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The recovery and exit of public zombie firms

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Abstract

The number of zombie firms (firms that are unable to cover debt servicing costs with their operating profits) has seen a steady increase over the last decades. This study analyses which determinants increase or decrease the odds for a zombie firm to recover or exit the market by using annual data of global public firm data over the period 2002 – 2021. My results show that the share of zombie firms has indeed increased in the last two decades, during which it rose from around 8% of all firms in 2002 to 12% in 2021, while peaking at 16% during the global financial crisis. The increase in zombie firms results in more capital and labour being held by insolvent firms, which would create more value if used by non-zombie firms, thus slowing down economic growth. The regression results show that employee downsizing and debt restructuring are effective in increasing the odds for zombie firms to recover, as well as increasing sales and investing in a firm's assets. The odds for zombie firms to exit the market is significantly lower after the global financial crisis than during the crisis.

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1 Introduction

Over the last decades, the number of zombie firms, which are firms that are unable to cover debt servicing costs from current profits over an extended period, has seen a steady increase (Banerjee & Hofmann, 2018). Zombie firms have received more attention from both researchers and policymakers in recent years (Carreira et al., 2021). This is because zombie firms go against the theory of creative destruction, which states that firms should adapt to recent innovations to remain profitable and stay in the market. If zombie firms do not innovate their own firm, they are expected to leave the market and make room for more profitable firms. Caballero et al. (2008) reported that banks continued to lend credit to zombie firms during the Japanese macroeconomic stagnation that began in the early 1990s, which helped zombie firms survive for longer in the competitive environment without any form of innovation. The surviving zombie firms held onto capital and workers, which would create more value if used by their profitable competitors, thus slowing down their growth opportunities and lowering the average productivity (Adalet McGowan et al., 2018).

This study contributes to the literature by analysing which factors determine why zombie firms stay afloat as zombie firms, why some recover and become profitable again, and why others exit the market and/or file for bankruptcy. This research aims to answer the following research question:

Which factors increase the recovery rate of zombie firms?

Previous studies on zombie firms have mostly focused on what causes zombie firms to remain in the market and on their implications on total productivity and growth issues (Caballero et al., 2008; Adalet McGowan et al., 2018; Andrews & Petroulakis, 2019). There are a handful of papers that focus on the transition of zombie firms, but they all focus on firms within one country (Fukuda & Nakamura, 2011; Dai et al., 2019; Carreira et al., 2021). To the best of my knowledge, this paper is the first to look at publicly listed firms from multiple countries worldwide.

This study uses financial fundamentals of public firms that report in the most popular traded currencies for the period 2002 – 2021. By flagging firms whose Interest Coverage Ratio has been lower than one for three consecutive years as zombie firms, it was possible to find differences

between the groups by analysing descriptive variables. Determinants that result in an increase or decrease in the odds ratio for those firms to recover and exit are found by using a multinomial logit regression.

The results of this study imply that zombie firms are often more debt-driven than non-zombie firms, and that reducing their total debt increases both the odds of recovery and the odds of exit. Other methods that improve the odds of recovery are investing more in assets, increasing sales, and dismissing employees, where selling off assets, decreasing sales and dismissing employees increase the odds of exit. When comparing the global financial crisis with the period afterwards, zombie firms had lower odds of exiting the market when the global financial crisis was over. Furthermore, increasing the share of sales that is used for restructuring expenses lowers the recovery rate of zombie firms.

The remainder of this paper is structured as follows. Section 2 shows the theoretical background of this research. Here, the definition of zombie firm is given, which is applied within the rest of this thesis. Section 3 contains the methodology of this research, and in Section 4 the results of analyses run within Stata17 are shown. Section 5 contains the conclusion and discussion.

2 Literature Review

2.1 The rise of zombie firms

The causes of zombie firms

On a theoretical level, unprofitable firms should exit the market and seize their operations due to a process called creative destruction. However, Peek & Rosengren (2005) and Caballero et al. (2008) reported that during the Japanese macroeconomic stagnation that began in the 1990s, unprofitable firms, which they called ‘zombies’, continued their operations due to receiving additional loans from Japanese banks. This was especially the case for weaker banks, which continued to lend additional credit to these insolvent firms, as well as evergreening these loans (Peek & Rosengren, 2005). Weak banks have lower capital, return on assets, and net income than healthy banks (Andrews & Petroulakis, 2019). These banks were gambling that somehow

these insolvent firms would financially recover or that the government would bail them out (Caballero et al., 2008). This caused the insolvent firms to avoid or delay their bankruptcy, and it allowed the banks to avoid increasing their reported nonperforming loans (Peek & Rosengren, 2005; Storz et al., 2017). The banks were also externally incentivized by the government to continue lending money to insolvent firms to keep the unemployment rate low and temporarily limiting the costs associated with massive bank bailouts. (Peek & Rosengren, 2005).

Another factor for the rise of zombie firms is the downward trend of interest rates that firms must pay on their loans (Banerjee & Hofmann, 2018). Lower interest payments could reduce the pressure on unprofitable firms to attempt restructuring their business, as well as increase the risk appetite of banks to earn more money in the short term by lending additional credit to existing (zombie) clients (Acharya et al., 2019).

