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# Zombie Firms and the Process of Natural Selection

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**Abstract:** The topic of zombie firms has become an increasingly researched topic over the years, specifically in Portugal, as zombie firms' presence in the market is no secret, especially comparing to other European countries. In this paper, I decided to look at the presence of zombie firms in the Portuguese market over 9 years, studying their evolution and the most relevant contributing indicators. For this purpose, I looked at the decision zombie firms take when it comes to staying in the market, and, under which conditions: by restructuring themselves and thus becoming healthy firms, by remaining zombies, or simply exiting the market. While this "choice" is not only dependent of firms themselves and of the variables studied, I found that increases in debt have a negative relationship on firms' ability to restructure themselves (vs. exiting the market), while increases of number of employees, total assets and of the return on assets indicator have a positive relationship with the ability to recover. Meanwhile, for firms who stick with their zombie status (vs. leaving), increases in the labour force and on return on assets have a negative association with this outcome, while obtaining more debt and increases in total assets have the opposite effect. I find that the variable leverage has little impact in terms of economic significance, despite being statistically significant (for restructured firms). Finally, I have also found that different definitions of zombie firms can lead to different conclusions despite analysing the same sample.

**Abstract (PT):** O t3pico de zombie firms tornou-se ao longo dos anos um assunto bastante procurado, especialmente em Portugal, uma vez que a presen7a de zombie firms 3 uma realidade aquando comparada com outros pa3ses europeus. Neste estudo, decidi investigar a presen7a de zombies no mercado portugu3s ao longo de 9 anos, estudando a sua evolu73o e os seus maiores contribuintes. Para tal, estudei como as zombies encaram a decis3o de sa3rem ou n3o do mercado, e o que acontece quando escolhem n3o sair: se est3o mais inclinadas para se reestruturarem, tornando-se empresas saud3veis, ou se se mant3m zombies. N3o esquecendo que esta decis3o n3o depende apenas das empresas nem das vari3veis aqui inclu3das, o que encontrei com a minha sample foi uma rela73o negativa entre as d3vidas das empresas e a capacidade de se reestruturarem (vs. sa3rem do mercado), enquanto aumentos no n3mero de empregados, ativo total e retorno no total to ativo t3m uma rela73o positiva com a capacidade de reestrutura73o. Para as empresas que se mant3m no mercado como zombies em vez de sa3rem, aumentos de empregados e do retorno do total do ativo t3m uma associa73o negativa,

enquanto aumentos da dívida e do total do ativo têm o efeito oposto. Para além disto, verifiquei que a variável leverage tem pouco impacto em termos de significancia económica, apesar de ser estatisticamente significativa (para empresas reestruturadas). Por fim, verifiquei que diferentes definições de zombie firms podem levar a conclusões bastante diferentes, apesar de impostas sobre a mesma sample.

**Zombie firms and the Process of Natural Selection, by Mariana Rodrigo Dias.**

**Keywords:** Zombie firms; exit; recovery; restructuring; forbearance lending.

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## **Introduction:**

The Great Financial Crisis of 2008-2009 (and the euro area sovereign debt crisis in Europe, from 2010 onwards) brought not only terrible consequences and an eye-opening reality of the way markets and the banking sector were working, but also several research topics which we would have never picked up had it not happened. Mainly in markets and banking supervision, the crisis brought a turnaround in the way things were done, approached, and even thought about. The relationship between banks and firms had to be redefined, with new products, rules and expectations being defined. One of the causes of this redefinition allowed us to realise the presence of zombie firms in the European markets and their close relationship to banks, especially those in distressed situations. Alas, zombie firms were not a discovery of the Financial Crisis, as they had already been identified by some authors (Caballero et al., 2006) in the Japanese crisis of the 1990s, but no one can deny they were a very unknown, undiscussed topic. Even nowadays, if you recognize the topic of “zombie firms” without needing some sort of explanation, it means you are most likely working in the banking sector.

The lack of research on this topic until the year of 2011-2012 changed after the crisis: as authors began to study banks’ behaviour in the European crisis, they discovered the (quite extensive) presence of these firms and began discussing the causes and consequences of their existence. This is the main topic discussed in the literature, as authors simply cannot agree on what exactly causes zombie firms to exist and the respective effects they have on markets and on the sectors they are most present in. The difference of opinions and results throughout the research done on this topic will be discussed in Section 2.

I chose this topic for my paper since I knew about the presence of zombie firms in Portugal and thus believed I could bring something to the table on a sub-topic that is quite unexplored yet: what happens to zombie firms over time (once their presence is identified). My original plan consisted of studying the comparison of zombie firms’ presence in the financial crisis of 2010-2012 in Portugal and the newly, still ongoing, COVID-19 crisis. I knew that given the differences between these two periods of economic instability, relevant aspects would also be found regarding the presence and evolution of zombie firms. However, this comparison was not possible due to several data quality issues, as will be explained in Section 3, when I discuss my data sample and the empirical analysis conducted.

Still, keen on the zombies’ topic, I decided to explore the evolution of these firms from 2011 until 2020, and to study how several indicators influence their ability to either remain

zombies, restructure themselves into healthy firms or exit the market over time. Namely, these indicators reflect balance sheets' indicators, investment measures, variation in labour force, and indebtedness indicators. The respective variables used for my regression and discussion on the obtained results is presented in Section 4.

Without spoiling too much the conclusions of this paper, I have found that my chosen indicators are statistically significant for the previously mentioned firm outcomes, but not all present economic significance (i.e., some coefficients have very little impact). I have also found that zombie firms, based on the indicators chosen, would prefer to not remain in their current status, as opposed to the findings in Carreira et al. (2021), who have also conducted a study on zombie firm evolution in Portugal and concluded that exit and recovery are not preferred by zombie firms given the difficulty in concluding these processes. The differences between my findings and theirs can be related, in part, to their study of (what are) the barriers to firm mobility into restructuring and/or bankruptcy processes: while they studied how these processes (and the bureaucracy associated) hampered firms into completing their recovery or exit processes, I only determined the resulting outcome. Still, with very similar samples, we managed to obtain very different results in terms of presence of zombies in the market. The main reason for these differences, in my opinion, would be the different zombie definitions used on this paper and theirs, which of course has its influence on the results. I find that most of my zombie firms left the market or restructured themselves after 3 years, evidencing the short lives of zombie firms. This also evidences that forbearance lending is one of the main reasons zombies can survive in their respective state (Blattner et al., 2019), and that when this help is no longer a possibility, they are left with one of two options, evolving/adapting, or ceasing to exist. This brings me to the title of this paper: the Process of Natural Selection, as defended by Darwin himself: "*Natural selection is the process through which species adapt to their environments. It is the engine that drives evolution.*"<sup>1</sup>. This concept also applies to firms in the corporate sector, perhaps not literally as a species, but indeed as a group constantly struggling for survival and for improvement. Thus, those zombie firms who can continue to obtain lending from their banks in favoured conditions are able to survive and maintain their status, while the remaining must indeed adapt, by evolving into healthy firms who contribute to market efficiency, or by exiting the market, effectively dying.<sup>2</sup>

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<sup>1</sup> Charles Darwin, *On the Origin of Species*, 1859.

<sup>2</sup> Bonfim, Diana, et al., "*Inspect what you expect to get respect*": *Can bank supervisors kill zombie lending?* May 2020.

This paper contributes to the analysis of Portuguese firms, specifically in the two groups mentioned, and contributes to the understanding of what indicators may possibly influence a firm's decision to keep struggling for survival or not. However, it is important to note that this decision is not only dependent of financial ratios: the firm's decision depends first and foremost of their own creditors, their management and other external factors which may be uncontrollable (unlike the variables here described).

The remainder of the paper is organised as follows: Section 2 refers to the related literature and includes my identification of zombie firms, Section 3 reports the dataset used and a first empirical analysis of results, Section 4 includes the multinomial logit regression and its results, and Section 5 presents concluding remarks, limitations of this paper and possible future research questions.

