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A ZOMBIE OUTBREAK

A STUDY OF UNHEALTHY FIRMS' INFLUENCE ON HEALTHY FIRMS' GROWTH PROGRESSION IN SWEDEN.

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Abstract

This paper examines the impact of zombie firms on healthy companies' growth indicators in the Swedish market. By utilising fixed-effects regression analysis and analysing a comprehensive data set, the paper aims to shed light on the dynamics between zombies' effects on nonzombies' development. The findings indicate that zombies have limited effects on healthy companies in Sweden. Contrary to previous literature suggesting that zombies hinder the growth of nonzombies, the regression analysis does not consistently support this notion. The competitive nature of the Swedish market is identified as a probable factor that mitigates any negative impact of zombies on nonzombies' relative growth in total assets. The paper suggests that different sectors may be influenced differently by the presence of zombies. Capital-intensive industries, which heavily rely on capital inputs, appear to be more susceptible to the effects of zombies. Misallocations of capital in these industries can have significant repercussions on the growth of healthy firms. However, caution is advised as certain branch sectors may not be ideal for studying zombie impacts due to specific industry circumstances that could lead to misclassification. To enhance the precision of the results, the paper proposes incorporating additional control variables, particularly time-varying sector-specific ones. These variables can capture shocks that vary over time and differ across sectors, providing a better understanding of the effects of zombie presence on nonzombie growth measures. The paper also suggests refining the criteria for labelling zombies based on branch sectors and exploring sector-specific effects in future research. The paper concludes that the long-term effects of zombies on the growth of healthy firms in Sweden remain inconclusive. The resilience of Sweden's growth rate suggests the need for further investigation and analysis. Policymakers can benefit from understanding the implications of zombie survival and the trade-offs between the benefits derived from low-interest rates and the negative externalities that may arise. Continued research in this area can provide valuable insights for informed decision-making. Overall, this study contributes to the existing body of knowledge by providing insights into the dynamics between zombies and nonzombies in the Swedish market by considering sector-specific effects. Future research can deepen the understanding of the long-term implications of zombies and guide policymakers in addressing potential challenges and opportunities.

Keywords: zombie firms, spillover effects, capital misallocation

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1 Introduction

In the realm of business, *Zombies* (hereinafter zombies) are a growing concern and are often referred to as the walking dead. Despite their financial fragility, zombies continue to function, often relying on low-interest rate environments and various forms of financial assistance to stay afloat. Even though zombies are technically still in business, they are not generating enough income to pay off their debts and become profitable again. Although the term zombie is not a recent addition to the business lexicon. In fact, zombies have been plaguing markets worldwide and Japanese firms were first referenced as such during the Japanese asset price bubble in 1990. The bubble refers to a period (1986-1991) wherein the stock market and real estate prices were severely inflated due to delayed monetary reactions by the Bank of Japan (BOJ). During the period, Japanese banks continuously supported weak and failing companies. The banks supported the firms due to the concept of companies being *too big to fail*, wherein banks were intimidated by the consequences of a liquidation, e.g., bank runs (Denny, Charlotte, 2002). The OECD (2018) would go on to define a zombie firm as a 10-year-old (or older) company with an interest coverage ratio (ICR) [1] less than one over three consecutive years. The phenomenon of zombies has become more relevant lately as the share of zombies has doubled since 2010 worldwide. More specifically, in a report by the consulting company Kearney, the zombie trend is especially strong in Sweden compared to neighbouring countries as there were approximately 64 companies labelled as zombies on the Swedish Stock Exchange in late 2021. However, it is worth noting that the report does not capture the recent rise in interest rates; therefore, whether this will cause an influx in defaulting companies remains an unanswered question (Häggman, 2022).

According to Caballero et al. (2008), a macroeconomic environment that permits zombie lending can lead to diminished restructuring and delayed recovery by hampering the transfer of assets to high-productivity firms (nonzombies). Such a lending environment can result in increased misallocation of resources, which ultimately can lower a country's total factor productivity (TFP), as discussed by Hsieh and Klenow (2009). Essentially, the existence of zombies can impede productive companies in several ways: one being that zombie lending inhibits streamlined credit flows from credit institutions to productive firms as supply is limited; another being that zombie lending allows nonviable corporations to compete with healthy actors' products and services (Schivardi et al., 2020). McGowan et al. (2017a);McGowan et al. (2017b) also make the case that the presence of zombies creates entry barriers as they inflate wages and productivity requirements due to market congestion, ultimately hindering growth, as newer, more innovative and productive firms might not be able to enter. Hence, it is argued that this so-called crowding-out effect caused by the presence

[1] The ICR indicates how easily a company can pay interest on outstanding debt and is calculated as the ratio of earnings before interest and taxes (EBIT) and interest expenses during a period (Hayes, Adam, 2023).

of zombies is adverse, with only a few claiming that their effects are negligible.

To illustrate the crowding-out effect of zombies, consider a scenario where two companies operate in the same sector and compete for capital. Suppose one is a zombie and is granted capital; it is highly probable that the funds will primarily be used to address existing debt obligations within the company. Whilst if a healthy company receives financing, it is more likely that the funds will be utilised for business development purposes, increasing productivity and growth. Such a distinction is expected to be reflected in growth indicators in this paper. Hence, the purpose of the paper is to evaluate the share of zombies in the Swedish business market to shed some light on the following research question: *How has the share of zombies affected the productivity and growth of healthy companies in Sweden over the period 1998-2021?*

The remainder of this paper is structured as follows. Section 2 introduces the reader to the background of zombies, motivating the choice of topic and offering an account of the previous literature and theoretical framework that will be used as a theoretical baseline when interpreting results. Section 3 Data & Methodology covers the choice of data, delimitation, descriptive statistics, and presents the choice model. In Section 4, results are presented and subsequently analyzed. Lastly, Section 5 discusses the results and the paper is concluded by Section 6 Conclusions.

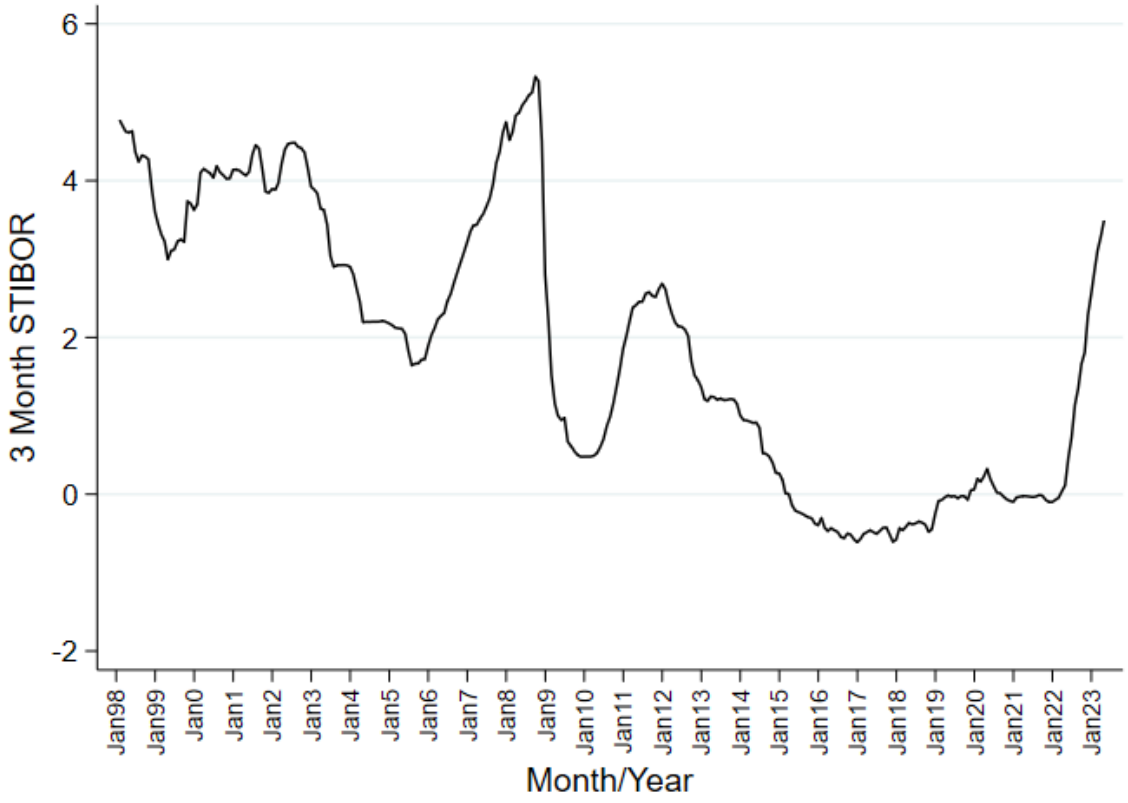
2 Background, Previous Literature, and Theory.