Another factor that drives up the share of zombie firms and their survival is governmental aid during crises (Papava, 2020). This financial aid delays the bankruptcy of zombie firms and turns insolvent firms from before the crisis into zombies (Papava, 2020). The rise of zombie firms is followed by an increasing interest from the literature on this topic over the last decades.

The consequences of zombie firms

The presence of zombie firms is harmful for the competing profitable firms. Because of the misallocation of credit, the banks have less available money to lend out to profitable firms, thus slowing their growth (Peek & Rosengren, 2005). Andrews & Petroulakis (2019) argue that healthy banks foster productivity-enhancing capital reallocation, which enables profitable firms to grow even more. This zombie lending softened the economic downturn by keeping insolvent firms afloat and not losing the jobs they create, while slowing the recovery in the economic upturn by limiting the growth of solvent firms.

Zombie firms also compete with solvent firms on the prices of their product and the available labor to create value, thus lowering the revenues and margins of solvent firms, while driving up labor costs (Banerjee & Hofmann, 2018). The labor force that zombie firms hold on to is also less productive than that of solvent firms (Carreira et al., 2021). The higher the share of zombie firms

and the longer these firms survive as a zombie, the higher the economical impact is for the whole industry.

2.2 Defining zombie firms

One of the earliest definitions of a zombie firm is given by Caballero et al. (2008), which state that a firm that receives subsidized credit or abnormal financial support from banks should be seen as a zombie. Due to the poor transparency on bank loans to individual firms, they measured zombie firms by comparing if their actual interest payments are lower than the hypothetical risk-free interest.

This simple criterion, however, is often criticized in the literature as both solvent firms were categorized as zombies and insolvent firms were not classified as zombies (Carreira et al., 2021; Fukuda & Nakamura, 2011; Shen & Chen, 2017). An alternative classification is given by Adalet McGowan et al. (2018), which classify zombie firms as firms that have an interest coverage ratio (ICR) that is lower than one for three consecutive years (excluding firms younger than 10 years since these are often not directly profitable from the start). They argue that the ICR is better comparable across countries and that it is less endogenous to productivity than negative profits. This idea is backed up by Ji (2019), who shows that the ICR can be a useful indicator for determining whether a firm is insolvent because it has a low forecast error and high predictability, and by Meryana & Setiany (2021), who show that firms with a lower ICR are more likely to be in financial distress. However, the ICR might exclude zombie firms that receive subsidized loans with lower interest payments, which results in a higher ICR for the firm (Banerjee & Hofmann, 2018).

The firms' characteristics could also be used to identify firms with persistent financial problems. Typically, these measures combine indicators of low profitability and high default risk (Schivardi et al., 2022). Schivardi et al. (2022) used the following criteria for these measures: (i) the return-on-assets (ROA) – measured as the three-year moving average of Earnings Before Interest and Taxes (EBIT) over total assets – below the low-risk interest rate; and (ii) a leverage, defined as the total financial debt over total assets that exceeds 40% – 60%. A similar identification is used by Shen & Chen (2017), who classify firms as zombies who have (i) a leverage higher than 50%, (ii)

while still able to obtain more debt, (iii) with no potential to pay back the debt due to negative operating profits for three consecutive years.

While the ICR and ROA are useful indicators for finding potential zombie firms, the calculations for both use the same numerator – the operating income (EBIT). If the operating income is positive, both ratios will also be positive as well, unless the denominator (interest expenses and assets, respectively) is negative. The only difference is that the ICR requires the operating income to be at least equal to the interest expenses. Therefore, the ICR seems to be a more reliable ratio for finding firms that are and insolvent, and thus zombies.

2.3 Hypothesis development

The emphasis of this paper is to find out what determines the recovery or exit of zombie firms on a global level. This is important because the share of zombie firms has increased over the past decades, and it is essential to understand why these firms transition to either recovery or exit. Previous studies on this topic have often focused on one specific country or subset of countries, whereas my study focuses on a broader range of countries by using data from public firms. This allows for a better view of the fundamental changes of a firm, where country-specific events have less impact. To test the research questions of this paper, multiple hypotheses have been created based on the discussed literature.

The first hypothesis concerns the impact of financial crises on zombie firms. Papava (2020) suggest that government aid during crises helps zombie firms avoid bankruptcy during the crisis, but that the existence of zombie firms after the crisis slows down the economic recovery. This government aid does not protect all zombie firms from bankruptcy and the exit rate of zombie firms is expected to be higher during a crisis than before the crisis due to the harsher economic conditions. It is expected that the recovery rate of zombie firms is lower in the years after a crisis because they no longer receive governmental aid that helped them survive. This leads to my first hypothesis:

H_1: *The recovery rate of zombie firms is lower in the years after the global financial crisis*

Because of the financial aid zombie firms receive from both (weak) banks and governments, they have less incentive to reform and restructure their business. This causes zombie firms to bleed out, before finally "pulling the plug" out of their own firm. The firms that attempt to reform and restructure their business through *corporate restructuring* have proven to be more likely to recover from their zombie status (Carreira et al., 2021; Fukuda & Nakamura, 2011). These restructurings require non-structural expenses from firms to reorganize themselves. Where previous studies used proxies of corporate restructuring, I use the financial fundamental 'restructuring expenses' to measure corporate restructuring. This is an improvement compared to a proxy because it differentiates an incremental change of book values to an actual attempt at restructuring for a firm. This leads to my second hypothesis:

