of the Covid-19 crisis. Extrapolating from the diverse approaches used, it can be determined that this sector is seeing expansion due to an increased number of consultations occurring in recent years, which may be the result of the inverted demographic pyramid that has affected the eurozone countries. Nevertheless, the sector's lack of positive earnings presents a potential future concern.

6. Zombie firm's characteristics

6.1. Variables studied in the model

Throughout this study, there has been a strong emphasis on identifying the differences between zombie firms and their healthier equivalents, which is being done primarily by an evaluation of balance sheet data. As previously stated, the identification of zombie firms in accordance with Definition 1 is based on three primary criteria: i) an interest coverage ratio (ICR) below one; ii) increased leverage relative to peers in the same sector; and iii) a negative trajectory in sales growth sustained over two consecutive fiscal years. This delineation method provides insights into discernible differences in debt ratios and low sales growth rates across recognized firms. The second definition requires adherence to the same criteria for two consecutive years, with the conditions pertaining to ICR < 1 persisting and the rest criteria being replaced by negative profit indicators. This methodological paradigm anticipates the emergence of poorer returns among recognized zombie entities, emphasizing the importance of statistically

assessing such discrepancies to better understand the creation of them and thus be able to help mitigate the problem they cause.

Taking all of the above into consideration, regression analysis, as described in (1), is essential for evaluating and measuring differences across different balance sheet components. This study aims to firstly characterize the zombie firm presence in the eurozone, and to properly understand their biology estimate the balance sheet differences that exist between healthy companies and the ones identified as zombies through the different methodologies. In addition, differences in business size are assessed using the logarithmic transformation of debt and assets along with their corresponding fluctuations, providing information on both the differences in amounts and the directions of change. In conclusion, the investigation of profitability metrics, such as Return on Assets (ROA) and the Interest Coverage Ratio (ICR), are essential tools for assessing the financial stability of companies that are being examined.

6.2. Regression Results

Looking at Table 5, a few noteworthy findings show how several financial parameters and a company's designation as "zombie" relate to each other. All variables, with the exception of the change in assets, clearly show statistical significance when it comes to size variables. More precisely, it is found that "zombie" enterprises are, on average, 0.76 percentage points smaller than non-zombie firms. In addition, their total debt value decreases by roughly 0.54 percentage points, and they carry 0.14 percentage points more debt on average.

Definition 1

	(1) Log Assets	(2) ΔAssets	(3) Log Debt	(4) ΔDebt	(5) ΔIntangible	(6) ΔPPE	(7) Int. Rate	(8) ΔRevenue	(9) ROA	(10) ICR
Zombie	-0.755***	-0.402***	0.544***	-5.248**	-4.764***	-0.777**	-1.271***	-1.323***	-.215***	-52.156***
	-0.047	-0.015	-0.039	-0.118	-0.347	-0.039	-0.009	-0.24	-0.004	-4.513
Observations	30,805	27,618	30,805	27,618	27,618	27,618	30,805	27,618	30,805	30,805
Adjusted R^2	0.208	0.132	0.144	0.029	0.038	0.215	0.062	0.021	0.188	0.025

*Table 5 notes: estimations of β for definition 1 in the period of study from 2010-2022 with ***, **, * representing significance level for 1%, 5% and 10% respectively. The standard error of each variable is given in parentheses.*

The noted rise in debt levels among zombie companies points to possible limitations on their capacity to obtain further funding. This limitation could result from adverse credit circumstances or current unmanageable leverage levels. Furthermore, the weak correlation between the change in assets and business health (-0.402 percentage points) highlights the intricate nature of this relationship. Noting that this variable is statistically significant for a 1% level, it is important to note that in the dataset from 2010 to 2022, there is indication that healthy enterprises see a positive change in their assets when comparing to their unhealthy counterparts.