The following section commences with a background to the topicality of zombies by first giving a context for Swedish interest rates and employee layoff development. Subsequently, subsection 2.2—Previous research—discusses the paper's relation to previous literature within the field. The section concludes by introducing the reader to some basic concepts of endogenous growth to utilise when interpreting results.

2.1 Background

Since the 2010s, Europe and namely Sweden, has seen among the lowest policy rates in the world (see Figure 1 below). The monetary policy decision has been a crucial part of the global economy's recovery post the financial crisis of 2008 by keeping demand high for goods and services and enabling struggling firms to borrow and bounce back after the recession. On the firm side, lower interest rates imply lowered borrowing costs, debt repayments, and increased consumer consumption, resulting in higher business revenue (Cella, 2020).

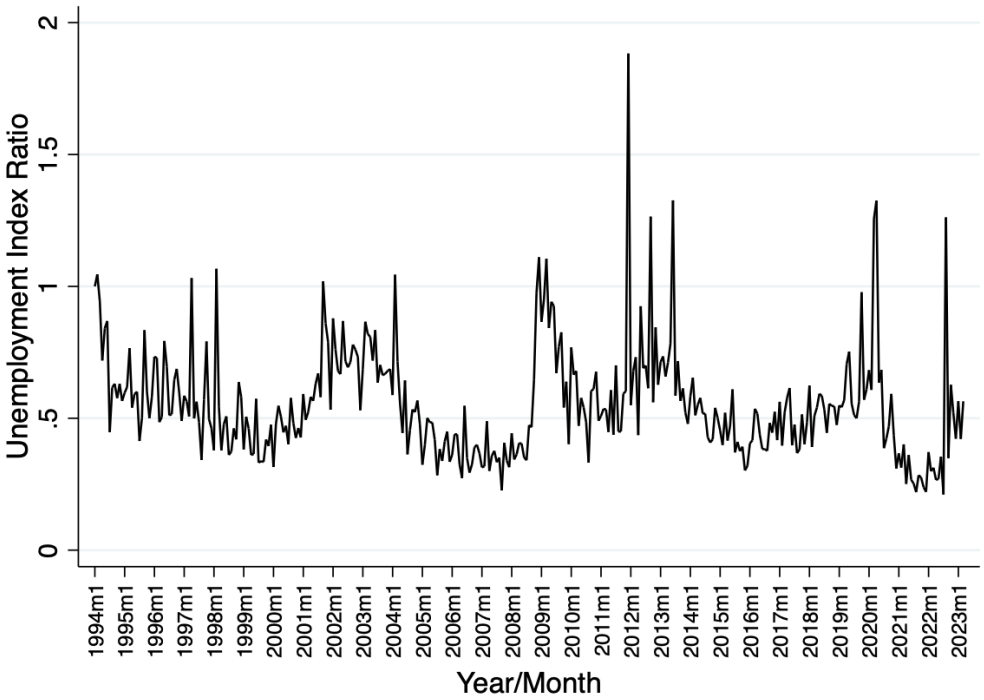
Figure 1: The 3-month Stockholm Interbank Offered Rate (STIBOR), stretching from 1998-01-31 to 2023-04-31 ECB Statistical Data Warehouse (2023).



However, there has been a consistent presence and rise in the proportion of zombies within the past decade. The trend of a rising share of zombies has been especially strong in Sweden, even when accounting for the fact that Sweden has more listed companies on its exchanges relative to neighbouring countries (Häggman, 2022). The question is if low-rate environments have enabled unhealthy firms to persist due to relaxed credit constraints over a longer period and if their presence has had adverse effects on healthy firms. Studies by Banerjee and Hofmann (2018) and De Martiis and Peter (2021) have provided some evidence that supports this conjecture. Therefore it is crucial to bring further clarity to the research area in order to determine if Sweden is particularly exposed to the associated risks so that monetary policymakers can take zombies into consideration.

Further, during the COVID-19 pandemic, a common policy employed to mitigate the effects of the economic shutdown was to offer financial aid to firms. In Sweden, the support package included various credit loosening measures, looser amortisation requirements, postponement of tax payments, and rent subsidies. Clearly, credit-constrained companies were alleviated, but at the same time, zombies had the ability to increase or sustain their share of allocated capital. A report from the National Institute for Economic Research (Konjuktursintitutet) finds that the fraction of defaulting firms did not increase during the pandemic (Konjunkturinstitutet, 2021) (see Figure 2 below).

Figure 2: Employees affected by bankruptcies in Sweden. Index starting in 1994-01-01, ending in 2023-03-01 SCB (2023).



Since the number of defaulting firms did not increase during the pandemic, it suggests that firms who would normally exit the market during an economic downturn stayed in. A potential reason why firms did not exit is the support packages provided by the government, entailing that the market was unable to self-select out inefficient firms and, thereby, potentially crowding out healthy ones. In Schivardi et al. (2020), the consequence of COVID-19 policies, such as credit guarantees to firms, is scrutinised as previous literature argues that such expansive fiscal policies might have generated zombie lending. Whilst credit leniency might seem irresponsible, as it enforces zombie lending, such uncritical lending policies could be a logical response to financially stressed stages of crises. On this matter, the literature is divided as it, by nature, requires a broader analysis of the socioeconomic benefits and drawbacks of policies. Therefore, the positive welfare implication of policies of such nature could, arguably, always outweigh the negative externalities incurred by zombies.

2.2 Previous research

Although being a relatively young avenue of research, the field has experienced a high output of published papers in recent years. Research has been widespread in terms of geography, spanning mainly the US and Europe but also featuring East Asian economies as well. The focal point of the previous literature spans from the early 2000s and forward. Namely centring around the stagnation of the Japanese economy in the late 90s and early 00s, the global financial crisis of 2008, the European debt crisis in 2009-2014, and finally, the COVID-19 pandemic in 2020-2022. However, before the coining of the term zombie, Kornai (1986) investigated the concept of *soft budget constraints*. The paper develops on concepts in Kornai (1980) and is an overall critique of the socialist and pseudo-socialist mixed economies, which Kornai (1986) claims creates these so-called soft budget constraints for firms. According to Kornai (1986), economies characterised by extensive government intervention in firms tend to alleviate the firms' budget constraints. This is due to the ability of such firms to receive bailouts and subsidised credit when they face the risk of default. The paper not only engages in a philosophical discourse on the competing interests of efficiency and security solidarity but also presents an empirical investigation into the relationship between state ownership and profitability. Kornai (1986) classifies firms into four different categories based on productivity and proceeds to study the probability of moving between productivity classes. In countries with greater state ownership, Kornai (1986) finds that firms transition less often at the bottom of the productivity classes compared to the top.

Following Kornai (1986), the literature is mainly centred around Japan during the 1990s. In a paper by Ahearne and Shinada (2005), the authors investigate the weak performance of the Japanese economy between 1981-2002. Ahearne and Shinada (2005) argue that the poor growth exhibited

by Japan is a result of zombie lending, a phenomenon in which banks have arbitrary lending policies enabling unproductive firms to prolong and take on new debt. Ahearne and Shinada (2005) use a model of creative destruction inspired by Atkeson and Kehoe (1995) in which operating returns in the current period measure firm-level productivity, and managers decide to do business based on these returns. The model yields an optimization problem in which two types of firms are differently credit constrained. Ahearne and Shinada (2005) conclude that under these constraints, the managers' dynamic choice problem yields different results, namely, that unproductive firms subject to looser constraints might stay in, whereas productive firms subject to stricter constraints might exit. Ahearne and Shinada (2005) continue the analysis by sorting the productivity growth measures by non-tradable and tradable and note that the slowdown in productivity was more pronounced in non-tradable. In order to conclude whether the result is due to zombie lending or just poor performance, Ahearne and Shinada (2005) utilise a model of productivity growth inspired by Haltiwanger (1997) where productivity is defined as a market share weighted sum of the firms' productivity levels. The model is utilised to reflect market share as a proxy of allocated capital, meaning a large reallocation in market share, i.e., significant reallotment of capital to less productive firms, results in an overall productivity slowdown. By studying the impulse response functions generated by the model, Ahearne and Shinada (2005) conclude that there is evidence to support their hypothesis; moreover, they also find a correlation between the change in market share and changes in the proportion of outstanding loans from banks (Ahearne and Shinada, 2005).