H_2: *Zombie firms that have higher restructuring expenses have a higher likelihood of recovery*

Another example of corporate restructuring is downsizing. This is caused by firms selling off their (unprofitable) fixed assets and dismissing employees. The money that becomes available from downsizing could be used to pay off debt to lower future interest payments, which increases the ICR of a firm (Fukuda & Nakamura, 2011). However, Carreira & Teixeira (2011) point out that downsizing could also flag the presence of the *shadow of death* effect, which means that a firm is preparing for their bankruptcy. This leads to my third hypothesis:

H_3: *Zombie firms that downsize their assets and employees have a higher likelihood of recovery*

3 Methodology

3.1 Model

To test the hypotheses, I need financial information of firms to test whether they can be identified as zombie firms, how they differ from solvent firms and which changes in financials determine if a zombie firm recovers from its zombie status or exits the market. The data form is

unbalanced panel data because it follows multiple firms over time, where not all firms have observations for the entire period.

The regression that is used to test which change in financials makes a zombie firm more likely to recover or exit is a multinomial logit regression. For this study, all firms that are flagged as a zombie are coded with a 1, as well as for the years after in which the firm remains a zombie. The year a firm recovers from their zombie status is coded as a 2, and the year a zombie firm exits the market is coded as a 3. After a firm recovered from their zombie status, they are coded as a 0 for as long as they do not return to being a zombie. If a firm does become a zombie again, they are coded as a 1. By using a multinomial logit regression, the independent variables have a coefficient which indicates whether it increases or decreases the odds for a zombie firm to move into that group compared to staying a zombie. This creates one model with the transition rate (likelihood for a zombie firm to either recover or exit) as dependent variable. The panel model is shown in Equation [1].

$$[1]\ transition\ rate\ zombie_{it}$$
$$= \beta_0 + \beta_1 \Delta ln.assets_{it} + \beta_2 \Delta ln.debt_{it} + \beta_3 \Delta ln.employees_{it} + \beta_4 \Delta ln.sales_{it}$$
$$+ \beta_5 ln.employees_{it} + \beta_6 restructuring sales\ ratio_{it} + \beta_7 profitability.ratio_{it}$$
$$+ \beta_8 dummy.aftercrisis_t + \mathcal{E}_{it}$$

In this model, the subscripts *i* and *t* represent the firm and year, respectively. Coefficients can be positive for the recovery of a zombie firm and negative for the exit, or vice versa. β_0 represents the constant in the equation. β_1 to β_4 represent the change in the natural log value of the respective variable between year t and year $t-1$. β_5 represents the natural log of the employees. β_6 represents the ratio that is created by dividing the total restructuring expenses by total sales. β_7 represents the ratio that is created by dividing net income by total sales. β_8 represents the dummy that is used to separate the global financial crisis and the period after.

For H_1, I expect the coefficient of for the after-period dummy (β_8) to be significantly negative for the recovery of zombie firms. To test this, a dummy variable is used to separate the period during the global financial crisis and the period after, where the years during the crisis (2008 to 2013, which is in line with Schivardi et al. (2022)) are coded as 0 and the years after the crisis

(2014 to 2019) are coded as 1. The years 2020 and 2021 are not taken into consideration for the after-crisis period because of the Covid-19 crisis.

For H_2, I expect the coefficient of restructuring/sales ratio (β_6) to be significantly positive for the recovery of zombie firms. I use the restructuring expenses as a ratio compared to the total sales for each firm-year observation, because larger firms are expected to have higher values for all their financial fundamentals. I chose to use total sales as the denominator in this equation as restructuring expenses are subtracted from a firm's revenue in its income statement. By creating this ratio, I want to test if higher restructuring expenses lead to a higher recovery rate.

For H_3, I expect the coefficients of both the change in the natural log of assets (β_1) and the change in the natural log of employees (β_3) to be significantly negative for the recovery of zombie firms, since both are used in the literature as a form of downsizing a firm. Downsizing on assets creates additional cash that firms can use to pay off loans and lower their interest expenses or get rid of a division that generates a negative net income. Dismissing employees lowers the total salary payments, which lowers monthly expenses. This only works if the dismissed employees are not essential for running their business. This is often paired with shutting down a division or replacing human labor with machinery. These coefficients are also expected to be negative for the exit of zombie firms as they portrait their (unsuccessful) restructuring attempt.

3.2 The dataset

The initial data used for this study is retrieved from S&P Global Market Intelligence – also known as Compustat – Through Wharton Research Data Services. In Compustat, annual fundamentals are retrieved from all public firms globally that report their fundamentals in one of the top 15 most traded currencies worldwide[1] (Bank for International Settlements, 2019), because traded currencies are more stable, which is favorable for firms that want to reduce currency risks. Table 1 shows the number of firms in the sample that report in which currency. It seems that 55% of all firms in my sample report their fundamentals in Japanese Yen or Chinese Renminbi.