It is clear that both variables—change in intangible assets and Property, Plant, and Equipment (PPE)—are statistically significant and show continuous trends when it comes to investment. In particular, the variable "change in PPE" shows that, compared to healthy ones, zombie firms make around -0.77% fewer in this category, and change in intangible assets brings an even more exacerbated result, zombie firms have a tendency to change negatively these results highlight an ongoing problem with the upkeep of these financially troubled businesses. They not only make it difficult for new players to enter the market, but they also cause their own operations to stagnate, which may have wider macroeconomic ramifications and repercussions at the national and international level.

Regarding Return on Assets (ROA) and Interest Coverage Ratio (ICR) in the analysis of profitability ratios to assess and anticipate the differences between healthy and unhealthy enterprises. With an ICR of almost -52.16%, a significant discrepancy is seen, indicating the difficulties these businesses encounter in covering their loan-related costs. Similar trends may be seen in the ROA, with companies labeled as "zombies" showing returns on assets of about -0.22%. As a result, it can be said that companies listed in the Eurozone that are categorized as "zombie" companies according to the first definition are, in fact, less profitable, often have smaller sizes, and have made smaller investments between 2010 and 2022.

Based on the examination of Table 6, which shows balance sheet characteristics for zombie firms that are identified based on the second definition that was used throughout this paper, it can be observed that there is an increased expression of results, which appear as differences in magnitude. The logarithm of assets shows a decrease of 1.72 percentage points and a change in assets of 0.252 percentange points when a company is classified as a zombie, which are both statistically significant results. Other size-related indicators, such as the debt logarithm, also show differences from those under Definition 1, and the debt change becomes even more pronounced—-16.128 percent—when compared to healthy enterprises.

Definition 2

	(1) Log Assets	(2) ΔAssets	(3) Log Debt	(4) ΔDebt	(5) ΔIntangible	(6) ΔPPE	(7) Int. Rate	(8) ΔRevenue	(9) ROA	(10) ICR
Zombie	-1.726***	-0.252**	1.536***	-16.128**	1.823*	-0.026*	-2.338	-0.019*	-0.326***	-91.907***
	-0.029	-0.085	-0.035	-0.752	-0.092	-0.009	-1.868	-0.723	-0.002	-2.866
Observations	30,805	27,618	30,805	27,618	27,618	30,805	30,805	27,618	30,805	30,805
Adjusted R^2	0.283	0.032	0.196	0.052	0.031	0.017	0.009	0.015	0.476	0.053

Table 6 notes: estimations of β for definition 2 in the period of study from 2010-2022 with ***, **, * *representing significance level for 1%, 5% and 10% respectively. The standard error of each variable is given in parentheses.*

There is a noticeable difference in the results when using the first definition when the variables related to investment are analyzed. The difference between zombie and healthy organizations may be seen in the change in intangible assets variable, which goes from a negative to a positive value. Zombie firms show a 1.82% larger change in intangible assets than healthy firms. Combining the earlier results from the sectorial analysis section—which showed that some industries, like healthcare, had much higher rates of zombification—and the fact that this industry has a large amount of intangible assets, it makes sense to see a higher value in this area. The other variable assessing investments aligns closely with the outcome obtained when employing the first definition, albeit with a diminished disparity that is less statistically significant, dropping to 10% from its prior significance level of 1%.

The profitability-assessing variables saw an increase in their values, making them much more negative than they had been before. Given the selection criterion for observations designated as zombie enterprises, which additionally consider the existence of negative profits for two consecutive years, this result is expected. In particular, the estimated difference for Return on Assets (ROA) was -0.33%, while the estimated difference for the Interest Coverage Ratio (ICR) was -91.91%, when compared against healthy firms. Worth mentioning that both variables indicated are statistically significant for a 1% significance level for both definitions used thus translating into concordance with (Albuquerque and Iyer 2023) that found that zombie firms are less profitable.