In Caballero et al. (2008), ideas published by Ahearne and Shinada (2005) are built upon and extended by not only investigating the issue of zombie lending but also by capturing the effects of restructuring in Japan and its correlation to the stagnation of the Japanese economy. Caballero et al. (2008) use the same theoretical framework as the previous research but take a more econometrical approach to the empirical evidence. Another key aspect in which Caballero et al. (2008) differs is the labelling of zombies. Caballero et al. (2008) define a firm as a zombie based on whether or not they receive subsidised credit, thereby disregarding whether firms are actually productive or not as in Ahearne and Shinada (2005). Caballero et al. (2008) motivate the labelling choice by arguing that it allows the paper to evaluate the overall effect of zombies on the economy since using profitability measures to define zombies assumes that industries dominated by zombies would have low profitability and, thus, low growth. Instead of assuming the aforementioned relationship, Caballero et al. (2008) attempts to test it by using this broader definition. In order to identify subsidy-receiving firms, Caballero et al. (2008) construct a function for the annual minimum required interest payment by using corporate bonds and other short-term bank loans available to firms. The hypothetical lower bound created by the function is compared to the actual interest payments for a given firm in order to determine their status (zombie or nonzombie). The paper's methodology captures most

forms of credit subsidies, e.g., moratoriums on interest payments, debt for equity swaps, debt forgiveness, et cetera. However, the employed methodology fails to account for firms acquiring new debt to repay existing debt. Further, Caballero et al. (2008) present a framework similar to Ahearne and Shinada (2005) but depart from the previous literature by identifying the mass of entrants and exits and then applying their classification of zombies. The model predicts that the presence of zombies alters the model's equilibrium creation and destruction patterns, generating larger creation adjustments post TFP-, cost-, and profitability shocks. Consequently, the findings suggest that permitting inefficient firms to occupy capital hinders productivity. Therefore, Caballero et al. (2008) conclude that the main channel through which zombies hurt the economy is congestion or the crowding out of healthy firms. To assess the consequences of the congestion caused by zombies, Caballero et al. (2008) construct a simple regression using panel data consisting of firm-level data on employee growth, investments, sales, and productivity, which is run on a zombie dummy, industry sales growth, and, zombies as a percentage of the industry. Caballero et al. (2008) find that investment and development in nonzombies would be higher if it were not for the presence of zombies. Further, the effect of zombies differs across industries, with large differences in wholesale in particular. Regarding employment growth, there are large discrepancies as well, specifically in the real estate sector. In conclusion, Caballero et al. (2008) note that destruction would increase due to a tightening of the credit constraint. However, Caballero et al. (2008) find the destruction rate to be declining, thereby giving a motive for further investigation.

Later, a string of research by the OECD was published. The papers by McGowan et al. (2017a);McGowan et al. (2017b) take two distinct approaches to the topic of zombies on the market. The latter takes an ex-post approach, focusing on the subject of zombies themselves and their inherent effects on the economy. Therefore, McGowan et al. (2017b) is not relevant to the purposes of this paper. However, the former is an ex-ante analysis and focuses on the topic of zombie lending and the policy decision-making that has led to the rise of zombies. McGowan et al. (2017a) extends the empirical framework developed by Caballero et al. (2008) by using cross-country data from OECD countries over a 10-year period combined with the same method for identifying zombies as in Caballero et al. (2008). The findings in McGowan et al. (2017a) show that countries exhibiting a higher share of capital sunk into zombies crowd-out growth in terms of investment and employment when compared to healthy companies. McGowan et al. (2017a) also hypothesise that market congestion caused by zombies might act as an entry barrier, according to the paper's results, wages inflate relative to productivity and depress nonzombie market shares. The effect causes a higher productivity requirement to enter the market in order to compensate for lower profitability. McGowan et al. (2017a) also note that the presence of zombies affects younger firms to a larger extent.

More recently, Schivardi et al. (2022);Schivardi et al. (2020) investigated the topic of zombies.

Schivardi et al. (2020) study credit misallocation during the European debt crisis and whether low capital banks extended credit to financially exposed companies so as to determine if this affected aggregate efficiency. In other words, the paper focuses on the topic of zombie lending. Schivardi et al. (2020) use panel data of nearly all bank-firm relationships in Italy over a 9-year period from 2004 to 2013. In order to identify zombie lending, Schivardi et al. (2020) use measures of *capital adequacy* based on bank liquidity, as a ratio before and after the crisis, and bank profits. The log difference in total lending from a bank is then run on capital adequacy, dummy variables indicating zombie status and if the crisis is ongoing. Schivardi et al. (2020) find the probability of banks with low capital cutting credit to zombies to be lower during the European debt crisis than under normal financial circumstances. Another significant finding regards the misallocation of credit. Namely, due to the misallocation of credit, healthy firms were more prone to failure, while zombies were more likely to survive. Lastly, the authors found that the dampening effects of credit misallocation on growth were trivial. Schivardi et al. (2020) conclude by stating that although there might be long-run effects of such market inefficiencies, they were of no contribution to the magnitude of the European debt crisis.

In Schivardi et al. (2022), the main focus shifts and the perspective is broadened as the paper inspects the general, real effects of zombie lending. The paper attempts to account for the recent responses to the COVID-19 pandemic. Schivardi et al. (2022) investigate if zombie lending affects the performance of nonzombies and if the relative impact declines with a smaller fraction of zombies on the market. Schivardi et al. (2022) argue that the regression method previously employed by Caballero et al. (2008);McGowan et al. (2017a);McGowan et al. (2017b) has a critical flaw, that is, the portion of zombie is correlated with the shocks to market performance. The so-called *spillover* is partly addressed by the literature by including a full set of country-year or sector-year dummies. However, Schivardi et al. (2022) claims that this is not robust enough of a countermeasure to ensure the integrity of the results. The authors proceed by taking an analytical approach in order to show the impossibility of obtaining an unbiased estimator of the covariate representing the share of zombies. Further, Schivardi et al. (2022) argue that the most likely direction of this bias is negative due to high standard deviation and low kurtosis (i.e., fat tails in the distribution). Using data for Italy, the paper argues that the previously accepted notion that COVID-19 policies increased zombie lending during and after the pandemic might not have been a certainty. In fact, the paper finds that the majority of firms with high liquidity demand, as a result of the pandemic, were financially sound before the crisis, meaning they were not zombies (Schivardi et al., 2022).

In the context of Sweden, one relevant paper regarding the subject of zombies was published by the Swedish Riksbank. The staff memo by Cella (2020) offers more insight into the zombie issue in the context of the Swedish economy. The empirical framework of the paper is based on the work

of McGowan et al. (2017a) using Swedish firm data from 2002 until 2016. The paper finds that the proportion of zombies decreased post the global financial crisis and that the majority of capital sunk into zombies stemmed from private financing and not financial institutions. The conclusion in Cella (2020) is different from previous works and is important in the sense that banks are not the main culprits of the zombie pandemic. Further, Cella (2020) shows that zombie presence in the Swedish market is largely uncorrelated with healthy firms' growth. Although the contrasting result, Cella (2020) also finds that the probability of being resurrected from a zombie firm to a healthy one increased between 2010-2016. Cella (2020) argues that this is the result of a consistent lowering of policy rates during the period.

2.3 Theoretical Framework

In order to give context and offer a macroeconomic interpretation of the result, this paper presents the basic concepts of an endogenous growth model. The use of macroeconomic theory is beneficial when reflecting on the result and offers a deeper analysis of any potential effects caused by zombies. However, unlike traditional growth models, this paper does not examine growth in terms of aggregate productivity but rather in terms of five different growth measures. Therefore, the results might not be perfectly explained by traditional literature. However, the referencing of, as in our case, a sectoral Schumpeterian model of endogenous growth deepens the analysis and enables a discussion of the long-term consequences of the results found later in the paper.

2.3.1 The Schumpeterian Growth Model.

The Schumpeterian growth model, first put forward by Aghion and Howitt (1992) and later expanded on in Howitt and Aghion (1998), is a model of endogenous growth which argues that growth happens through innovation, capital accumulation, and creative destruction. Creative destruction is the process by which the market forces unproductive firms out and makes way for new and more productive firms as they innovate and develop new goods or means of production. This idea that innovation happens at the cost of the destruction of firms was developed in the 40s by Joseph Schumpeter, hence, *the Schumpeterian growth model*. A benefit of looking at the results through the lens of this model is that it is already specified at a sectoral level, making it easier to contextualise our results.