[1] The top 15 traded currencies include: USD, EUR, JPY, GBP, AUD, CAD, CHF, CNY, HKD, NZD, SEK, KRW, SGD, NOK, and MXN

Currency	Number of firms	% of total
JPY	3633	27.8%
CNY	3567	27.2%
EUR	1780	13.6%
GBP	1377	10.5%
HKD	1108	8.5%
USD	546	4.2%
AUD	331	2.5%
SEK	239	1.8%
NOK	157	1.2%
CHF	151	1.2%
SGD	94	0.7%
MXN	63	0.5%
NZD	35	0.3%
KRW	9	0.1%
CAD	1	0.0%

TABLE 1: CURRENCIES OF THE USED DATASET

The same data is retrieved from Eikon, as well as additional annual fundamentals that were missing from Compustat, such as total debt, interest expenses and restructuring expenses. The data from Eikon is retrieved twice; once in the in the local currency of the firms, and once where all annual fundamentals are converted into Euro's through Eikon's own exchange rate. The local currency dataset is used to compare the data from Eikon with the data from Compustat, because both databases show different values for the same firm-year observation. These differences are firm-specific rather than completely random. After comparing the total equity of four randomly picked firms[2] with their annual report for that year, it can be concluded that the data from Eikon is correct and that the data from Compustat is reported in the wrong year. Therefore, the dataset from Eikon is used as the main dataset, and the data from Compustat is used to fill potential gaps.

For the analyses, the dataset that has all fundamentals reported in Euro's is used to overcome the large numeral differences between the currencies. This enables me to compare firms that use different currencies and strengthen the conclusion of this research, with the downside that this creates an exchange rate risk. This risk is mostly present when comparing the performance of a

[2] The four firms from the used sample were: Longrun Tea Group Company Limited (ISIN KYG5636D1051), BT Group PLC (ISIN GB0030913577), Avingtrans PLC (ISIN GB0009188797) and Makita Corp (ISIN JP3862400003)

firm over multiple years or when comparing firms who use different currencies, as international asset pricing depends on temporary differences in consumption opportunity as markets are internationally segmented (Stulz, 1981), which is limited by only using the 15 most traded currencies.

The date on which a firm went inactive is used as the legal death date of the firm. If there is a gap between the last observation and the legal death date of a firm, the last observation is coded as the death date.

The sample used in this study has observations for the period 2002-2021. This period is chosen because it contains both the global financial crisis and the Covid-19 pandemic, up until the most recent available data.

Filtering the dataset

To have meaningful data, the raw data required filtering. Firstly, all firms from the Compustat database that did not have an ISIN were removed from the dataset. This is because the ISIN was used to find retrieve the data from Eikon. Secondly, all firms with four or less firm-year observations were deleted, because at least three years of data are required for my definition of zombie firms.

Thirdly, all firm-year observations that had missing values for employees, net income, sales, debt, interest expenses or EBIT at the start or end of the period were deleted from the dataset, because these are key variables in the analyses. In addition, firms that consistently have nine or less employees were also removed from the database, because a change in employees on this level is a huge percentual step (Carreira et al. (2021) used a threshold of three employees, but because my data has public firms, this threshold is increased to ten employees).

Fourthly, firms with 2-years or higher reporting gaps were deleted. Firms 1-year reporting gaps were interpolated linearly. The final sample consists of an unbalanced panel of 13,091 firms with a total of 153,198 firm-year observations. Out of these firms, 3,173 firms are coded as a zombie at least once.

3.3 Independent variables

To evaluate what increases the recovery (exit) rate of zombie firms, multiple variables are retrieved from Eikon and Compustat, of which some are used to create ratios. The dataset contains financial variables, such as *total assets, common equity, total debt, total sales, R&D expenses, EBITDA, EBIT, interest expenses, net income, and restructuring expenses*; discrete variables, such as *number of employees*, and categorial variables, such as *industry code* and *currency code*. The following ratios are created using the financial variables: *ICR*: EBIT divided by interest expenses; *D/E ratio*: total debt divided by common equity[3]; *restructuring/sales ratio*: restructuring expenses divided by total sales; and *profitability ratio*: net income divided by total sales.

3.4 Flagging zombie firms

For this, I used the Interest Coverage Ratio (ICR) method, which is in line with the existing literature from Defining zombie firms2.2 and is also the method that is used in previous research on zombie firms by Adalet McGowan et al. (2018). This method flags zombie firms if their ICR is lower than one for three consecutive years. The existing literature combined a high leverage together with the ICR requirement to flag zombie firms, however I have decided to not use the leverage since public firms can obtain equity rather easy by issuing more shares, which influences their D/E ratio. I still test whether zombie firms have a higher D/E ratio than non-zombie firms in my dataset.

Classification errors

As in Carreira et al. (2021), the flagging of zombie firms is screened by including “one-shot restructuring” firms that could bypass the used methods. These so-called one-shot restructuring firms are firms that recover from their zombie status in one year and return to this status in the next year. These firms are corrected to be classified as zombies for the entire duration. The one-off ICR that is above 1 can be due to selling off assets as a restructuring attempt, but if the firm

[3] 2,951 observations with a negative common equity have no D/E ratio to avoid harming the analysis

returns to being a zombie in the year after, the restructuring failed to remain profitable (i.e., "false" restructuring). This process is done five times to include firms that used to be zombies and who were not able to keep their ICR above one for two consecutive years.

Another correction for zombies is to exclude "one-shot zombie" firms, also called one-off zombies or false zombies (Carreira et al., 2021). However, this exclusion is already in place because firms are only flagged as zombies when their ICR is lower than one for three consecutive years.