Regarding the regressions' outcomes, one more thing to note is that of the implicit interest rates. These rates seem to be negative in both regressions, suggesting that healthy enterprises have higher implicit interest rates. This conclusion goes along with the finding of (Banerjee and Hofmann 2022) and (McGowan, Andrews and Millot 2018) who found that the lower implicit interest rates translates in a higher probability of a company being/becoming a zombie. Although this notion seems counter-intuitive, one would think fact that companies that are deemed healthy have better loan-securing circumstances, due to their risk of defaulting being lower. As previously reported by (Rosengren and Peek 2005) banks tend to artificially subsidize by giving lower interest rates to zombie firms. However, it is important to note that this variable lacks statistical significance.

7. Conclusion

This study seeks to examine the presence of zombie firms in the Eurozone and the balance sheet characteristics that distinguish zombie firms from healthy ones during the period from

2010 to 2022. Zombie firms are characterized by an inability to generate sufficient earnings to cover their expenses and are sustained by creditors who prefer to avoid recognizing impairments on their loans. (Rosengren and Peek 2005). In this study, zombie firms are defined as those with an interest coverage ratio (ICR) below 1, debt levels exceeding those of their industry peers, and a negative sales growth rate, all persisting for two consecutive years. To enhance the robustness of the findings, a second definition was also employed, which identifies zombie firms as those with an ICR below 1 and negative earnings for two consecutive years.

The analysis reveals that, within the study period, the Eurozone exhibited a zombie firm presence of 7% under the first definition and 20% under the second. The sectors most affected by zombification were identified as energy, consumer discretionary, and materials. Identifying this phenomenon is of particular importance, as zombie firms hinder industry entry for new competitors and exhibit lower levels of investment, thereby exerting a detrimental impact on the broader economy.

In the second section of this study, 2 linear regressions were used to study the balance sheet characteristics of the companies identified as zombies and their counterparts. In this way, it was possible to understand and more accurately characterize these companies. From this more in-depth knowledge of the existing differences, we can set out to better identify zombie companies in the future and, through better monitoring by supervisors, find ways of mitigating this problem.

The variable Zombie exhibits noteworthy correlations with several financial metrics in various regression models. Several financial performance metrics, such as Log Assets, Log Debt, Δ Debt, Δ Intangible, Δ PPE, Δ Revenue, ROA, and ICR, seem to be significantly negatively correlated with it. This shows that, in comparison to non-zombie enterprises, corporations that are labeled as "zombie" firms typically have lower asset values, higher debt levels, worse profitability, and weaker investment ratios.

It is noteworthy, although, that the direction and degree of the correlation change throughout the dependent variables, suggesting a complex effect of being labeled as a zombie company on many facets of financial performance.

A limitation of this study lies in the dataset employed, which encompasses only publicly listed companies. Given that SMEs have a significant presence in the economies of the Eurozone, as previously noted, this constraint may limit the generalizability of the findings. Additionally, the identification of zombie companies presents another limitation. The absence of a universally accepted definition means that conclusions drawn from differences in balance

sheets and the identification of zombie firms are subject to variation, depending on the specific definition adopted by each researcher.

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Appendix

Variable	Definition
Return on Assets	Ebit/Total Assets
Debt Ratio	Debt/Assets
Interest Coverage Ratio	Ebit/Interest Payments
Intangibles Change	Intangible Assets yearly change
Log Assets	Log(Total Assets)
PPE change	Property Plant & Equipment yearly change
Debt change	Total Debt yearly change
Implicit Interest Rate	Interest Payments/Total Debt
Log Debt	Log(Total Debt)
Assets change	Total Assets yearly change