### **Related Literature and Identification of Zombie firms:**

The literature in line with my paper can be separated into three big inter-related themes: the origins of zombie firms, real consequences of the existence and prevalence of zombie firms, and the recovery and exit processes of these firms. Of course, within these topics, the disagreement amongst the literature is present, and there are still various unexplored topics which can provide rich and policy-implicating research.

With regards to zombie firms' origins (from here onwards referred to as "zombies"), we can begin by distinguishing relationship banking, (Hu and Varas, 2021), which is perceived as one of the main reasons behind the existence and rising of zombies ever since the beginning of the second millennium.

This topic has been discussed for almost a decade now, and while we know that zombies were a trend during the European crisis (McGowan et al., 2017), mostly in weakened economies (Storz et al., 2017), it was the Japanese financial crisis, back in the 1990s, which was first brought to light by some of the pioneers in this topic (Caballero et al., 2006) (Peek and Rosenberg, 2003). These authors defended that weak banks, under-capitalized banks, and consequently, stressed banks, would provide loans to non-viable firms simply to gamble for their own resurrection, to delay their balance sheet hits, or simply in the hopes these firms would return to solvency once again. Other reasons include the borrowers' reputation (associated to the length of the relationship between the lending bank and the borrower), and even the pretence that "no bad news have occurred" in the case of a project being bad/the firm being insolvent.

As mentioned, within this topic views and results are quite different, making it a hyper-complex and quite unpredictable subject. While some authors find that the relationship between a lender bank and their borrowers has its toll on the prevalence of zombies, contributing to their survival (Hu and Varas, 2021), other authors find that banks in stress situations will increase indebtedness of the zombies, as they are more prone to risky lending towards distressed borrowers (the so-called “gambling for resurrection”) (Storz et al., 2017). Alongside these views, according to Okamura (2011) the cause of the zombie problem is the undercapitalization of banks. Therefore, the best solution to ensure zombies’ extinction is strengthening of the respective banks’ balance sheets (also in accordance to Peek and Rosenberg, (2003)). In this case, taking into consideration the Japanese banking crisis, the author finds that those banks with lower capital strength increase levels of indebtedness of zombies. This is also in line with the results registered by Storz et al. (2017), despite very different samples and methodologies, as the latter took data from several countries in the European Union in the recent Great Financial Crisis.

On the same note, Schivardi et al. (2017) find that undercapitalized banks were more likely to sustain their credit lines to zombies during the global financial crisis, and they describe the effects of this credit misallocation in the EU. However, despite the similarity in this topic as compared to the previous two cited, their results go against other findings and most of the literature in zombie lending and zombie firms. They do agree that under-capitalized banks will most likely keep lending to zombies when compared to stronger banks with the same type of firms, therefore affecting firm survival and exit (as we will explore further on). Nonetheless, they do not find evidence that bank under-capitalization is damaging to growth of healthy firms, but instead only has negligible (absolute) effects. The authors defend that while under-capitalization improves the growth rate of zombies, it only hurts the relative performance of healthy firms vs. zombies, therefore resulting in a negligible absolute effect. While this paper is only applicable to the sample years (which end in 2013) and cannot be extrapolated to Italy’s recovery phase (past 2015), it is an intriguing paper which makes us wonder about the effects of under-capitalization of banks beyond those generally known and defended by most literature, as well as the credit misallocation issues observed in Europe’s crisis.

Regarding other possible causes for zombies, Caballero et al. (2006) observe that in the Japanese banking crisis there were hardly any constraints set out by regulators (somewhat like our own European Crisis), and there was pressure by the government for banks to increase

lending to small and medium enterprises, to ease the existing “credit crunch”. These pressures, according to the authors, were also inciters of continued financing to distressed and insolvent borrowers by banks.

Further on this “pressures” note, Banerjee, and Hofmann (2018) provide us with several overviews on the causes (and consequences) of zombie firms, even analysing some of the root causes I discuss above. However, their most interesting results regard the effect of poorly designed insolvency regimes (also defended by Andrews and Petroulakis, 2019) as an inhibitor of corporate restructuring (through recovery or market exit), and the effect of the downward trend (since the ‘80s) in interest rates (which continues a relevant topic even today).

According to the authors, an environment of low interest rates has its advantages (such as rises in aggregate demand, investment, and employment, as well as lower levels of credit overdue) and its downsides (as everything in the domain of the living): by reducing pressure on creditors to clean-up balance sheets, it encourages evergreening towards non-viable firms, and it creates incentives for risk-taking (and zombies are the riskier types of debtors), leading to misallocation of resources.

Besides, Andrews and Petroulakis (2019) observe that insolvency frameworks which do not allow for effective corporate restructuring, and which reduce the rates of recovery will reduce incentives for banks to initiate any processes of recovery, liquidation or restructuring, even for those banks that are healthy.

Therefore, we can infer that it is not only important to have strong, well-capitalized banks, but an efficient insolvency regime which allows orderly and clean resolution of non-viable firms. On this topic as well, Carreira, Teixeira and Nieto-Carrill (2021) test whether the 2012 reform applied to the insolvency regime in Portugal reduced resources sunk in zombies and the negative impact of these firms on productivity-enhancing resource allocation (defined as attraction of more capital by above average productivity firms). They conclude on the importance of good insolvency regimes and frameworks to reduce barriers in restructuring of companies.

Moving to the second literature topic, consequences of zombies’ (rising) existence, these involve productivity denigrating consequences (McGowan et al., 2017) on the sectors zombies are present in; effects on the investment, employment, and growth rates for non-zombies; market congestion and consequent barriers to entry of young innovative firms

(alongside constraints on the post-entry growth of those who can enter the market); depression of product prices, increase of wages and funding costs (Banerjee and Hofmann, 2018); reduced available credit to healthy firms (Andrews and Petroulakis, 2019), i.e., further misallocation of capital; total factor productivity dispersion (Schivardi et al., 2017), meaning a widened productivity gap in comparison to non-zombies (Caballero et al., 2006); lack of productive efficiency; difficulty for banks to find good lending opportunities (Caballero et al., 2006), and decline in potential output growth (McGowan et al., 2017).

On the other hand, Schivardi et al. (2017) show us that zombie lending may have positive effects during a recession, as it does not force these firms to shrink or exit the market, allowing for mitigation of adverse aggregate demand and externalities in an input/output perspective. Still, possible positive consequences of zombie lending in the industries they are present or in the general economy lacks evidence, for obvious reasons, as enumerated above.

Finally, on the topic of zombies' recovery, the chosen subject of this thesis, we have two important papers with significant evidence to the literature.

Fukuda and Nakamura (2011) investigate how zombies recovered after the Japan crisis, and the effect of restructuring processes in resuscitating these firms. Through usage of several financial variables, plus additional macro environmental variables as their explanatory variables, they give us several causes for zombies recovering into the non-zombies category (measures of the degree of restructuring the companies, through employee strength variations and fixed asset values variation, p.eg.; special losses and sales values; measures related to firms' external debt and equity; macro variables, such as time being a zombie and changes in total assets).

The most relevant part of their results, in my perspective, relates to the need of accounting transparency and the implementation of structural changes during and after the crisis, which are crucial points to obtain an effective corporate restructuring. Besides this, the authors point out the need for a good macroeconomic environment and external (large amounts) of financial support, therefore implying prerequisites for a successful revival of distressed and non-viable firms.

Carreira, Teixeira, and Nieto-Carrill (2021) provide us with the evolution of zombies in the aftermath of the Great Financial Crisis. They find that those firms considered zombies during the crisis were more likely to remain zombies than those which became such before the crisis,

but that altogether, remaining a zombie has a high probability, which signals us towards high barriers to exit/restructuring in the Portuguese corporate market.

The authors observe in a somewhat contradictory way, that due to decreasing information asymmetries over time, firms should not last very long in their zombie status, therefore, they take around three years to either exit the market or recover. It is observed that downsizing and restructuring are the typical strategies adopted, although the latter involves debt reduction and an overall change in the firm's structure, therefore being the hardest to implement.