The model assumes a standard Cobb-Douglas production function:

$$Y_{it} = A_{it}^{1-\alpha} K_{it}^{\alpha} \tag{1}$$

where A_{it} is a parameter of productivity associated with the latest technology in a given sector i

at time t, and K_{it} denotes the flow of an intermediate good that is used in the production of Y_{it} for sector i, which can be thought of as the final output in terms of capital for sector i. It is assumed that the marginal product of K_{it} is equal to one, meaning that output is produced at a 1:1 ratio in relation to the intermediate good. Further, it is assumed that the most recent innovator is the sole producer and purveyor of the intermediate good in that sector. If an innovation is made, the supplier of intermediate goods is then replaced as $A_{it} < A'_{it}$ since innovations are productivity improving. This yields an interesting implication of the Schumpeterian growth model, which is that:

> *"faster growth generally implies a higher rate of firm turnover, because this process of creative destruction generates entry of new innovators and exit of former innovators[...] (Aghion and Howitt, 2008)"*

The idea that firms' turnover is an important factor of growth can also be found in Paul Romer's Product-Variety model, another endogenous growth theory of the innovation-driven kind where innovations are horizontal, unlike the Schumpeterian case where innovations are vertical. This has also found empirical support in studies by Fogel et al. (2008) and Comin and Mulani (2005), both of which have shown that the firm turnover rate is positively related to the likelihood of innovation happening and thus also the likelihood of growth. If something were to hinder this process of creative destruction, it might be the case that it can also hinder economic growth in the long run. In the context of this paper, the presence of zombies is suggested to have a negative spillover effect on healthy companies, as discussed in Caballero et al. (2008), hindering sectoral innovation and, thus, growth by hampering creative destruction.

2.4 Contribution

This paper contributes to the literature by focusing on the case of Sweden as well as accounting for the policy decisions made during the COVID-19 pandemic by widening the time period studied. By accounting for sectoral productivity and growth, the paper is novel in its granularity, given the geographical and temporal context. The model specified in section 3.5, based on previous research by Schivardi et al. (2022) and McGowan et al. (2017b) aims to offer more insights by controlling for the prevailing interest rate environment as an indicator of credit availability to zombies.

3 Data & Methodology

The following section, 3 Data & Methodology, is commenced by discussing the applied database, followed by an outline of the delimitation where the methodology in Kalemli-Ozcan et al. (2015) is adopted in hopes of optimising qualitative data processing. The section concludes by presenting and motivating the adopted approach—fixed effects regression—and model specification.

3.1 The Serrano database

In this paper, the Serrano database by Bisnode is utilised (The Swedish House of Finance, 2023). The database consists of financial statement data on the company level from the Swedish Companies Registration Office (Bolagsverket), bankruptcy data from the Swedish Companies Registration Office, and general company data from Statistics Sweden (SCB) over the time period 1998-2021 ($N = 14,449,502$ across $1,485,176$ unique organizations).

The Serrano database is a controlled environment with a quality-assured data history created for statisticians' needs and contexts. The database is built with the mindset to be able to transform and modify the underlying register data into comparable calendar year values. The database tackles problems such as broken accounting periods, omissions and gaps in reported financial statements, and rules determining whether the company is active. The database is used in the paper as it consists of relevant data when pursuing an analysis of zombies in Sweden. The database is convenient as it consists of only one data entry per year for each firm, resulting in an agreeable data set for one to modify and apply. Specifically, the data is sorted by panel data on legal entities' corporate ID numbers and SNI07 industry codes, specifying companies' branch sectors and whether it is a financial company or not. Further, the data set consists of time-series data with yearly granularity, with each respective source's contents being statements as of December 31 of each respective year. The following annual financial statements are extracted from the database and utilised in the paper:

- Total assets
- Firm salaries
- Capital expenditures (CAPEX)
- Net sales
- Cash & Bank balance
- Profits and losses (EBIT)

- Interest expenses
- Company registration dates

where the first five—Total assets, Firm salaries, Capital expenditures (CAPEX), Net sales, and Cash & Bank balance—reflect the dependent variables and the last three—EBIT, interest expenses, and company registration dates—are utilised to label companies as zombies according to the definition provided by OECD (2018). This choice of dependent variables reflects previous research and theory about zombie effects on healthy companies. Firm figures on total assets, net sales, and cash & bank balances are extracted from the Serrano database to reflect general financial key measures. Total assets and net sales are regressands utilised to measure performance in Cella (2020) and Schivardi et al. (2020). The company reports about CAPEX and firm salaries are extracted as McGowan et al. (2017a) suggests that capital allocated to zombies leads to a crowding-out effect in healthy companies in terms of investment and employment[2]. The latter two are, therefore, vital when investigating any presence of zombie crowding-out effects on nonzombies.

As the data set spans more than 20 years of financial data, a control variable is introduced to capture time-specific effects closely related to market movements that might hold explanatory power to trends in the dependent variable. The Stockholm Interbank Offered Rate ($STIBOR$) is included as a control variable, a commonly utilised reference rate for financial contracts denominated in SEK with variable interest rates. It is applied in various instruments, including bonds, loans, and most types of interest and foreign exchange derivatives. Including the control variable, $STIBOR$ aims to consider fluctuations in interest rate environments that could impact the likelihood of a zombie's survival. Specifically, in a low-interest environment, the probability of a zombie surviving is expected to be higher, while in a high-interest environment, the likelihood of survival is anticipated to be lower[3]. The data is gathered from the Swedish Riksbank database (Riksbank, 2023).

3.2 Delimitation

Since the Serrano database consists of financial statements and company data not used in the paper, a delimitation is necessary to maintain a robust analysis and consistent results. As previously mentioned, the delimitation process of the Serrano database is an adopted approach of Kalemli-Ozcan et al. (2015). The paper's goal by Kalemli-Ozcan et al. (2015) is to construct a guideline on how to construct nationally representative firm-level longitude data using financial statements from European countries. Even though the authors apply Orbis data, the methodology in the paper

[2]As a typical strategy when competing for employees is salary adjustments.

[3]Note, $STIBOR$ is an interbank rate, and companies do not finance themselves to these rates. The control merely controls for changes in the interest rate environment where financial organizations provide loans to borrowers.

ensures data quality and consistency when utilising the Serrano database. The data cleaning process is the following:

- First, duplicates with the same corporate ID and year are dropped. The first observation per duplicate in the Serrano database represents the primary industry. Hence, the leading ID number is saved and excludes the other observations if the company has reported being active in multiple industries.
- Second, non-financial companies, such as non-profit associations and unemployment benefit funds, are dropped from the data set as these organizations do not represent the relationship the paper aims to investigate. For instance, organizations classified as, e.g., Church of Sweden entities could likely be defined as zombies according to the definition by OECD (2018). The data set now consists entirely of limited liabilities (Aktiebolag) to observe more reliable results.
- Third, annual company observations that display missing values for all relevant regressands are excluded as they will otherwise represent a nonzombie group and thus skew the regression results. This limitation significantly decreases the number of observations.
- Last, several companies in the Serrano database reported null values for significant explanatory variables, such as net sales and personnel expenses, over the entire lifespan. Although having no personnel expenses and sales might be consistent data for a young company's first couple of years, it is argued that data of older companies displaying zero net sales is likely because the data is missing. Hence, such fiscal-company year data is excluded.