4 Results

4.1 Descriptive statistics

I start out the analysis by describing the difference in characteristics of zombie firms and non-zombie firms based on their ICR. In Figure 1, the percentage of zombie firms over the years can be seen. It also shows that the share of zombie firms gradually increased from 2005 and peaked in the years 2009 and 2012. This is probably due to the global financial crisis that started in 2008. A notable decrease in the share of zombie firms can be seen in 2020 and 2021, during the Covid-19 crisis. The decrease in zombie firms in 2021 is lowered by the fact that is has not been corrected for one-shot restructuring (Carreira et al., 2021).

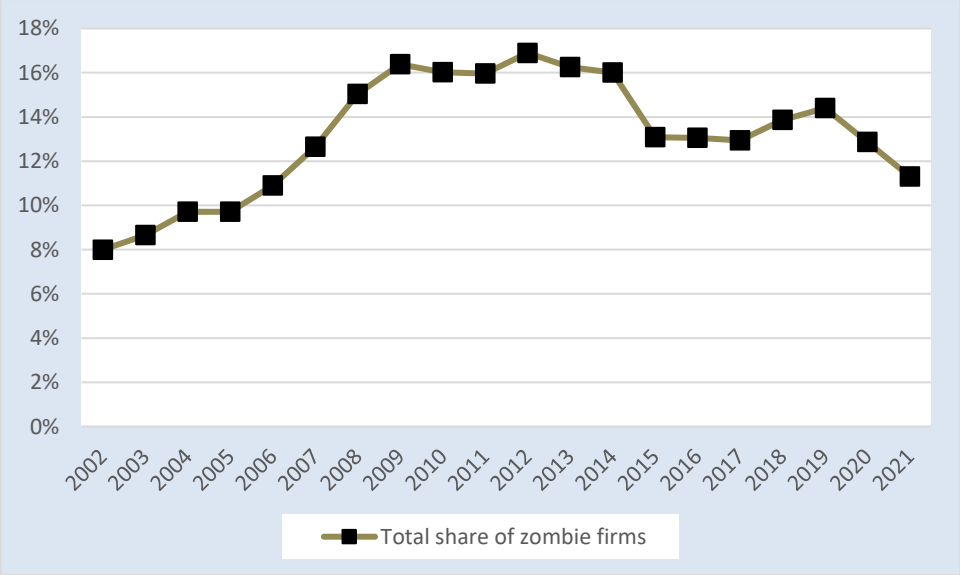

FIGURE 1: SHARE OF ZOMBIE FIRMS AS A % OF TOTAL FIRMS PER YEAR

4.1.1 Characteristics of zombie firms and non-zombie firms

To compare the basic difference in characteristics between zombies and non-zombies, Table 2 shows the mean and standard deviation of multiple descriptive characteristics for both zombies and non-zombies. The p-value represents whether there is a statistically significant difference in the means using the two-sided t-test. With the highest p-value being 0.0061, all means between zombies and non-zombies are statistically different from each other at the 1%-level.

The characteristics show the difference in natural log of financial variables (as well as employees), the Debt/Equity ratio, the Restructuring/Sales ratio, and the number of employees. For zombie firms, the assets, employees, and sales decrease per year, whereas these increase for non-zombie firms. On average, the Debt/Equity ratio is twice as high for zombie firms, and they have four times less employees than non-zombie firms. It seems that both zombie firms and non-zombie firms increase their debt over time, but that the increase is higher for non-zombie firms. This could be because these firms have more profitable investment opportunities than zombie firms and are not as close to their debt ceiling.

	Zombie mean (S.D.)	Non-zombie mean (S.D.)	p-value
Δ log Assets	– 0.0099 (0.5211)	0.0781 (0.2534)	0.0000
Δ log Debt	0.0291 (1.0772)	0.0575 (0.7802)	0.0016
Δ log Employees	– 0.0285 (0.4586)	0.0402 (0.2569)	0.0000
Δ log Sales	– 0.0151 (0.8189)	0.0632 (0.3272)	0.0000
Debt/Equity ratio	2.17 (23.12)	1.08 (9.47)	0.0000
Restructuring/Sales ratio	0.0144 (0.6665)	0.0014 (0.0238)	0.0061
Employees	1916 (9709)	8175 (29492)	0.0000

TABLE 2:DESCRIPTIVE STATISTICS OF ZOMBIE AND NON-ZOMBIE FIRMS

4.1.2 The survival of zombie firms

By analysing the flagged zombie firms that transitioned into either recovery or exit, I find that the average zombie firm that recovers from its zombie status takes approximately 5 years and 1 month to recover, and that the average zombie firm that exits the market takes approximately 6 years to exit. These averages show that the chance for a zombie firm to recover decreases and the chance for a zombie firm to exit increases the longer they stay a zombie.

Figure 2 shows that the exit rate of zombie firms was the highest during the period of 2010-2013. Due to the nature of my data, it is impossible for zombie firms to recover or exit the market

in 2002 and 2003, because they cannot be flagged as zombies if their ICR was lower than one for only 2 years. Surprisingly, in 2004 and 2005, no zombie firms exited the market. The increase in zombie firms that have recovered from their zombie status in 2021 is inflated by the fact that it cannot be corrected for one-shot restructuring (Carreira et al., 2021). This cannot be done because there is no data for 2022, and it is unclear which firms were able to keep their ICR above 1.