The authors also find that the leverage ratio negatively influences the likelihood of recovering and positively the probability of exit, while return on assets should have a positive effect (via higher revenues and less severe future financial constraints) on recovery and a negative effect on exit of firms. Besides, the 2012 reform of the insolvency regime, as mentioned previously, proved efficient in reducing barriers of corporate restructuring, therefore increasing the likelihood of firms recovering or exiting.

As per the literature, I will explore whether zombies recover or exit the Portuguese market or whether they stayed as zombies since the dawn of the Financial Crisis, and how are they doing now in the aftermath of the COVID crisis.

Zombie firms, as previously mentioned, are non-viable firms mostly kept alive due to the so-called "good will" of their lending banks, also known as evergreen lending. Therefore, it is only sensible that to identify this peculiar type of firms, we should look, for instance, at certain debt variables. Consequently, a very common approach amongst the literature is the method by Caballero et al. (2006): zombies are those firms which receive subsidized credit (defined as interest rate concessions, debt-equity swaps, debt forgiveness, and moratoriums on loan principal or interest), with special focus by the authors on credit assistance involving a direct interest rate subsidy.

This method is also used and extended by Fukuda and Nakamura (2011), who introduce additional criteria for identifying zombies, besides the subsidized credit criterion: a profitability criterion (excluding from the zombie definition firms whose EBIT is above the hypothetical risk-free interest payments) and an 'evergreen lending' criterion (including as zombies those firms which are unprofitable and highly leveraged but are still able to increase their external borrowing). Besides, Shen and Chen (2017) adopt the previous definition with some changes, but overall, all the authors present the same purpose: to capture those firms

which can increase their debt despite already being debt-ridden and having no outlook to repay that debt.

However, despite a large use of this methodology, there are quite a few shortcomings when using this definition. The first shortcoming is related to the tendency of this definition to type one and two errors: first error type refers to the possibility that healthy firms could be incorrectly classified as zombie firms if their interest payments are paid at a rate below the prime lending rates. Meanwhile, the second error type refers to the misclassification of zombies as non-zombies when their interest payments are at the prevailing rate (due to the received evergreen loans).

Therefore, the authors mentioned in the paragraphs above decide to extend Caballero et al.'s method, to avoid these errors. Nevertheless, the methods described are used for samples of only listed firms, which in our case, makes little sense, as most Portuguese firms are not listed, and are of small or medium size, meaning detailed information on debt structure of each firm is hard to find. This difficulty is reflected in my data, which has a large amount of missing data related to debt variables.

Another well-known classification of zombie firms is the one by Schivardi et al. (2017), who use firm characteristics, i.e., indicators of low profitability and high default risk (or high leverage) to identify zombies. Specifically, the authors in this paper identify zombies as those for which return on assets is below the cost of capital measure (which in their case is the average interest rate charged on credit lines to the safest firms) and for which leverage exceeds a given time invariant threshold. This method is also used by Carreira et al. (2021), who add a three consecutive years constraint and an age constraint to the definition.

Finally, the McGowan et al. (2017) method is one of the most known methods. Firms are classified as zombies whenever their interest coverage ratio is below one for three consecutive years, and if they are older than 10 years. Benerjee and Hofmann (2018) pick up this method and use two measures, of which one is the McGowan et al.'s definition, and the second is a narrower measure, where they add a requirement for zombies to have a lower expected future growth outlook, based on stock market variables. Andrews and Petroulakis (2019) also use McGowan et al.'s method, as, according to them, the interest coverage measure serves to capture those firms which are unprofitable enough to not incur in their debt payments.

However, this method has its drawbacks, as every other method in the academic universe. Zombies, as we know, are usually associated with subsidised payments, so when interest rates

are low for a long period, subsidised lending rates can tend to zero or below, hindering the identification of zombies through interest coverage ratios. Besides, this measure requires data on interest payments, which again, brings to the surface data quality and retrieving issues.

Nevertheless, it is important to note some of the literatures' contributions through their methods: the age restriction is an important consideration from my perspective, as it allows to solve (in part) the problem of distinguishing zombies and young innovative firms which have just started in the market (and therefore may have negative profitability measures).

Besides, there are several reasons for negative profits by a firm, as described by McGowan et al. (2017): start of firms' lifecycle and difficulty to start making profits, high expected future profits for currently weak firms and state-owned enterprises whose purpose is not profit.

Beyond this, the three consecutive years condition set by several authors allows to control for the potential effects of business cycles on firm performance and on their respective indicators. This is extremely relevant because as we know, firms and the corporate sector in general are not immune to business cycle fluctuations and the overall status of the economy.

Finally, Storz et al.'s (2017) method corresponds to identifying zombies whenever their return on assets is negative, net investments are negative, and the respective debt servicing capacity is below a given threshold (corresponding to the median firm in their sample), all for at least two consecutive years. This method is also adopted by Andrews and Petroulakis (2019), who due to the data issues with McGowan's method, use a complementary measure following Storz et al.'s definition (low debt service capacity, with a different lower bound, for three consecutive years, and either negative return on assets or negative investment for three years in a row).

In my methodology, I will adopt consider several constraints of different authors, as these are the ones which in my view make the most sense. Therefore, I will identify zombies whenever: i) return on assets is below the risk-free cost of capital (as in Schivardi et al., 2017) for at least two consecutive years (either two or three), ii) debt servicing capacity (defined as EBITDA over total debt) is below the median threshold for at least two consecutive years (as in Storz et al., 2017) and iii) the firm is debt-ridden, meaning leverage (defined as total debt over total assets) is above the median threshold (as in Carreira et al., 2021).

It is important to note that there are several variations to the leverage constraint. While some authors (Nakamura and Fakuda, 2013) use as threshold level 50% (and test other values for robustness), other authors use the median threshold of their sample. Given the fact that the

50% threshold can be context-specific, i.e., depending on the several characteristics of the sample and external effects, I decided to set the leverage level to the median threshold of my sample.

Unfortunately, due to lack of data, it was not possible for me to set an age restriction, as was my original plan (to set a 5-years and a 10-years age restriction on firms). This, of course, can cause a bias in terms of mixing up newly born start-ups with no profits yet and zombie firms (even though not all authors in the literature decide to use this condition).

### **Data and Empirical Analysis:**

My sample consists of Portuguese firms taken from the Iberian-firm platform SABI. Out of a total of around 700 thousand Portuguese firms present in this platform, the raw dataset consisted of 200 thousand firms, around 27% of the Portuguese corporate sector.

Unfortunately, further data was impossible to be taken due to restrictions imposed by this platform (only a given number of firms can be retrieved at once, leading to a total of over 200 Excel files to clean up, plus accessing issues – this platform can only be accessed on campus). After treating the raw dataset in Stata, we ended up with an initial sample of 194 932 firms for a period of 16 years (2004 – 2020) corresponding to 26,41% of the total Portuguese firms present in the database. Besides the restrictions already mentioned, it is important to note that SABI has several data quality issues, such as missing values for several firms, fields, years (you name it), therefore leading to limitations in my data analysis, especially for years further in the past. Thus, due to the extreme presence of missing values, further clean-up was needed, ending up in the end with a total sample of 149 797 thousand firms, corresponding to 20% of the total amount of firms present in SABI, analysed throughout a period of 9 years (2011-2020).

Besides the initial clean up performed in Stata of our dataset, I have decided to exclude firms in several sectors (financial sector, utilities, social services) and firms which are either inactive or dissolved, therefore only keeping those which are active or in insolvency processes. Besides these constraints, I eliminated all firms which had reporting issues, namely: i) total assets, ii) indebtedness (in %), iii) debts to third parties and iv) sum of total equity and liabilities were negative, and v) those for which sum of equity and passive was above 101% of total assets, as several authors before me have exemplified. Finally, due to very extreme values on my variables, I decided to clean outliers (winsorize), in the 1st and

99th percentile (yearly). In the end, before computing the models, we ended up with 36 variables and around 839 thousand observations.