3.3 Descriptive Statistics

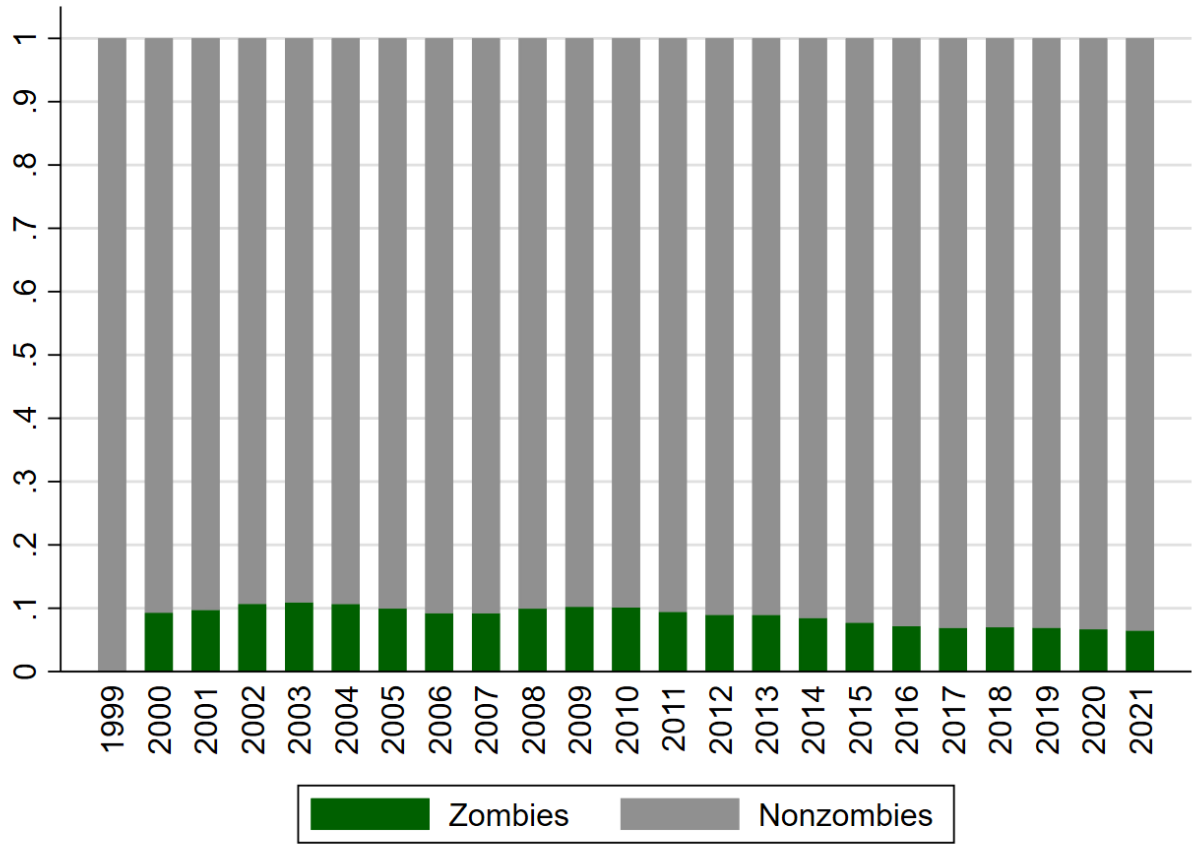
After applying the delimitation, the data set consists of $6,763,878$ observations of firm/year data stretching from 1999 to 2021 across eleven different industrial sectors (see Table 3 in Appendix). The joint number of observations per sector and year is sufficient for regression analysis for almost all sectors. The observations per branch sector and year are collected and presented below in Table 1.

Table 1: Observations per year and branch sector in Serrano data after applying limitations. For branch code specifications, see Table 3 in the Appendix.

Year	Branch sector													
	10	15	20	22	25	30	35	40	45	50	60	98	99	Total
1999	1842	3728	24201	20433	45690	8911	9119	20130	8330	3301	50878	7489	2141	206193
2000	1826	3787	24285	20723	46150	8956	9566	21084	9147	3464	52612	7707	2087	211394
2001	1826	3860	24667	21382	46907	9003	10109	21877	10121	3685	55283	7980	1949	218649
2002	1854	3858	24560	21798	47109	8911	10535	22454	10401	3700	56082	8054	1533	220849
2003	1754	3939	24592	22127	47191	8817	10963	22781	10859	3750	56692	8215	1057	222737
2004	1779	3929	24576	22369	47731	8827	11290	23160	10899	3810	57572	8495	884	225321
2005	1796	4021	24540	23028	48828	9009	11645	24141	11161	3867	59033	8627	734	230430
2006	1868	4016	24392	24088	49692	9074	11935	26078	11649	3952	59772	8906	724	236146
2007	2037	4073	23440	25307	50256	8874	12362	27446	11713	4285	62783	9340	797	242713
2008	2123	4187	23525	26838	51139	8972	13126	29336	12347	4464	65820	9620	874	252371
2009	2245	4266	23308	28049	51535	8970	13971	30550	12792	4626	68589	9892	796	259589
2010	2316	4313	23027	29037	52309	9096	14656	31950	13102	4694	70684	10438	794	266416
2011	2453	4486	23274	31703	54809	9376	16008	34294	14132	5010	75753	10551	863	282712
2012	2614	4651	23467	34783	57682	9751	17359	36015	15387	5460	81527	11250	903	300849
2013	2747	4754	23449	36878	59851	10063	18532	37490	16268	5767	86302	11852	1000	314953
2014	2829	4831	23407	38887	61960	10426	19791	39127	17048	6126	91140	12444	1055	329071
2015	2883	4883	23332	41266	64330	10834	21300	41360	17965	6478	96288	13110	1089	345118
2016	2871	4864	23215	43654	66479	10946	23080	43963	19000	6700	100869	13775	1148	360564
2017	2910	4931	23170	46100	68612	10851	24824	46862	20228	7002	106103	14420	1217	377230
2018	2932	4982	23182	48310	70449	11028	26180	49305	21669	7262	111014	15067	1381	392761
2019	2985	5037	23093	50296	71966	11249	27252	51332	23283	7637	115882	15799	1397	407208
2020	3000	5108	22940	52371	73808	11360	27960	53739	24604	7896	120207	16478	1559	421030
2021	2998	5239	22951	55419	76753	11724	28929	56219	25905	8385	125819	17450	1783	439574
Total	54488	101743	544593	764846	1311236	225028	390492	790693	348010	121321	1826704	256959	27765	6763878

In Figure 3, the annual fraction of zombies is compared to that of healthy companies in the Serrano data set. The earliest observation in the Serrano data set is in 1998, implying that the earliest time a company can be labelled as a zombie was in 2000. As previously mentioned, according to the definition, a company has to be at least ten years old with an ICR below one for three consecutive years to be labelled a zombie (OECD, 2018). Hence, one cannot label companies as zombies before 2000. Further, as shown in Figure 3, the share of zombies has remained relatively constant from 1999 to 2021, hovering around $5-10\%$. The presence of zombies remains throughout the data set. Although, the share of zombies has somewhat decreased since 2010.

Figure 3: Share of firms labelled as zombies in the delimited Serrano data set, stretching from 1999 to 2021.



Note. Zombies are defined and labelled according to the definition by OECD (2018), and the visualisation represents the share of zombies after applying the delimitation to the Serrano data set (The Swedish House of Finance, 2023).

3.4 Biases introduced when defining zombies

Although the economic rationale behind the existence of zombies is clear-cut, pinpointing them in data poses a significant challenge. Some studies aim to establish a direct correlation between weak firms and weak banks, while others rely on ratios derived solely from accounting data to classify zombies. In the latter, any distortion that affects the input variables can generate bias by incorrectly identifying the proportion of zombies. The magnitude of the bias hinges on several factors. Perhaps the most critical factor is the definition of the data employed, but others might include data quality and the sectors and firms under analysis.

Nonetheless, numerous approaches exist for identifying zombies, and cash flow analysis could be one of them. Examining the stated cash flows of individual firms can potentially assist in categoris-

ing them as zombies. For instance, if a company has a negative cash flow from financing activities for several consecutive years, it may indicate that it is a zombie firm that survives solely due to financial assistance from its owners. However, identifying zombies through cash flow analysis also presents challenges. For example, some years may be more investment heavy than others, which could temporarily impact cash flows. Therefore, it is necessary to consider each company's unique characteristics and scrutinise its cash flows over multiple years before reaching a definitive conclusion. Further, cash flow analyses on the individual firm level are pretty demanding as it is typically not collected in a standardised manner.

Identifying zombies using the definition proposed by OECD (2018), which calculates a firm's EBIT-to-interest paid ratio based on accounting data, is prevalent in the literature. McGowan et al. (2017a) adopts the definition by OECD (2018), as it is easily applicable. However, it is crucial to acknowledge that this approach may introduce some bias. In Sweden, for instance, companies can reduce their taxable income for multiple consecutive years, which increases their likelihood of being classified as zombies. Since firms self-reported accounting data to authorities, the potential for bias in zombie classification cannot be dismissed. However, for convenience, the condition of a company being labelled a zombie by OECD (2018) is applied in this paper.

3.5 Modelling Framework

3.5.1 Econometrics

When utilising panel data, a common starting point is to treat all observations as independent and employ pooled ordinary least squares:

$$Y_{it} = \beta_0 + X_{it}\beta_1 + \varepsilon_{it} \quad \text{where} \quad i = 1,\ldots,N \quad \text{and} \quad t = 1,\ldots,T \tag{2}$$

Pooled OLS could be a beneficial approach when selecting a different sample for each period (e.g., month or year) of the panel data. Yet, one possible downfall of the pooled OLS model in equation (2) has to do with a violation of the zero conditional mean assumption (Angrist and Pischke, 2008);(Woolridge, Jeffrey, 2010). The condition states that:

$$E[\varepsilon_{it}|X_{i1},\ldots,X_{iT}] = 0 \implies Cov(\varepsilon_{it}) = 0$$

meaning, the conditional expected value of the error term, ε_{it} has to be independent of the regressor $X_{i1}\ldots X_{iT}$ in equation (2) to achieve unbiased and consistent estimates of parameters. Unfortunately, fulfilling the condition might be difficult in this framework. For example, the condition of the assumption is considered violated when an omitted variable exhibits correlation with the in-

cluded regressors. Hence, the pooled OLS regression model in equation (2) might be plagued by omitted variable bias (OVB), meaning, excluded covariates may affect estimates.