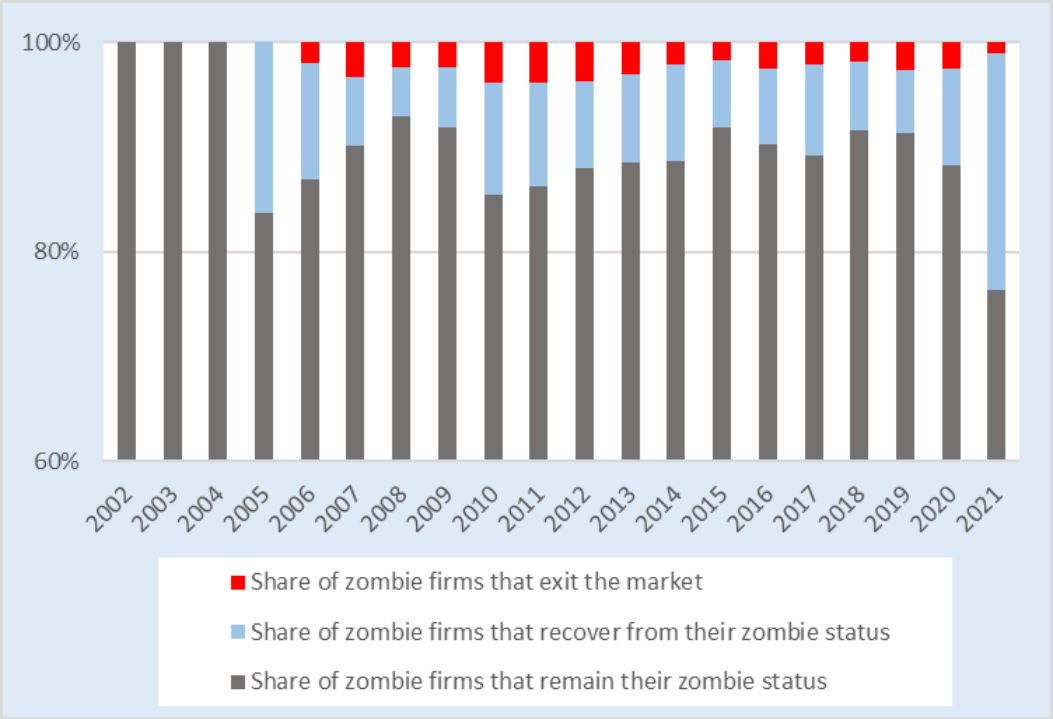

FIGURE 2: SHARE OF ZOMBIE FIRMS THAT STAY A ZOMBIE OR TRANSITION INTO RECOVERY OR EXIT

Note: The bottom 0 percent to 60 percent are cropped for increased visibility

4.2 The recovery and exit of zombie firms

After looking at the descriptive statistics of zombie firms, it is time to find out which (financial) variables determine the transition of zombie firms into recovery or exit by using a multinomial logit regression. Each year, a zombie firm can either stay a zombie, recover from the zombie status, or exit the market. These transitions are coded as follows: firms that remain a zombie are coded as 1, the year a firm recovers from its zombie status is coded as 2, and a firms last observation before going inactive is coded as 3.

The independent variables can be categorized into three groups. The first group consists of the yearly log differences (differences between the log values of one year (t) and the year prior ($t-1$)) of multiple essential (financial) variables, which are *Log change in Assets*, *Log change in Debt*, *Log change in Employees* and *Log change in Sales*. Based on the discussed literature, it is expected that downsizing the assets and employees increases the recovery rate of zombie firms. The effect of downsizing is expected to decrease the exit rate, but it could be the other way around due to the *shadow of death* effect (Carreira & Teixeira, 2011). Decreasing outstanding debt and increasing sales should increase the recovery rate and decrease the exit rate of zombie firms.

The second group of variables consists of the financial variables *Profitability Ratio*, *Log D/E Ratio*, and *Restructuring/Sales Ratio*. The first two ratios are used to test how big the losses of a firm are compared to its sales, and how debt-driven the firm is compared to its equity. The last ratio is used to test whether allocating a higher share of total sales to restructuring expenses increases the likelihood that a restructuring succeeds, and a firm recovers from its zombie status.

The last group consists of the *Log Employees* as firm-level control variable. This variable is added to test if larger firms are more or less likely to successfully restructure their firm and recover from their zombie status. Larger firms have more resources, experience, and higher managerial ability to restructure, but the management may feel less pressure to actively restructure their firm (Carreira et al., 2021). On top of the three groups, the dummy variable *After Crisis* is added to test if the recovery or exit rate of zombie firms is higher in the after-crisis period of 2014 – 2019 compared to the crisis period of 2008 – 2013.

Table 3 shows the results of the multinomial logit regression for these three outcomes – remaining a zombie (the base outcome), recovery and exit. Two models are reported for the regression: one without the after-crisis dummy and one where it is included. This is done because the after-crisis dummy does not take the years 2002 – 2007 into consideration as it is used to compare the global financial crisis period (2008 – 2013) with the period afterwards (2014 – 2019). Model 2 is used to answer hypothesis 1 and Model 1 is used to answer hypotheses 2 and 3. The outcome coefficients shown in Table 3 are the relative Odds Ratio and can be interpreted as follows: a one unit increase in the independent variable results in an increase (a decrease in case

of a – sign) in the odds ratio for a firm to recover or exit, in comparison to the base outcome of staying a zombie (Kwak & Clayton-Matthews, 2002).