In Table 1, we can observe summary statistics for the entire dataset and for the zombie firms in my sample, with the most relevant indicators which will contribute later to our definition of zombie firms and to their comparison with the whole dataset. As has been discussed previously in this paper and so many times before by several authors, zombie firms clog the market and the sectors they are present in, relocating resources and credit from healthy and efficient firms without contributing to the growth of the sector or to overall productivity. Therefore, we can already expect that these firms will present us with not only lower net results, investments, and own capital (alas, equity), but also higher debts, overall liabilities, and a higher difficulty in (re)paying their debts.

As we can observe in the last column, number of observations in the sample and sub-sample are not the same for the different variables due to data (reporting) issues. In the Appendix, I have added the separate summary statistics tables for all firms and for zombies, and we can observe extreme values throughout the reported variables, mainly in standard deviations and in skewness. However, some interesting remarks for the entire dataset can already be noted before any further analysis: Debts to Third parties' amount to over 600 thousand EUR in the long term and 400 thousand in the short term (on average), more than double the amount of EBITDA (as can be seen in the Appendix).

What is also interesting to see is the average Number of Employees of the over 400 thousand firms, corresponding to 17 employees. This is a very low number which allows us to initially conclude that Portuguese firms are low in size and therefore mostly familiar firms, with small businesses. Regarding other indicators taken from SABI, namely some of the ratios or percentages (last rows in Table 1), though they could be indicators of firm health given their average and median values, their t-tests indicate their non-statistical significance (standard errors of the mean are too low to reject the null hypothesis that their mean is significantly different from zero).

	<i>All firms</i>				<i>Zombie firms</i>			
	<b>Mean</b>	<b>SD</b>	<b>Median</b>	<b>N</b>	<b>Mean</b>	<b>SD</b>	<b>Median</b>	<b>N</b>
Total Assets	3137.94	72393.35	402.38	808209	7460.65 **	104380.6	-27.30	9684
Equity Capital	1019.93	24001.2	118.37	837940	-801.29 **	54432.47	19.37	10089
Employees No.	16.57	143.20	6	766102	19.35	144.78	5	9950

Debts to third parties (LT)	670.56	23301.82	5.68	819386	4153.26 **	110192.9	107.54	10105
Other debts to third parties (ST)	400.54	5065.72	41.24	817030	679.08 **	4550.73	81.23	10105
Financial Debt (ST)	280.42	13697.94	0	839653	1876.28 **	50017.8	0	10105
Indebtedness (%)	66.86	44.87	64.71	808147	115.55 **	67.14	95.97	10105
ROA (%)	3.88	22.67	1.74	550964	-17.27 **	28.83	-5.66	10105
Profit Margin (%)	2.99	26.63	2.96	714347	-19.17 **	47.03	-4.49	8711
Debts to third parties (%)	170.07	797.89	0	466408	188.2	947.81	1.69	7055
ROIC (%)	16.56	62.67	10.10	839646	-5.67 **	91.01	-1.40	10105
Leverage	258.54	98648.74	0.32	805356	0.96	2.73	0.69	10105
Debt servicing capacity	7430.96	4240635	0.23	769617	-0.090	0.66	0	10105

Table 1: Summary statistics for all firms and for the identified zombie firms (analysed throughout 2011 – 2020).

(\*\*) represent that the mean for non-zombies is significantly different from the mean of zombie firms at a 1% significance level.

The statistics' means were tested against those of the whole dataset, and those for which mean is statistically different from the whole dataset are duly signalled. As expected, we see that zombie firms in our sample have much higher values of both Total Assets (EUR 7461 thousand) and Liabilities (long-term and short-term amount to over EUR 8200 thousand, an amount bigger than that of non-zombies in over EUR 6000 thousand), reinforcing the idea of resource “stealing” from non-zombies and that zombie firms are bigger in size as compared to all the firms in my data sample. Regarding my remaining expectations regarding what a zombie firm's balance sheet and income statement would look like, it can be observed that in fact Debts to Third parties are significantly higher on average than those reported for the whole data sample, as well as the respective Indebtedness of these firms (over 100% for zombie firms, and around 67% for the whole dataset). Besides this, zombie firms have lower investments, as can be seen by the negative averages of both Return on Invested Capital (in %) and Return on Total Assets. Finally, as expected, zombies also present us with negative profitability, as demonstrated by the negative average of Profit Margin (-19% for zombies vs. 3% for all firms).

Unfortunately, two of the most relevant variables in our sample regarding analysis of zombie firms are not statistically significant in terms of mean-difference to the whole dataset. I am

referring to both leverage and debt servicing capacity, variables for which missing values were extreme (as can be seen by the differences in total number of observations), even after the clean-up performed, and which present no statistical significance in this analysis even despite the differences of the average values between the two samples. As a result, I expect that the leverage ratio, one of the independent variables in my regression, will also present little or no significance. Besides this, the average number of employees and the percentage of Debts to Third Parties for the whole dataset and for zombie firms are not statistically different. What this means is that on average, one can expect that the number of employees (and the percentage of debts towards counterparties) will be around the same as that of all the firms in my sample. The lack of statistical significance of the first variable can be interpreted somewhat as surprising; however, several authors have found that zombie firms typically have a larger labour force than non-zombies, thus contributing to an important point of discussion: while zombies clog the market in terms of productivity, resources, and credit allocation, they can contribute to employment in the sectors they are most present in. When you put the two sides of the scale into perspective, it can be understood why some authors argue for caution when discussing the zombie problem: their elimination, while possibly improving the efficiency of the market, would contribute to increases in unemployment and all the consequences associated with high and long-lasting unemployment.

Before jumping with both feet into the multinomial logit regression definition and interpretation, I decided to analyse the zombie firms in my sample in terms of their evolution and regarding two relevant comparison indicators. Figure 1 shows how the share of zombie firms in my sample has evolved throughout time. Given, as previously mentioned, the number of missing values in the dataset, along with the gaps in years throughout the sample, I expect a variation in zombies number throughout each year. Unlike previous work conducted for the presence of zombies in the Portuguese corporate sector (Carreira et al., 2021), which shows a notable and somewhat constant presence of zombies in the market, my sample has a very limited and variable share of zombies. However, the sample size of the authors is double that of mine, and their identification of zombies is different from my own, including an age restriction which I was unable to include in my sample.

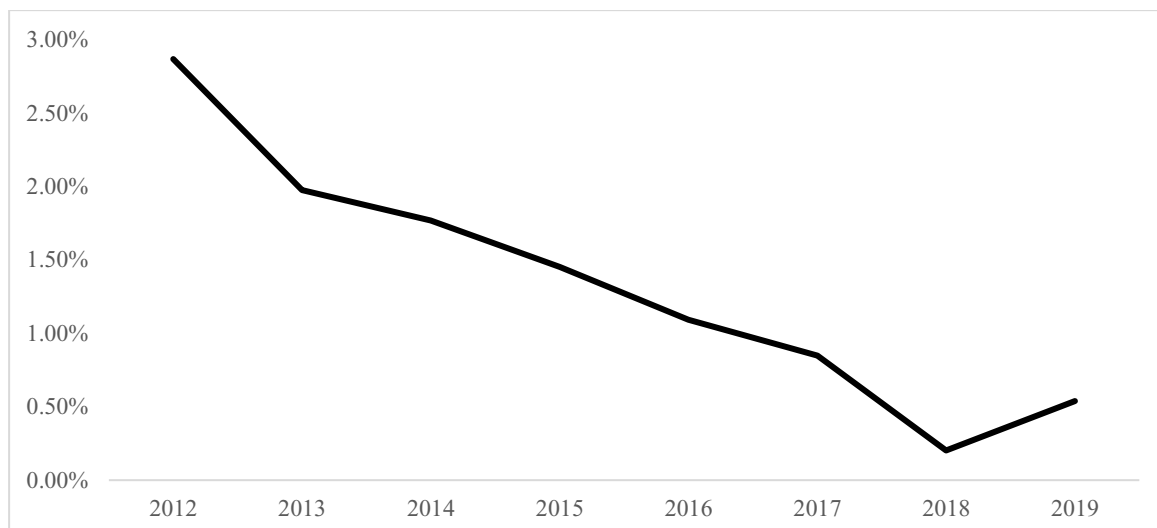


Figure 1: Evolution of zombie firms (percentage) throughout time-period (2012-2019).