Consider a basic linear panel data model to ensure the accuracy of causal inference. In this model, the variable of interest, the growth factor (Y_{it}), is determined by a set of exogenous regressors represented as a vector.

$$Y_{it} = \beta_0 + X_{it}\beta_1 + \nu_{it} \quad \text{where} \quad \nu_{it} = \varepsilon_{it} + \eta_i \tag{3}$$

and ν_i now consists of a time-invariant error term (η_i) that is constant over time and another which one allows to be time-variant (ε_{it}). Hence, the error term, η_i, is an individual-specific error that does not change over time. Regarding this paper, η_i could reflect business characteristics that do not necessarily change over time, such as business acumen and cultural factors (Date, Sachin, 2023). By employing a two-part error term as in equation (3), it is possible to leverage the benefits of panel data in conjunction with the bias elimination property of a fixed-effect model by capitalising on the availability of repeated observations across different periods, effectively eradicating within-group discrepancies (Angrist and Pischke, 2008). To illustrate the effect, equation (3) is rewritten in terms of means as:

$$\bar{Y}_i = \beta_0 + \bar{X}_i\beta_1 + \bar{\varepsilon}_i + \bar{\eta}_i \tag{4}$$

and subtracting equation (3) from equation (4), one gets the deviation from the mean:

$$\bar{Y}_{it} - Y_{it} = (\beta_0 + X_{it}\beta_1 + \varepsilon_{it} + \eta_i) - (\beta_0 + X_{it}\beta_1 + \nu_{it}) \tag{5}$$

$$= (X_{it} - \bar{X}_i)\beta_1 + \varepsilon_{it} - \bar{\varepsilon}_i \tag{6}$$

The OLS method is then employed to estimate β_1, where the within estimator implicitly controls for omitted individual-specific variables. As a result, this estimation approach partially eliminates the issue of OVB. Further, given the research question, it is more logical, compared to the pooled OLS model, to employ a fixed effects model to observe the same sample of firms over a set period.

Hence, a fixed effects regression model is employed in the paper to account for the impact of inherent attributes of individuals within different groups in the Serrano panel data set. Examples of these intrinsic characteristics applicable to this paper might be business acumen and cultural factors within different Swedish branch sectors. Such features are not observable or measurable but are crucial to estimate, as neglecting them could result in a regression model that is sub-optimally trained. The Fixed Effects model is specifically designed to tackle this issue.

3.5.2 Model

In previous papers, the baseline model employed when scrutinising the effect of zombies on healthy firms is a fixed effects model. The model is usually defined as (Schivardi et al., 2020, p.577):

$$X_{ist} = \beta_0 + \beta_1 D_{ist}^{NZ} + \beta_2 Z_{st} + \beta_3 D_{ist}^{NZ} \cdot Z_{st} + D_t + S_s + \varepsilon_{ist} \tag{7}$$

where X is the dependent variable, describing a growth measure of company i in the branch sector s at time point t. Further, D_{ist}^{NZ} is a dummy variable for nonzombies ($= 0$ if labelled zombie)[4]. Further, Z_{st} is a variable measuring the presence of zombies in sector j (where in McGowan et al. (2017a), Z_{st} describes the share of zombies in a sector), D_t and S_s are time and branch sector dummy variables and ε_{st} is the error term. Hence, β_1 captures the average impact of nonzombies within a specific branch sector during a particular year on nonzombie performance. The dummy takes a value of one if the firm is labelled as a nonzombie, meaning a significant positive value implies that healthy companies perform, on average, relatively better than zombies in terms of the growth regressands. β_2 represents a differential effect of nonzombies, i.e., the coefficient measures the average impact of the proportion of zombies within a specific sector during a particular year, on nonzombies, by capturing a deviation effect on zombies.

The baseline model was later developed in Schivardi et al. (2020) to account for demand shocks affecting nonzombies and zombies differently. Such a shock could increase the number of zombies in s while negatively affecting the performance measure in a healthy firm in the same sector. The vector of covariates D_t in equation (7) controls for factors that differ between zombies and healthy firms, causing time trends in outcomes. In this paper, there is a worry that the changing interest rate environment in Sweden may have changed time-varying characteristics for Swedish firms, making, e.g., CAPEX more suitable during different periods. Further, the survivability of zombies has likely also altered over the years. A time-specific control variable is introduced to account for time-varying effects and increase precision (reduce standard errors), namely, the three-month *STIBOR* in Sweden from 1999 to 2021. The purpose of including the control in the analysis is to account for variations in the interest environment, which can influence the survival prospects of zombies. In statistical terms, explanatory and control variables are indistinguishable. Control variables are included to rule out alternative explanations while testing hypotheses with explanatory variables. The motivation behind including and interpreting control variables is based on theory rather than statistical grounds. If control variables do not show statistical significance or do not affect the estimates of explanatory variables, one may remove them to make relationships more simple to explain, but reporting this decision is essential (Cinelli et al., 2020).

[4]In this paper, the dummy D_{ist}^{NZ} takes value 1 if the interest coverage ratio $\left[\frac{EBIT}{Interest\ Expenses}\right]$ is less than one for three consecutive years, in a 10-year-old (or older) company

The condition for control variables is exogeneity which is almost assured for the covariate $STIBOR$, meaning the independent covariate D_t is not dependent on the dependent growth regressand X_{ist} (Angrist and Pischke, 2008). Instead, the expectation is that the dependent growth variables depend on $STIBOR$ as different interest environments determine, e.g., firms' CAPEX. The inclusion of control variables at the individual level (Z_{ist}) is optional to obtain unbiased estimates, but it is typically not a necessity. However, it might help to reduce standard errors and increase precision when estimating the relationship (Angrist and Pischke, 2008).

To account for heterogeneity across sectors, the baseline model is run by controlling for each sector specified in the Serrano database (see Table 3 for branch-sector detail). With these additions to the model, the adopted model applied in this paper is the following:

$$\Delta X_{ist} = \beta_0 + \beta_1 Z_{ist}^{NZ} + \beta_3 Z_{ist}^{NZ} \cdot ShareZ_{st} + STIBOR_t + \varepsilon_{ist} \tag{8}$$

In equation (8), one estimates the relative effect on nonzombies growth measures, relative to zombies, in the regressor β_3. Worthy of mention is that as the dependent variable measures the rate of growth inputs, such as net sales and salaries, the coefficient β_3 provides insights into two crucial draw-backs of zombies. One is that β_3 captures the fact that zombies are allowed access to financing, crowding out nonzombies, and another is that zombies are granted credit despite their inability to repay it organically; they effectively receive a type of financial support from their creditors. This implicit subsidy allows zombies to compete with their competitors, harming both firms in input and product markets. In other words, the subsidy affects sales and results in a reduction of resources for growth. These two competition channels reinforce one another, decelerating input growth (Schivardi et al., 2020). It is expected that the coefficient β_3 takes on a significant negative value, implying a negative spillover effect from zombies to healthy firms. In theory, the higher the share of zombies in a sector is, the greater the negative spillover. Granted, this assessment requires that β_3 correctly identifies the negative spillovers.

Using the Serrano data set, the regression in equation (8) is run across the period 1999-2021 together with robust standard errors clustered at the branch sector level. Employing this multivariate approach allows for the control of time-specific effects of firms, given their infrequent changes in the industry. In addition, this approach reduces the risk of omitted variable biases at the sector-year level by incorporating year specifications and sector dummies. These dummies control for firms' time-invariant characteristics—sector dummies—and the influence of aggregate trends—year dummies. Finally, the model is run to test the following hypotheses:

- H_0*: The share of zombies does not affect healthy firms' growth measures.*
- H_1*: The share of zombies affects healthy firms' growth measures.*

4 Empirical Analysis

In this section, 4 Empirical Analysis, the regression in equation (8) is run across the period 1999-2021 using the delimited Serrano data set and the output is presented in Table 2 in 4.1 Results[5]. The regression output is then analysed and interpreted according to macroeconomic theory and utilising short-term and long-term growth model aspects.

4.1 Regression Results & Analysis

Table 2: Regression results. Effect of sectoral zombie proportion on healthy companies' growth response variable.