Multinomial Logit Regression				
Variables	Model 1		Model 2	
	Recovery	Exit	Recovery	Exit
Δ Log Assets	1.0193 *** (0.1425)	– 0.3725 *** (0.1045)	1.0483 *** (0.1762)	– 0.4151 *** (0.1053)
Δ Log Debt	– 0.2320 *** (0.0246)	– 0.1104 (0.0657)	– 0.2577 *** (0.0290)	– 0.1089 (0.0733)
Δ Log Employees	– 0.2346 *** (0.0571)	– 0.1701 (0.1291)	– 0.2063 ** (0.0724)	– 0.0906 (0.1548)
Δ Log Sales	0.4751 *** (0.0580)	– 0.0883 (0.0831)	0.4137 *** (0.0637)	– 0.1161 (0.0838)
Log D/E ratio	0.0488 *** (0.0171)	0.1555 *** (0.0398)	0.0563 *** (0.0210)	0.1736 *** (0.0453)
Profitability ratio	0.0004 * (0.0002)	0.0001 (0.0004)	0.0003 (0.0002)	0.0001 (0.0003)
Restructuring/Sales ratio	– 1.0000 *** (0.0002)	0.1205 (0.1417)	–0.9998 ** (0.0006)	0.0906 (0.1405)
Log Employees	0.1563 *** (0.0188)	– 0.0874 ** (0.0331)	0.1628 *** (0.0667)	– 0.0934 ** (0.0359)
After-crisis dummy			– 0.0496 (0.0054)	– 0.3857 *** (0.0836)
Constant	0.0428 *** (0.0047)	0.0354 *** (0.0104)	0.0389 *** (0.0054)	0.0532 *** (0.0176)
Number of observations		14,669		10,829
Wald chi-square		372.73 ***		286.95 ***
Log pseudolikelihood		-5545.6784		-4016.2367

TABLE 3: MULTINOMIAL LOGIT REGRESSION FOR ZOMBIE FIRM TRANSITION

Notes: The base category for the dependent variable is "continuing as a zombie". The coefficients show the relative odds ratio compared to the base category. ***, ** and * indicate statistical significance at the 1 percent, 5 percent, and 10 percent level, respectively.

Model 2 in Table 3 shows the regression in with the after-crisis dummy is included. The coefficient of the after-crisis dummy shows an insignificant coefficient for the recovery of zombie firms, meaning that my data does not show enough evidence that the recovery rate of zombie firms is lower in the years after the global financial crisis compared to during the crisis, which is not in line with my first hypothesis. However, the negative coefficient still hints towards this fact, but it can also be coincidental. The after-crisis dummy does show a significant negative coefficient for the exit rate of zombie firms, which means that zombie firms are less likely to exit after the global financial crisis than during the crisis. This means that zombie firms during the crisis were more likely to exit, meaning that the harsher environment of the global financial crisis resulted in more bankruptcies of zombie firms (which can also be seen in Figure 2 in 4.1.2).

The coefficient for the restructuring/sales ratio is significantly negative for the recovery of zombie firms and not significant for the exit of zombie firms, which is not in line with my second hypothesis. The regression shows the change in the relative odds ratio when the independent

variable increases by 1 unit, however the restructuring/sales ratio only generates values between 0 and 1 (0 being a firm does not spend any of its sales on restructuring expenses and 1 being a firm that spends all its sales on restructuring expenses). These values are extreme outliers as no firm that wants to restructure spends either none or all its sales on restructuring expenses. As the regression shows that an increase in the restructuring/sales ratio from 0 to 1 decreases the relative odds ratio on recovery by 100%, a smaller step of 0.01 (spending 1% of total sales more on restructuring expenses) leads to a 1% decrease in the relative odds ratio for the recovery of a zombie firm. This is not what is expected in the hypothesis, because this shows that firms who have higher restructuring expenses compared to their total sales are less likely to recover. This could be explained by the possibility that zombie firms who spend more on restructuring expenses are not efficient in doing so or are overspending, which moves them away from recovery.

The coefficient for Δ log assets shows a positive sign for the recovery of zombie firms. This means that one unit increase in its log assets increases the relative odds ratio to recover by 101.93% compared to the base outcome of staying a zombie. This is not as expected in my third hypothesis, as this means that a firm who downsizes their log assets by one unit decreases their relative odds ratio of recovery by 101.93% and increases their relative odds ratio of exit by 37.25%. This implies that zombie firms that invest in their assets have higher odds to recover, which is counterintuitive as most zombie firms are debt driven and have limited accessibility to additional credit. It is possible that, because my data consists of public firms, that these firms received additional credit in the form of subsidies or equity, or that they had the credit already available to them. However, downsizing on employees does seem to have a significantly positive effect on the relative odds ratio of recovery for zombie firms, as a one unit decrease in Δ log employees increases the relative odds ratio of recovery by 23.46%.