Figure 1 – Definitions of the statistics used

Full Data Set

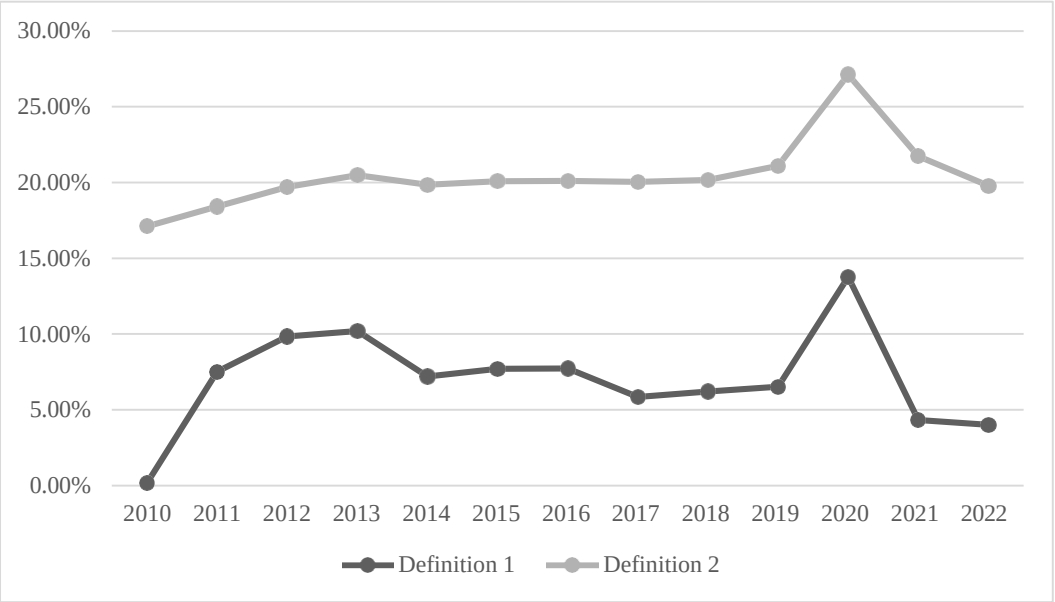
Variable	N	mean	sd	p10	p50	p90
ROA	30805	0,07	0,15	-0,06	0,07	0,24
Debt Ratio (Debt/Assets)	30805	0,28	0,22	0,02	0,25	0,54
ICR	30805	48,58	200,21	-5,4	7	84,67
Intangibles Growth	27618	3,12	6,68	-0,24	0,02	18,01
Log Assets	30805	5,52	2,33	2,63	5,33	8,73
PPE growth	27618	0,77	1,74	-0,16	0,03	5,06
Debt Growth	27618	2,46	5,25	-0,28	0,05	14,28
Implicit Interest Rate	30805	0,16	0,41	0,01	0,04	0,15
Log Debt	30805	4,22	2,94	0,69	4,06	8,31
Assets Growth	27618	0,31	0,68	-0,11	0,05	1,98