	Total Assets	Net Sales	Cash & Bank	CAPEX	Salaries
Z^{NZ}	0.0236***	0.237***	0.0414***	0.00969**	0.0238***
	(0.000)	(0.000)	(0.000)	(0.002)	(0.000)
STIBOR	0.00307***	0.165***	0.00112***	0.0157***	0.00877***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$Z^{NZ} \cdot ShareZ$	-0.00660**	-0.0278	-0.00920	0.00897	-0.00561
	(0.003)	(0.467)	(0.271)	(0.842)	(0.272)
β_0	-0.0311***	-2.043***	-0.0688***	-0.0604	-0.0289***
N	5,870,423	3,638,486	6,172,388	67,900	4,318,440
R^2	0.004	0.024	0.000	0.009	0.004

Note. The results of estimating the regression specified in equation 8 on the delimited Serrano sample from 1999-2021 are presented in Table 2. The dependent variable, ΔX_{ist}, captures a firm's growth performance. The log changes in (1) total assets, (2) net sales, (3) cash and bank balance, (4) CAPEX investments, and (5) salaries are represented as regressands in columns (1) to (5), respectively. Each regression includes sector and year fixed effects and is conducted with sector-clustered standard errors. P-values are indicated in parentheses and * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Running the regression, specified in equation (8), yields a statistically significant and positive coefficient for β_1 (Z^{NZ}) across all regressands at the 99 per cent confidence interval, except for the fourth dependent variable (log change in CAPEX) where the regressor displays a significance at the 95 per cent confidence interval. The result for the coefficient β_1 is not entirely surprising as, discussed in section 3.5, a positive significance implies that healthy firms, on average, perform relatively better than zombies.

[5]Note. For the complete regression result, see 7. Appendix.

Regarding the control variable *STIBOR*, one can observe that the covariate displays a significance at the 99 per cent interval for all regressions in Table 2. Since *STIBOR* is only a control, this result is considered inconsequential for the research problem. Still, it indicates that it is a reasonable control in that it strengthens the internal validity of the regression, i.e., the fit likely improved by reducing standard errors (Cinelli et al., 2020).

Moreover, the regressions show a negative and statistically significant result for the coefficient β_3 ($N^{NZ} \cdot ShareNZ$) when running on the dependent variable representing log change in total assets (column (1) in Table 2). In other words, Table 2 suggests that the growth of total assets in healthy firms is, on average, negatively affected by zombies. Column (1) in Table 2 suggests that for a one per cent increase in the share of zombies, the average change in total assets in nonzombies decreases 0.0066%. Hence, the first regression rejects the null hypothesis that zombies do not affect nonzombies growth in total assets. However, all other regressions (column (2)-(5)) show an insignificant result for the estimates of β_3, which suggests that zombies' market presence might not have a significant effect on the ability of other firms to compete in terms of net sales, cash & bank balance, CAPEX, and firm salaries.

Shown in Table 7 in section 7 Appendix, the model likely benefits from labelling firms to their respective sector as some sectors exhibit a significant estimate. In other words, the implication is that the firms' growth measures in different sectors are affected differently by the presence of zombies. Whilst the model cannot conclusively make remarks about effects in specific sectors, one can conclude that there some sectors are asymmetrically sensitive to the presence of zombies.

Nonetheless, given the inconsistent results across regressions in Table 2, the interpretation might be that the nonzombies can suppress the hypothesised adverse effects of zombies. This conclusion will be further discussed in the upcoming section 4.2 Theoretical Interpretation.

4.2 Theoretical Interpretation

The regression output in Table 2 shows significant estimates of β_1. The coefficient reflects the average impact of healthy firms on healthy firms' performance relative to zombies. Since the output in Table 2 shows significant positive estimates of β_1, healthy firms perform relatively better than zombies in terms of the dependent growth variables. On average, the result is not surprising as, by definition, zombies are companies that are not organically profitable but rather reliant on subsidised credit or cash inflows from shareholders. However, the coefficient of interest in this paper is β_3, as it tells something about the effect of zombies on nonzombies performance.

Regarding β_3, as stated, the output in Table 2 shows statistical significance in the log change of total assets. The result in Table 2 column (1) is in line with what has previously been shown by Cella

(2020). One might argue in line with Schivardi et al. (2022), i.e., that the negative significance stems from a misallocation of capital in the sense that unhealthy firms receive credit where healthy companies do not. In other words, a zombie might be granted credit if one healthy company is denied credit. The consequence might be that funds that would have been invested in business growth are now utilised to partially address the debt burden of the zombie firm. This can be due to many factors:

- One potential explanation worth considering is the *too big to fail* notion Denny, Charlotte (2002). The argument implies that unhealthy firms might be more significant than some smaller healthy companies and receive credit based on being so large that simply extending credit might be beneficial for financial institutions. Either because they already hold a heavy position in the company in terms of shares or debt or because the company is too big to fail (Denny, Charlotte, 2002).
- Another possibility is the loosening of credit requirements during the COVID-19 pandemic, as argued earlier in section 2 Background. Reasoning in the lines of Ahearne and Shinada (2005), which states that irresponsible lending policies on the side of banks are to blame for the zombie phenomenon. During the pandemic, firms could apply for financial aid, which could have been misallocated due to poor policymaking by the Swedish government. Although empirical evidence from Sette et al. (2020) supports this claim, the authors find the misallocation effects to be negligible when weighed against the positive effects created for healthy companies. This idea can be backed by Figure 2 in section 2 Background. The graph shows an apparent decline in the unemployment ratio due to the policies enacted in response to the pandemic.

In fact, the result in this paper seems to be more aligned with the latter notion. As observed in Table 2, the share of zombies does not affect healthy firms' ability to compete in terms of project investments, reflected in the insignificance of β_3 when running on the dependent variable CAPEX (column (4)). Further, they do not affect companies' competitiveness in attracting employees, as seen in the insignificant estimate of β_3 when running on firm salaries (column (5)). Hence, zombies might not necessarily result in a significant drain on resources or hinder the growth prospects of healthy firms in Sweden. Therefore, the idea that zombies cause crowding-out effects on healthy firms is not supported by the findings in this paper (at least not in Sweden's case regarding CAPEX and firm salaries). The result contradicts the previous literature, primarily, McGowan et al. (2017a) and Caballero et al. (2008), the implications of which will be discussed in the following section.

Although the short-term effects of zombies are not observed in Table 2, some of the long-run consequences of zombies can be discussed. To do so, it is helpful to recall the model discussed in

section 2.3.1 The Schumpeterian Growth Model. Similarly to McGowan et al. (2017b) and Caballero et al. (2008), one can argue that the misallocation of capital hinders the process of creative destruction by enabling inefficient firms to stay in and hinders more innovative firms from entering. This stops the technological frontier from moving, also causing the overall productivity in a sector to remain stagnant for more prolonged periods, which may hinder long-term growth. At the same time, growth measured over the long term may be the same but made with more significant leaps between innovations (Aghion and Howitt, 2008). Regarding the discussion of a low-rate environment, one can argue that low rates, in the short and medium term, can affect the market in different directions. On the one hand, investment surges spurred by low rates increase the capital available to firms. Therefore, in the long run, it might become easier for newer firms to make technological innovations, driving long-term growth as argued by the model presented in section 2.3.1. In contrast, zombies also have the opportunity to obtain more capital and slow the turnover rate as they inflate wages and productivity requirements, as argued by McGowan et al. (2017a). In the context of the Schumpeterian growth model in section 2.3.1, this can be reflected by a smaller probability of making an innovation. However, as observed in Table 2, it is more likely that lowered-interest environments have led to increased technological innovations and, thus, improved growth in healthy firms, absolving the adverse effects of zombies.

Whilst finding significance in terms of total assets, the output in Table 2 does not show the significance for the other regressions. Hence, Table 2 might provide some intriguing insights about zombies' shadow on the Swedish market. Namely, even though zombies are characterised by inefficiency, their presence might not substantially impact the competitive abilities of other firms. Consequently, the overall influence of zombies on the Swedish economy is expected to be relatively contained. Such an explanation challenges conventional assumptions that the existence of zombies automatically translates into detrimental effects for healthy competitors. On the contrary, the result might indicate that the impact of zombies on the overall economy might be mitigated due to the competitive dynamics and resilience of healthy firms remaining largely unaffected.

While it is possible that zombies could negatively impact healthy companies' log growth in total assets, it seems unlikely that the nonzombies log growth in net sales and cash & bank balance remains unaffected. Due to the inconsistency in the regressions in Table 2, it seems more likely that healthy companies do an adequate job absorbing the adverse effects of zombie company presence. The inconsistency is expanded on the coming segment 5 Discussion.

5 Discussion

This segment reflects on the empirical analysis, draws conclusions, and provides insights that may contribute to the existing body of knowledge in the field. Through this comprehensive examination and synthesis of the research findings, we aim to shed light on the implications, significance, and potential applications of the study's results in theoretical contexts.