In addition to the variables that are used to test the hypotheses, other variables that significantly increase the odds of recovery are decreasing the Δ log debt (increase in the relative odds ratio of 23.20% per one-point decrease) and increasing the Δ log sales (increase in the relative odds ratio of 47.51% per one-point increase). Neither of these two variables have a

significant impact on the exit rate of zombie firms. Lowering the debt of a firm is another form of restructuring, called debt restructuring.

The log D/E ratio has a significant and positive for both the recovery and exit of zombie firms, however the relative odds ratio for recovery increase less per one-unit increase than the relative odds ratio for exit (4.88% and 15.55%, respectively). This means that an increase in the log D/E ratio results in a higher transition rate out of the zombie status compared to remaining a zombie. The profitability ratio is only slightly significant and positive for the recovery of zombie firms.

The log value of employees captures the firm size in the regression and is significant and positive for recovery, and significant and negative for exit. This means that it is easier for larger firms to recover from their zombie status, as a one-unit increase in log employees increases the relative odds ratio of recovery by 15.63% and decreases the relative odds of exit by 8.74%.

5 Conclusion and Discussion

5.1 Conclusion

Over the last few decades, the share of zombie firms has seen a steady increase, which results in more capital and labor being held by insolvent firms, which would create more value if used by solvent firms. Using global public firm data over the period 2002 – 2021, the aim of this study is to find determinants that influence the odds for zombie firms to recover from their zombie status or exit the market. First, the basic characteristics of zombie firms are compared to those of non-zombie firms, which shows that zombie firms are more debt-driven, have less employees than non-zombie firms, and that the assets, sales and employees decrease per year for the average zombie firm, whereas these increase for the average non-zombie firm. The average zombie firm that recovers takes about 5 years to do so, while the average zombie firm that exits the market takes about 6 years, which shows that the odds of recovery decrease the longer the firm remains a zombie.

The main results are analysed using a multinomial logit regression in Stata17. The results from this regression show that zombie firms are less likely to exit the market after the global financial

crisis (2014 – 2019) than during the crisis (2008-2013), while the change in the recovery odds for zombie firms has no significant result between these time periods. The regression also shows that zombie firms who spend a larger share of their sales on restructuring expenses have lower odds of recovery, while this does not significantly impact the odds of exit. This shows that higher restructuring expenses do not correlate with a successful restructuring, but that restructuring should focus on how to efficiently create more business opportunities. Debt restructuring does seem to have a positive impact on the recovery of zombie firms, as the log change in debt shows a significant negative coefficient. The log change in assets shows a significant positive correlation with the odds of recovery, which means that zombie firms who increase their assets have higher odds to recover and lower odds to exit. The log change in employees shows that a decrease in employees increases the odds for both recovery and exit. This means that downsizing on assets does not improve the odds of recovery, while downsizing on employees does increase these odds.

Other determinants that increase the odds for zombie firms to recover are an increase in sales and the size of a firm, based on the log value of employees.

To answer the research question, factors that increase the odds ratio for zombie firms to recover are investing in assets, downsizing on employees and debt restructuring. Increasing the sales also increase the odds ratio of recovery, and larger firms have higher odds to recover.

5.2 Discussion

This research has some limitations, the first being the used dataset. The first dataset was retrieved from Compustat, which was accessed through Wharton Research Data Services (WRDS) and contained yearly fundamentals for all public firms. However, this data had its flaws, as there were (large) reporting gaps and a lot of firms had missing data for the retrieved fundamentals. To have useful data, all firms with missing data for the variable ‘employees’ were deleted, as well as the firms with reporting gaps of two or more years. The minimized dataset that remained did not include some key fundamentals, one example being interest expenses – which is crucial to calculate a firm’s ICR. This caused me to retrieve the same data of the minimized list of firms from Eikon, which was mostly complete. If the data were retrieved from Eikon in the first place, there is a large probability that the deleted firms whose data was missing in Compustat would have

been present in Eikon, which would have resulted in a larger dataset for my research. The only variable that was used from Compustat was the number of employees, as Eikon had more missing data on this variable.

The database of WRDS also gave access to BoardEX, a database that contained information about the board of directors of European firms. Initially, I had hoped to test whether downsizing the board of directors had an influence on the recovery or exit rate of zombie firms, but the information from this database was also limited. The board size was therefore not useful in the multinomial logit regression as it reduced the number of groups from 2,895 down to only 116, which resulted in very insignificant results about a small portion of the total sample, which is why I dropped this variable in this study.

The final data set contained the yearly fundamentals converted in Euro's rather than keeping the main currency of the firm, which made comparison between firms using different currencies possible at the expense of creating an exchange rate risk. To limit the exchange rate risk, I only included firms that reported in the 15 most traded currencies in the dataset.

The results from my analysis are mostly significant, but only one hypothesis was proven to be correct, which is that downsizing on employees increases the odds of recovery for zombie firms. Nevertheless, the outcomes of the multinomial logit regression can still be explained, as no firm should use a large share of its sales on restructuring expenses, and that investing in more assets results in more productivity and higher sales, which increases the profitability of a firm.

Future research could focus on testing additional determinants for their impact on the recovery and exit rate of zombie firms, add geopolitical variables to test their relevance, or include a better way of comparing firms using different currencies without the exchange rate risk. Additional research could also focus on predicting whether a firm is about to become a zombie to find out how this can be prevented. Knowledge about why the share of zombie firms rises or declines could add to the existing literature, which could also be useful for policymakers.

6 References

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