There is a clear trend since the dawn of the euro sovereign crisis, with a decrease of zombie firms in my sample as the IMF arrived in Portugal and austerity policies were implemented, together with more intrusive bank supervision. This decrease was gradual until the year of 2018, where it reached its lowest value (0.20%), after which it is possible to see again a slight rise in the share of zombie firms in the Portuguese corporate sector (0.54% in 2019). While this could signal the return of favoured relationships between banks and their creditors, on the one hand, this rise could also be due to the differences in yearly observations due to the data clean-up performed. This can be the case, since in 2018 we have an extremely low value of zombie firms as compared to previous and later years, despite an overall growth tendency in all firms throughout my time sample. The increase seen in 2019 is also not according to the Relatório de Estabilidade Financeira<sup>3</sup> published by Banco de Portugal on the evolution of zombie firms: the report shows a stable decrease in the presence of zombie firms in the market since its peak in 2013.

Besides the evolution of zombies' share in my sample, I decided to compare the evolution of two relevant indicators between the two samples. I chose Return on Assets as a profitability indicator, and Indebtedness (both in percentage) as a leverage proxy-indicator, to study how they evolve in the whole sample are compared for zombie firms. Figure 2 shows us the evolution of these two indicators. It is important to note that there was no data for these two indicators on zombie firms for the year of 2011.

<sup>3</sup> Relatório de Estabilidade Financeira - dezembro 2021 (bportugal.pt) (page 71).

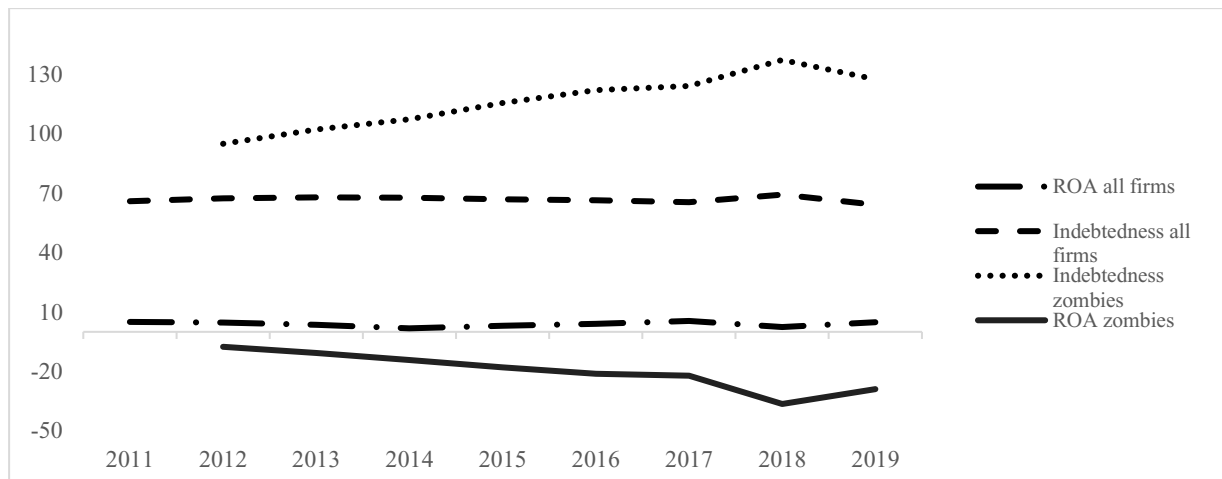


Figure 2: Evolution of ROA and Indebtedness (percentage) for all firms and for zombie firms (2011-2019).

For all the firms in my sample, Indebtedness is around 70% throughout the time sample, and this indicator is almost perfectly stable, while for zombie firms, this value presents an upward trend until 2018, with an average value always above 100%. Meanwhile, Return on Assets shows a similar trend for both groups of firms. While for all firms, the indicator is always small but positive, with a trend somewhat stable around 0%, for zombie firms the indicator is negative, with a downwards trend, until 2018.

After 2018, we see both a small increase of the ROA for zombie firms and a decrease of their indebtedness, which could possibly indicate an improvement of the zombies' balance sheets and income statements, or perhaps a decrease in their presence in the market. However, while the indebtedness value decreased from 2018 to 2019, it maintained a stable average value in the remaining years, whereas the ROA has been increasing since that year. Thus, based on Figures 1 and 2 and on my dataset, I can infer that, while the change is not very significant (yet), indeed zombie firms have begun to be more present in the market.

The data for 2020 does not allow me to draw any conclusions, thus I decided to remove it from the graphs analysis, though it will be used for the regression. However, if the trend seen in the graph above for 2019 would maintain, it can be expected that indebtedness would either increase or remain stable at above 100%, while ROA could approach zero or even a positive value. This since this crisis was different from others in the respect that liquidity kept being supplied to the market, allowing credit flows to continue, and firms to seem in a better shape than they actually are. Based on this, it is expected that firms will most likely increase debts to maintain their business-as-usual activities.

The previous graphs, along with the summary statistics analysis, allow me to conclude so far that zombie firms in Portugal are more indebted, with lower results and lower investments

than all the firms in my sample, as expected. Besides, while the tendency between 2012 and 2018 is that of a notable decrease in the number of zombie firms in the market, a rising trend begins to appear after 2018, which should be investigated with double care.

Regarding regression results, my regression is a multinomial logit regression, which differs from an OLS regression in the sense that the dependent variable is categorical, consisting of more than two outcomes. In my case, the dependent variable consists of three outcomes: firms who manage to restructure themselves, firms that remain as zombies and firms who exit the market (respectively, 1, 2 and 3). There is always a reference group, which in my case is Market Exit. The multinomial logit regression will tell us that for each outcome  $m$ , a unit change in the predictor variable will change the logit outcome  $m$  relative to the reference group by the respective parameter estimate (given that remaining model variables are held constant).

### **Results Discussion:**

Before computing the regression, I decided to study the frequency of my outcomes, which can be observed in Figure 3. I have defined the three outcomes as follows: a firm which remains a zombie is a firm which was identified as a zombie three years ago, and which three years later, is still a zombie; a firm which decides to exit the market is a firm for which there are missing data reports for two consecutive years (no matter if after those two years there is again data reporting); a restructured firm is a firm which was classified as a zombie three years ago, and after three years is not anymore. These outcomes were studied individually to ensure they are exclusive, meaning, that there is no firm with two outcomes for a given year. For the last two years, since it is not possible to look at the following three years, I have not included data.

In my sample, both Restructuring and Market Exit are the most frequent outcomes observed, as they register a much higher number of observations than the outcome of remaining a zombie. To determine this, I studied how a firm identified as zombie in  $t$  evolves in  $t+3$ , i.e., whether it exits the market, manages to recover, or remains a zombie. The result obtained was expected, since according to the literature (Carreira et al., 2021 per example), zombie firms do not last for long, either recovering or exiting the market as time goes by, because the main “zombie” contributor, forbearance lending, cannot last forever, as discussed previously.