Table 2 – Summary statistics for all firms from 2010 until 2023

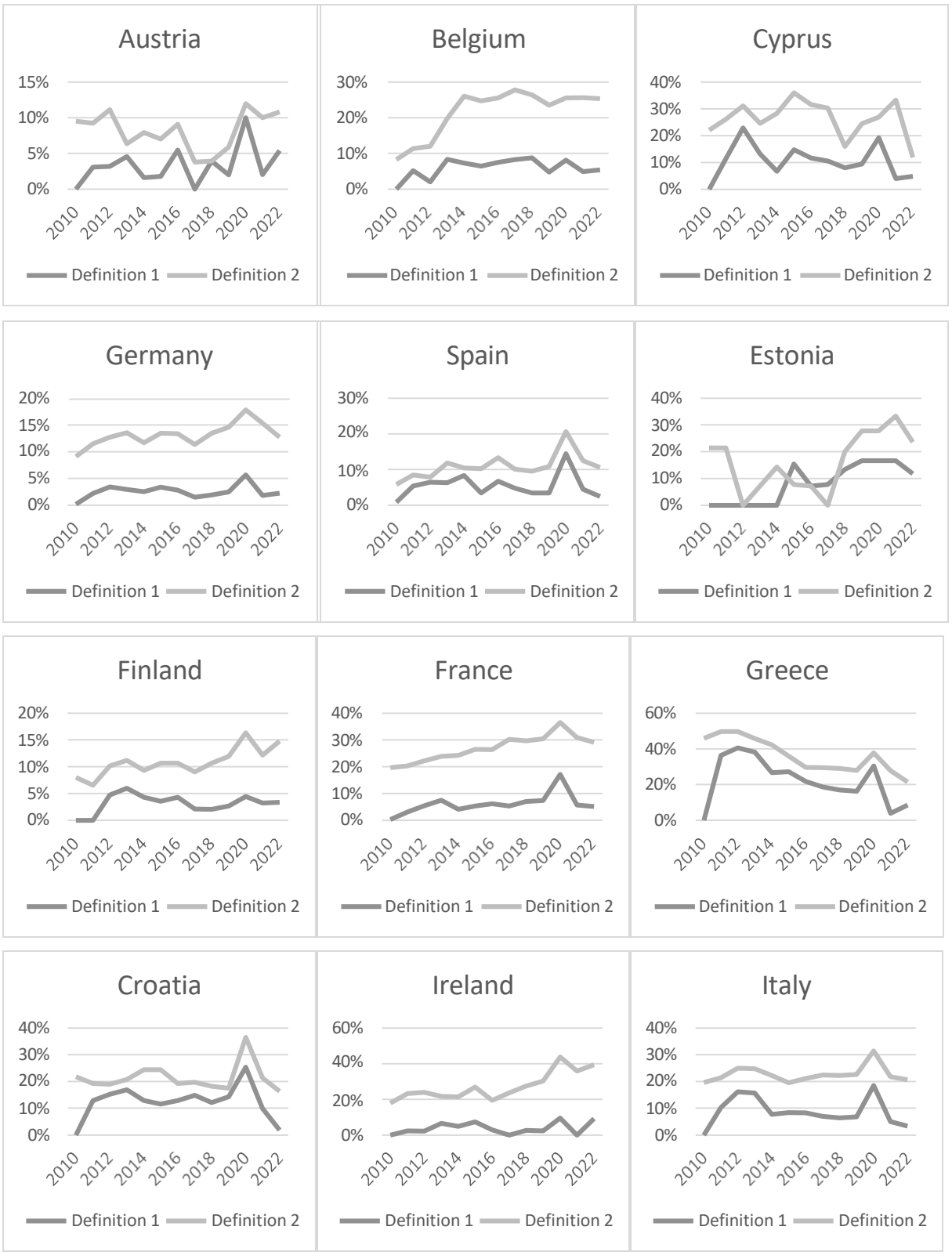
Zombie Firms

Variable	N	mean	sd	p10	p50	p90
ROA	2174	-0,08	0,14	-0,26	-0,04	0,01
Debt Ratio (Debt/Assets)	2174	1,27	21,92	0,27	0,46	0,92
ICR	2174	-7,99	23,59	-17,62	-1,54	0,55
Intangibles Growth	2174	1,75	5,4	-0,56	-0,06	9,65
Log Assets	2174	4,7	1,99	2,31	4,54	7,36
PPE growth	2174	0,03	0,71	-0,37	-0,06	0,25
Debt Growth	2174	0,25	1,4	-0,21	0,01	0,53
Implicit Interest Rate	2174	0,06	0,05	0,02	0,05	0,1
Log Debt	2174	4,03	2,01	1,57	3,92	6,68
Assets Growth	2174	-0,07	0,26	-0,32	-0,07	0,12