As concluded in section 4.2 Theoretical Interpretation, the interpretation of the regression output analysis is that zombies do not affect healthy companies' growth factors due to the competitiveness of the Swedish market. Although the output indicates that zombies impact nonzombies' relative growth in total assets, the inconsistency across regressions does not support this motion. Due to this competitiveness, the statement about the fraction of zombies' impact on nonzombies' long-term growth measures remains inconclusive. A possible drawback of this paper regards the application of the data set. An interesting approach could be to study sectoral-specific effects and focus on how different sectors are asymmetrically sensitive to the presence of zombies.

Further, some sectors might be more suitable for studying zombies. In the section 7 Appendix, we see that different sectors are affected differently. In our case, this is not very insightful beyond the fact that we can conclude that there are asymmetric effects at play. For example, capital-intensive industries may be more at risk of the impact of zombies since firms that are active in such industries are more reliant on capital inputs. Misallocations of said capital may significantly impact healthy firms' growth. Moreover, in specific sectors, it is possible that firms categorised as zombies may not deserve such a label due to industry-specific circumstances and conditions. For example, even though all companies within the employed data set are classified as limited liabilities (Aktiebolag), there might be outliers undeservedly labelled as zombies within the sector, e.g., Health & Education (see Table 3 in Appendix). In Sweden, Health & Education is a sector largely reliant on Governmental intervention and other subsidised credits. Whilst there do exist limited liabilities within this sector that are for-profit, many of these are also subsidised and receive various forms of support. Perhaps our regression output would differ if such companies and sectors were excluded. Nonetheless, in future research, the validity of the results could be improved by incorporating other criteria when labelling zombies, depending on branch sectors.

Regarding the choice of the control variable, *STIBOR* is interpreted to be successful in accounting for varying interest rate environments. However, whilst *STIBOR* serves the purpose of being a control variable well, in the context of increasing model precision, one could consider using a corporate rate index instead. The reasoning is that firms do not loan at the *STIBOR* rate, which does not capture the actual interest rate costs. Though, the purpose of the control variable is still argued to be fulfilled. Nonetheless, an essential addition to the regression could be to include more

control variables.

- First, the argument for lagging the control variable *STIBOR* could be reasonable as firms typically do not act on interest rate changes in the same period. However, such an adjustment is believed to require higher granularity of the data since firms might react to month-to-month (or quarter-to-quarter) changes in lending rates. For example, lowered lending rates during the first quarter might accomplish a desired effect in a later quarter. Currently, the data is annualised financial statements, and therefore the control variable is calculated as a yearly average of the three-month *STIBOR*. Although, such data is rare and not publicly available at the same scale as the data in this paper.
- Second, including more control variables could reduce variance in the standard errors and thus increase precision. Incorporating control variables that can identify the effects of specific shocks would likely improve the regression fit. For example, an illustration of the exchange rate between SEK and EUR (or USD) can indicate whether a country-specific shock potentially weakens the domestic currency. Other control measures could be incorporated to account for, e.g., inflationary pressure, expansionary fiscal policies, and consumer confidence using various indices.
- Last, a possible drawback of the utilised model in this paper is the lack of time-varying sector-specific control variables. The idea is that such control variables change over time and might differ across sectors. Time-varying sector-specific control variables might be able to increase precision by capturing possible shocks, having contrasting effects across different sectors. For example, one could include price elasticities for input factors to production in their respective sectors to capture the time-varying sector-specific shocks. This could aid in the process of isolating the effects of zombie presence. The idea is that when capturing deviations in growth attributed to demand shocks, one can separate the impact of the share of zombies on nonzombies development during these periods. Such price elasticities have likely fluctuated, primarily in goods markets, over the last decade whilst perhaps having a minor effect in other markets.

In closing remarks, it is interesting to analyse the long-lasting effects of zombies as any inference might advise future policymakers. Potentially due to low rates, as previously argued, the benefits that firms draw from low rates outweigh the negative externalities it produces regarding zombie survival. Over the long term, Sweden's growth rate has persisted. It is, therefore, inconclusive whether the presence of zombies affects long-term growth in Sweden. Nonetheless, the development is worth investigating in future papers.

6 Conclusion

This paper investigates the impact of zombies on the growth of healthy companies in the Swedish market. By employing fixed-effects regression analysis and interpreting a comprehensive data set, the study provides insights into the dynamics between zombies and nonzombies and their effects on growth measures. The study reasons that misallocations of capital can have repercussions on the growth of healthy firms through a crowding-out effect where healthy firms struggle to grow due to a scarcity of capital in the presence of zombies. However, the findings indicate that zombies have limited effects on the growth of healthy companies in Sweden during the time period studied. Contrary to previous literature, suggesting that zombies hinder the growth of nonzombies, the regression analysis did not consistently support this notion. The results might be explained by the competitive nature of the Swedish market, which might play a significant role in mitigating the negative impact of zombies on nonzombies' relative growth in total assets. This suggests that healthy companies in Sweden are able to absorb the adverse effects of zombie company presence and maintain their growth trajectories. Further, the results in 7 Appendix show that the presence of zombies may asymmetrically influence different sectors. Capital-intensive industries, which rely heavily on capital inputs, appear to be more susceptible to the effects of zombies. The paper provides insights for policymakers to understand the implications of zombie company survival and the trade-offs involved in addressing this phenomenon. While low-interest rates may provide benefits to firms, they can also generate negative externalities associated with the persistence of zombies. It is essential to exercise caution in interpreting these findings, as certain branch sectors may not be ideal for studying the impact of zombies due to specific industry circumstances that could lead to the misclassification of zombies.

The paper acknowledges that further research is needed to fully understand the long-term implications of zombies adverse effects. To enhance the precision of the results and gain a deeper understanding of the effects of zombie presence on nonzombie growth measures, the study suggests incorporating additional controls, particularly time-varying sector-specific ones. These covariates can capture shocks that vary over time and differ across sectors, thereby providing more accurate insights into the relationship between zombies and healthy firms. The paper also suggests refining the criteria for labelling zombies based on branch sectors and exploring sector-specific effects in future research. A more granular analysis that considers different sectors and incorporates additional controls can provide further insights into the relationship between zombie and nonzombies.

In conclusion, this paper contributes to the ongoing discourse on the impact of zombies on healthy firms. While the specific findings may be context-specific to the Swedish market, the insights and methodological approach can be valuable for researchers and policymakers in other countries facing similar challenges.

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7 Appendix

Table 3: Grouping of sectors according to SNI07 type.

Firm Code	Sector
10	Energy & Environment
15	Materials
20	Industrial Goods
22	Construction Industry
25	Shopping Goods
30	Convenience Goods
35	Health & Education
40	Finance & Real Estate
45	IT & Electronics
50	Telecom & Media
60	Corporate Services
98	Other
99	SNI07 Missing

Table 4: Full regression results. Effect of sectoral zombie proportion on healthy companies' growth response variable.

	Total Assets	Net Sales	Cash & Bank	CAPEX	Salaries
Z^{NZ}	0.0236***	0.237***	0.0414***	0.00969**	0.0238***
	(0.000)	(0.000)	(0.000)	(0.002)	(0.000)
STIBOR	0.00307***	0.165***	0.00112***	0.0157***	0.00877***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$Z^{NZ} \cdot ShareZ$	-0.00660**	-0.0278	-0.00920	0.00897	-0.00561
	(0.003)	(0.467)	(0.271)	(0.842)	(0.272)
Branch Sector					
10	0	0	0	0	0
15	0.00302	0.150**	-0.00316	-0.0471	-0.000115
20	0.000595	0.0453	-0.00629	0.0105	0.000814
22	0.0108***	0.134**	-0.0115	0.00765	-0.000154
25	-0.00858**	-0.0112	-0.0109	0.00530	-0.00229
30	-0.0117**	-0.148**	-0.0124	0.0349	-0.00188
35	0.00404	-0.0616	-0.000203	0.00411	-0.00611
40	0.000739	0.0730	-0.0112	0.0109	-0.0126*
45	-0.00138	0.115*	-0.0105	0.0141	-0.00559
50	-0.00365	0.0779	-0.0218*	0.00953	-0.00374
60	0.00604*	0.154***	-0.00808	0.0267	0.00202
98	-0.00511	0.230***	-0.0164	0.0111	-0.00881
99	-0.00729	1.457***	0.0273	0.396*	-0.0458*
β_0	-0.0311***	-2.043***	-0.0688***	-0.0604	-0.0289***
N	5,870,423	3,638,486	6,172,388	67,900	4,318,440
R^2	0.004	0.024	0.000	0.009	0.004

p-values in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$