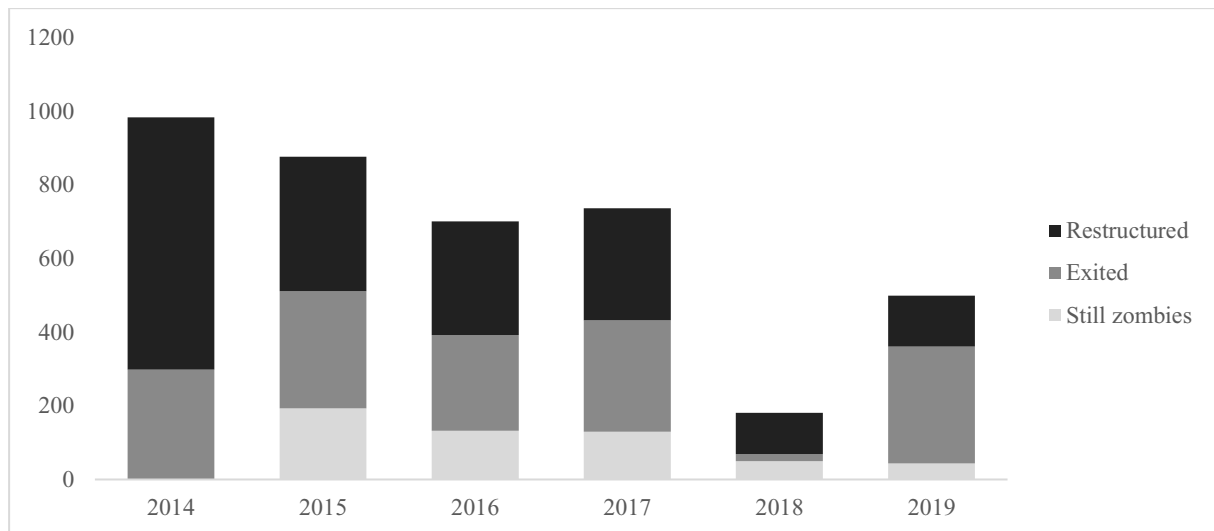


Figure 3: Evolution of zombie firms which restructure or remain zombies throughout time-period (2014-2019).

From what we can observe in the graph above, outcomes are not consistent as time goes by. This is both due to differences in year-to-year observations, but also due to the way the outcomes are defined. This is also one of the limitations of my study, as the outcomes have been defined quite simplistically, only considering the variable zombie for the outcomes of restructuring and remaining a zombie. Besides this, it is also possible that some of the exits reported according to my outcome definition are *fake*, i.e., data not collected by a firm for some given years may not mean they have in fact exited the market, but it is considered as such in my definition. Despite these setbacks, a trend can be observed in terms of firms which decide to restructure themselves in the first years, which are the dominant outcome until 2016-2017, after which market exit becomes the predominant outcome (2018 is the outlier). As expected, firms which remain zombies three years after first being identified as a zombie are a minority. Despite variation in the data throughout the years, this goes in accordance with my expectations. Important to disclose that for this analysis, outcomes for the first three years (2011, 2012 and 2013) were not taken into consideration since observations were not observed.

Now that we have seen the behaviour of zombie firms throughout time and their respective possible outcomes, I will define my independent variables and describe the logit regression. My independent variables can be divided into two groups: i) total assets, leverage ratio and return on assets and ii) changes in firm debt and changes in number of employees. Group i) are variables which are lagged by one year, as it is expected that the effects of these variables on the dependent variable will appear with a delay, and I want to avoid for simultaneity biases. Group ii) simply refers to the log differences of the respective variables, which were

chosen also accordingly to what I have seen in the literature. However, I can already expect that given the non-significance of employees' number between the whole sample and the sub-sample (zombies), this variable will have little significance in the model. Besides these variables, I controlled for year fixed effects.

When the multinomial logit regression is computed, there are some general observations that come along with the typical regression results we are familiar with. These involve number of observations used for the regression (256 828 observations), a pseudo-R-squared of 28.79% (which cannot be interpreted in the same way as a typical R-squared could be, and therefore, it is of little relevance), the value of the log pseudolikelihood (pseudo since the results are being controlled for robustness, corresponding to -125114.31) and the corresponding values to test whether all regression coefficients across the models are simultaneously equal to zero (Wald chi2 and Prob > chi2).

Given that the models are robust and that when Stata computes this model, its degrees of freedom only go up to 25 (in my case), Stata is unable to provide me with values for these last two indicators. When removing the robustness option and simply running the multinomial logit regression, the Chi2 obtained has 26 degrees of freedom, simply one more than the maximum that robustness can go to. Besides this, as we will be able to see below in Table 3, there is one coefficient which is extremely close to zero, which could also cause this error in Stata. Thus, I cannot fully reject the null hypotheses that all the regression coefficients across both models are simultaneously equal to zero.

Regarding the base outcome, Market Exit was chosen (both this outcome and Restructuring are the ones with higher number of observations, and the difference of number of observations to Restructuring is very small), meaning that the outcomes presented in Table 3 and the respective coefficients will be compared to this base outcome.

My regression can be defined as follows:

$$\Pr(Y_{it} = j) = \frac{\exp(X_{i(t-1)} \beta_j)}{\sum_{l=1}^3 \exp(X_{i(t-1)} \beta_l)}$$

Formally, my dependent variable is a categorical outcome variable, which can assume the values of 1, 2 and 3 (market exit, still a zombie and restructuring, respectively). Assuming independent and identically distributed extreme value distributed error terms, the outcome for individual  $i$  in year  $t$  is destination  $j$  ( $j = 1, 2, 3$ ) can be explained by the equation above,

where independent variables are divided into groups (defined by the vector X), as mentioned previously: the first two variables, variation of debt and variation of number of employees are the log-differences of the respective original variables, while the second group are the lagged variables (respectively, leverage, total assets and return on assets).

In Table 2, the regression results are presented, along with a 95% confidence interval for each independent variable and the respective Relative Risk Ratio. The latter indicator simply tells us about the relative risk for a one unit increase in each independent variable to prefer outcome  $m$  instead of the base outcome (given that other variables in the model are held constant).

	<b>Coefficient</b>	<b>z-Stat</b>	<b>[95% conf. interval]</b>	<b>RRR</b>
<b>i) Restructuring</b>				
Variation Debt	-0.0565 (0.0056)	-10.18 **	[-0.067, -0.046]	0.94 **
Variation no. Employees	0.317 (0.0195)	16.26 **	[0.355, 0.279]	0.73 **
Leverage	1.96e-06 (6.69e-07)	2.92 **	[6.45e-07, 3.27e-06]	1.00 **
Total Assets	0.00034 (0.0001)	3.34 **	[0.0001, 0.0005]	1.00 **
Return on Assets	0.005 (0.0003)	16.77 **	[0.004, 0.0056]	1.00 **
Constant	1.69 (0.012)	136.91 **	[1.66, 1.71]	5.41 **
<b>ii) Still a zombie</b>				
Variation Debt	0.034 (0.013)	2.57 *	[0.0081, 0.060]	1.03 **
Variation no. Employees	-0.289 (0.067)	-4.30 **	[-0.421, -0.157]	0.75 **
Leverage	6.32e-07 (4.89e-07)	1.29	[-3.25e-07, 1.59e-06]	1.00
Total Assets	0.00035 (0.0001)	3.45 **	[0.0002, 0.0006]	1.00 **
Return on Assets	-0.0040 (0.00079)	-4.34 **	[-0.0059, -0.0022]	0.99 **
Constant	-2.73 (0.044)	-61.63 **	[-2.82, -2.64]	0.06 **

Table 2: Multinomial logit results. (\*\*) and (\*) represent statistical significance at the 0.05 and 0.10 levels, respectively. For the last column, Constant estimates the baseline relative risk for each outcome.

For firms that restructure themselves instead of leaving the market, all chosen independent variables are statistically significant for this choice, even though the variable leverage's

coefficient is very close to zero. The low statistical and even economic significance of this variable was already expected, given that we had already seen the mean of this variable for zombie firms was not different from the mean of the whole dataset. However, some interesting results can be taken from the first outcome: increases in Debt and in the Number of Employees have a negative relation with the decision to restructure for firms, while increases in Total Assets and on Return on Assets have a small but positive impact. What does this mean in statistical terms? Per example, it means that if a zombie firm registers an increase of one (log) unit on its total debt from one year to the other, then the multinomial log-odds for restructuring (instead of exiting) would be expected to decrease by approximately 0.06 units, given that all other variables in the model are held constant. This interpretation is applicable to all the other variables in this outcome.

On the other hand, what does this mean in terms of practical conclusions? It means that this indicator has a positive relation with a firm's decision of exiting the market instead of staying and trying to recover and restructure themselves. On the other hand, increases in employees' number, total assets and return on assets will positively influence the decision to attempt at becoming a healthy firm instead of simply leaving the market.