Table 3 – Summary statistics for zombie firms from 2010 until 2023



Graph 1 – Zombie Evolution in the Eurozone from 2010 until 2022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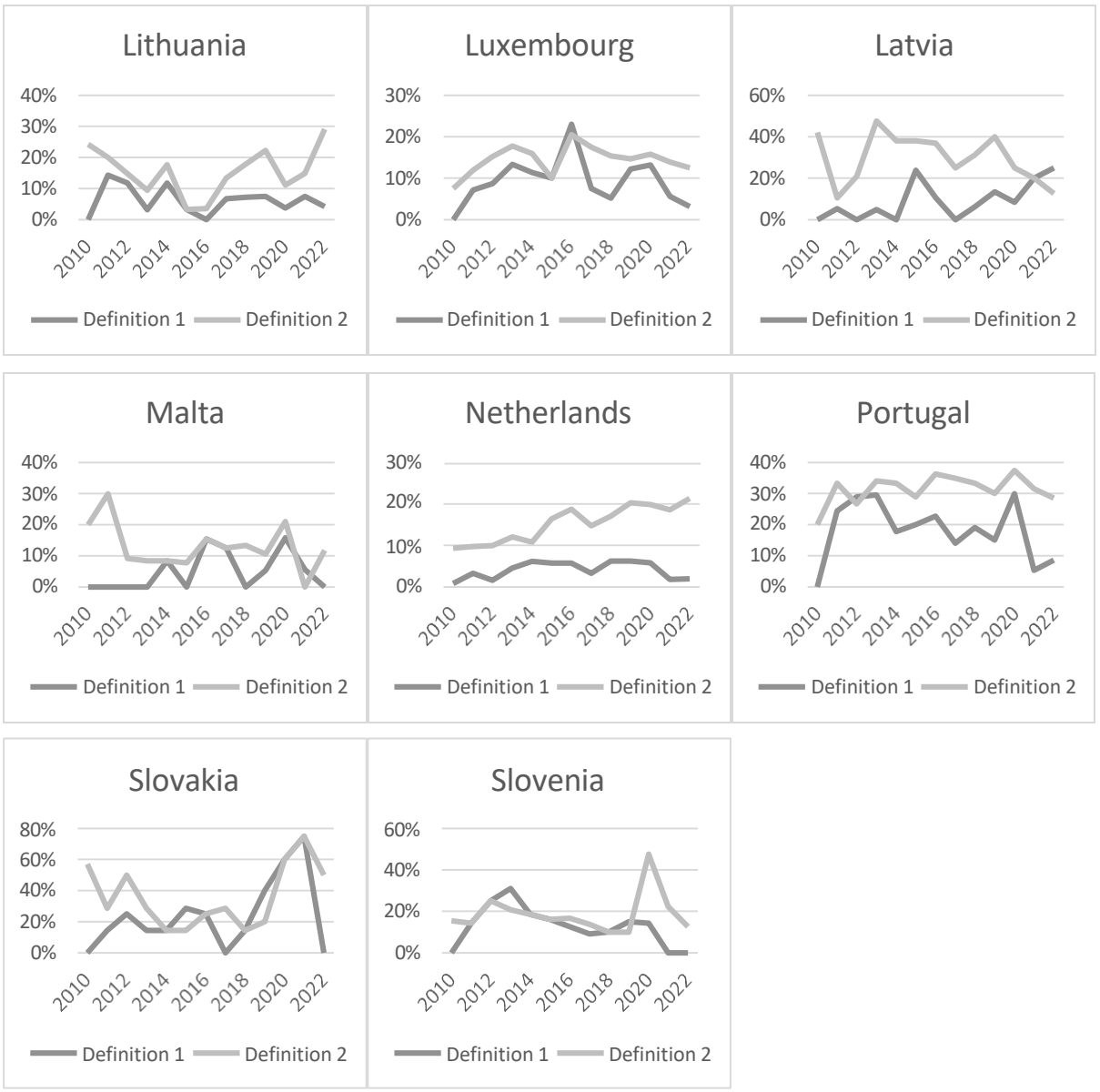

Graphs 2 – Zombie Evolution for both definitions including all countries members of the Eurozone