For the remaining outcome, firms which remain zombies, variation in debt is only statistically significant at a 10% significance level, and leverage is not significant. Thus, only changes in labour force, total assets and return on assets have any impact on the decision of a firm to remain a zombie instead of leaving the market. In this case, increases in the number of employees have a negative impact on the decision to remain a zombie, as well as increases on the Return on Assets, while Total Assets changes have a very low, although positive impact.

Besides my own definition of zombie firms and given the differences between mine and Carreira et al.'s results, I decided to test two other definitions of zombie firms: the one by Storz et al. (2017) and the one by Carreira et al. (2021), although adapted.

The first alternative definition, also used in the Banco de Portugal's Relatório de Estabilidade Financeira for December 2021, identified zombies whenever a company presents, for two consecutive years: i) assets rentability below 0 (defined by the ratio between net profit and total assets), ii) net investment below 0, and iii) debt servicing capacity (as defined previously) below the median value. In my sample, since I did not have net investment variables, I adapted the second condition and considered negative net investment whenever firms presented both ROA and ROIC below 0. The results obtained with this definition were

quite similar to the ones obtained with my own definition, and zombie share evolution according to this definition can be found in the Appendix.

However, since my definition was close to the one created by Storz et al., I decided to use one as close as possible to the one used by Carreira et al. to check for the source of the different conclusions. However, this was more challenging, given several constraints between their definition and my dataset. Their definition identifies zombies whenever a company's i) return-on-assets is lower than the low-risk interest rate at least for a period of three consecutive years, ii) its leverage is higher than the industry-median (at the two-digit NACE Rev.2 level) of the low return-on-assets exiting group and iii) it is older than 5 years. Firstly, the second condition uses industry level information, which I did not manage to obtain for my sample, thus making it impossible to define median thresholds at an industry level. For this situation, I used the overall median value. Secondly, they use an age restriction, which was not possible to obtain with my data, and thus this condition had to be removed. Once again, results are quite similar in terms of share evolution and can be found in the Appendix.

The main differences are two: firstly, for the Storz definition, the share of zombies reaches values much lower than the ones obtained with my own definition (average share is below 1%), while for the Carreira definition, the share of zombies is much higher in the sample (average value around 3%, however reaching values as high as 6%), as compared to my own definition (whose average value is around 1%).

The second difference relates to the significance of the independent variables: while for my own definition, only one independent variable in one of the outcomes is not statistically significant, for the other definitions we have more variables which show non-significance. Those variables which are not significant are always in the "Still a zombie" outcome (vs. Market exit). For the Storz definition, I can observe that leverage is not statistically significant, as well as the variation of debt. For the Carreira-adapted definition, we only have two statistically significant variables in this outcome: variation in number of employees and total assets. This of course reflects the variability associated with the ratios' influence in the decisions, which, as I have mentioned before, capture only an infinitesimal part of this complex corporate decision.

What this allows me to conclude is that different definitions lead to different conclusions: while the sample was the same for all definitions used, the number of total zombies identified for each definition was quite different, even though all showed the same evolution pattern.

Besides, the independent variables also had different relationships with the various outcomes according to the definition used.

This contributes to the literature in the sense that difficulty in agreeing with a general definition of what a zombie firm is can lead to different results and policy implications with the same sample.

Overall, even though the results can tell us that firms exit, or restructure more often than they remain zombies, thus being more inclined to either one of these two options, and we observe that changes in employees' amount, changes in total debt amount and increases of ROA all have some impact in this decision, the economic significance of my variables is little. I recognize that this may be so due to the missing values problem or due to the small size of the sample as compared to the total size of the Portuguese corporate sector, or even due to the own definition of the variables and outcomes, which can also skew the results. Besides this, we cannot forget that the decision of a firm to exit the market, restructure or remain as a zombie is not solely based on the indicators here studied, as mentioned previously, but it is rather a complex decision process, unlikely to be captured only by the ratios chosen.

## **Conclusions:**

Since the beginning of the new millennium, zombie firms went from being a non-discussed topic to having a wider presence throughout the European market, more relevant in some countries than in others (Storz et al., 2017). Portugal was one of these cases, with a notable presence of zombie firms (unlike what was observed in this study), and thus, using Portuguese firms, I decided to focus my research question on how this specific group of firms has evolved since the euro sovereign crisis. My results allow me to indeed conclude that zombie firms are the weakest link in the market, with lower profitability, lower investments, and much higher debts than the respective average Portuguese firm. I also see that as the years go by, it is small the relative number of firms which manage to remain as zombies, thus exiting the market or entering processes of restructuring to become healthy, non-zombies again. This brings us back to the main contributor to zombie survival, forbearance lending, and respective favoured relationships with their creditors.

I have remarked the little impact of the independent variables chosen on the three types of decisions previously defined. Still, important results can be derived from my analysis which are worth the mention: zombie firms are indeed not a myth, and their presence is easily spotted through higher debt values (absolute and relative), lower productivity, investments

and net results as opposed to their non-zombie peers, and they pose a reality in the Portuguese market up to these days. Besides, my results allow us to see that zombie firms' presence in the market decreased significantly as the euro area sovereign debt crisis took its toll, and during the austerity period in Portugal, only to show a zombies' comeback, as can be seen by the (shy) upwards trend noted as of 2018.

Besides, as according to the literature (Carreira et al., 2021), results show that zombie firms do not have a good life expectancy, since the outcomes defined in my sample evidence that most firms either exit the market or restructure themselves after 3 years of first being identified as zombies. This is of course related to the main contributor to zombie existence, as defined previously, forbearance lending: zombies survive while they can obtain lending from their creditors (at favourable conditions), and when this is no longer a possibility, they are faced with their existential question.

Finally, while there are several firm-health indicators which could have been chosen to study the evolution of zombie firms and their respective decisions on whether to exit the market or not, the ones I chose for my analysis proved to be significant for these decisions. As expected, increases in debt had a negative effect in the decision to restructure and a positive effect in the decision to remain a zombie, while increases in labour force had the opposite effect for the respective choices. Total assets had a positive (although low) impact on the decision to remain a zombie and to restructure, and lastly, increases of Return on assets increased the chances to restructure, while decreased the probability of a firm choosing to remain a zombie.

The limitations in my work have been pointed out throughout the paper, but when I bring them all together, I realize that they can be summed up into one main problem: data quality issues. I always thought that this would be the least of my problems when conducting my research, but it turned out to be this paper's biggest weakness. On one hand, there were issues with data collection for the overall Portuguese corporate sector (other papers have analysed over 200 thousand firms, while I have data for only 149 thousand, and with year gaps), and with the chosen variables, due to SABI reporting mistakes or lack of reporting values.

Besides, one limitation of my research is in the definition of the dependent variable's outcomes. I realize that my definition of the three outcomes is quite simplistic and could be further developed to include variables (per example, signalling a financial restructuring process) which allow to see whether a firm has indeed restructured themselves, per example.

This brings about a relevant question for future research: firstly, do the firms who manage to restructure themselves stay in the market, and in second place, do they stay healthy or eventually go back to their old habits. This since, as pointed out in this paper and in the general literature, it is much easier to going back to being a zombie or to exit the market than it is to complete a successful restructuring strategy and to stick with it given market conditions and economic cycles. This relates to the research done by Carreira et al. (2021), who find that well defined and easier restructuring frameworks (which involve insolvency processes) allow firms to restructure themselves instead of leaving the market.

Besides this, another future research question on the topic of zombie firms relates to the various possibilities for independent variables with have impact on a zombie's decision to become healthy, cease to exist or continue down the same road. These include, per example, zombie duration and firm age. Unfortunately, these variables could not be defined in my sample due to lack of data (again). The topic of zombie firms is thus full of possibilities and questions simply waiting to be answered, and I believe we will not see the end of it so soon.

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## Appendix:

<i>All firms</i>	<b>Mean</b>	<b>SD</b>	<b>se(mean)</b>	<b>Skewness</b>	<b>Median</b>	<b>N</b>
Operating Profit	137.88	8820.85	10.23	488.34	12.57	743341
Total Assets	3137.94	72393.35	80.53	238.25	402.38	808209
Equity Capital	1019.93	24001.2	26.22	74.59	118.37	837940
Employees No.	16.57	143.20	0.16	100.41	6	766102
Long-term Liabilities	903.09	42571.94	47.36	308.22	34.38	808037
Debts to third parties (long-term)	670.56	23301.82	25.74	166.12	5.68	819386
Short-term Liabilities	1116.23	19297.35	21.47	131.28	130.95	808173
Other debts to third parties (short-term)	400.54	5065.72	5.60	113.99	41.24	817030
Total liabilities and equity	1787.78	58223.13	64.31	281.80	64.56	819656
Interest supported	38.69	1341.66	1.50	238.27	0.9175	801539
EBITDA	230.95	8217.26	9.14	559.14	31.08	808173
Net Profit	59.70	2983.16	3.55	-88.82	0	705534
Financial Debt (short-term)	280.42	13697.94	14.95	350.01	0	839653
Indebtedness (%)	66.86	44.87	0.05	2.72	64.71	808147
Return on Total Assets (%)	3.88	22.67	0.03	-1.16	1.74	550964
Profit Margin (%)	2.99	26.63	0.03	-5.03	2.96	714347
Debts to third parties (%)	170.07	797.89	1.17	8.25	0	466408
Return Invested Capital (%)	16.56	62.67	0.07	-0.18	10.102	839646
Leverage	258.54	98648.74	109.92	505.61	0.32	805356
Debt servicing capacity	7430.96	4240635	4833.85	653.12	0.23	769617

*Table 1: Summary statistics for all firms in the data sample (2011-2020)*

<i>Zombie firms</i>	<b>Mean</b>	<b>SD</b>	<b>se(mean)</b>	<b>Skewness</b>	<b>Median</b>	<b>N</b>
Operating Profit	-531.83 **	13930.97	141.56	-86.92	-27.30	9684
Total Assets	7460.65 **	104380.6	1038.37	44.38	578.97	10105
Equity Capital	-801.29 **	54432.47	541.92	-52.49	19.37	10089
Employees No.	19.35 *	144.78	1.45	41.88	5	9950
Long-term Liabilities	4717.1 **	106215.3	1056.62	53.37	146.64	10105
Debts to third parties (long-term)	4153.26 **	110192.9	1096.19	55.03	107.54	10105
Short-term Liabilities	3542.9 **	61719.23	613.98	50.88	247.77	10105
Other debts to third parties (short-term)	679.08 **	4550.73	45.27	23.16	81.23	10105
Total liabilities and equity	6507.17 **	100104.7	995.83	45.89	450.35	10105
Interest supported	181.92 **	3536.57	35.31	50.28	3.005	10029
EBITDA	-116.39 **	10458.55	104.04	-86.62	0	10105
Net Profit	-416.69 **	13610.84	136.80	-91.99	-20.72	9899
Financial Debt (short-term)	1876.28 **	50017.8	497.57	69.24	0	10105
Indebtedness (%)	115.55 **	67.14	0.67	2.19	95.97	10105
Return on Total Assets (%)	-17.27 **	28.83	0.29	-2.51	-5.66	10105
Profit Margin (%)	-19.17 **	47.03	0.50	-3.51	-4.49	8711
Debts to third parties (%)	188.2	947.81	11.28	7.69	1.69	7055
Return Invested Capital (%)	-5.67 **	91.01	0.91	0.002	-1.40	10105
Leverage	0.96	2.73	0.03	35.48	0.69	10105
Debt servicing capacity	-0.090	0.66	0.007	-43.00	0	10105

*Table 2: Summary statistics for zombie firms in the data sample (2011-2020).*

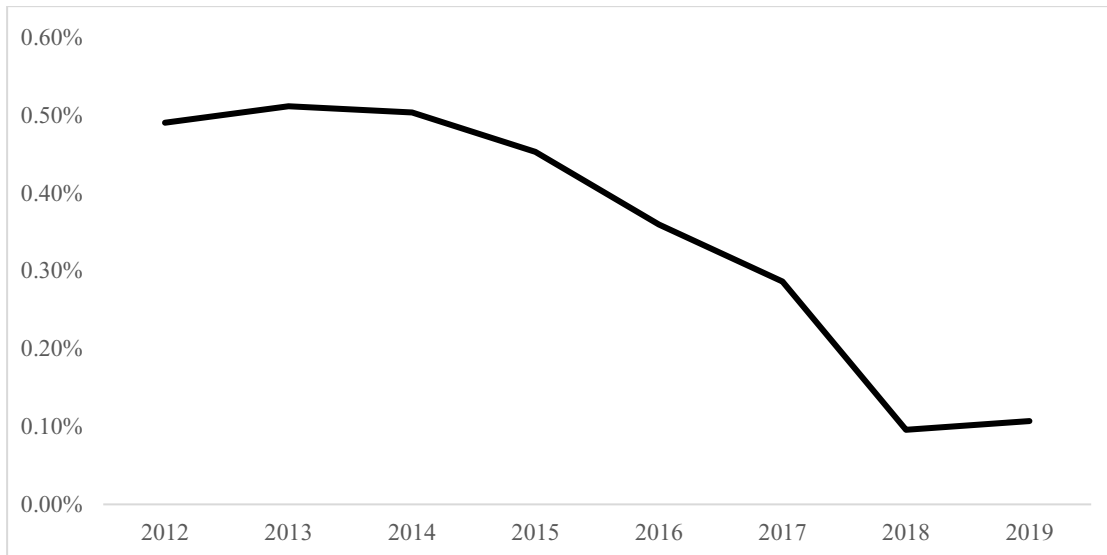


Figure 1: Evolution of the share of zombies in the sample (2012-2019) according to Storz et al.'s (2017) definition.

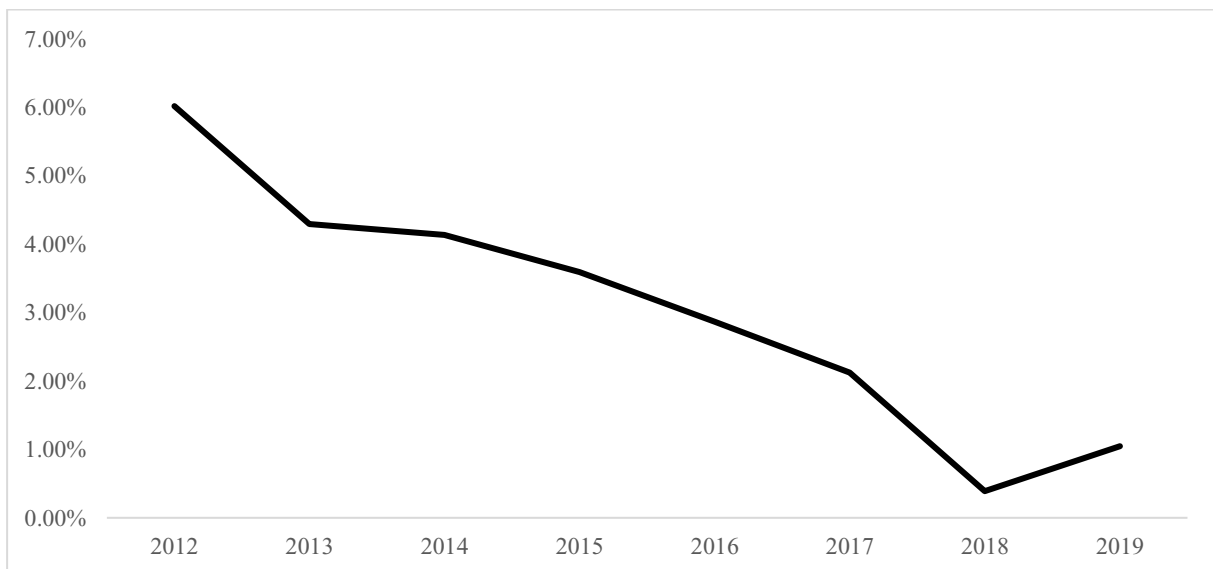


Figure 2: Evolution of zombie share in the sample (2012-2019) according to Carreira et al.'s (2021) definition.