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**Impact of zombie firms on the weak  
post-crisis growth of the Slovak Republic**

*Bachelor thesis*

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## **Abstract**

According to the Convergence Analysis of Slovakia from 2017, the current subject of Slovak economic growth and convergence is the slow growth in productivity as relative productivity of Slovakia to the EU average was decreasing in the period from 2014 to 2017. Moreover, it shows that Slovakia is one of the countries with low efficiency of using labour and capital, which means that there is an occurrence of misallocation of resources. According to recent literature, a significant role in this downturn might be the occurrence of zombie firms, which are old companies that do not have sufficient profitability to cover their interest expenses for a longer period. This thesis examines zombie firms and their significance in stifling productivity performance. Using a rich firm-level dataset for Slovakia, we research the determinants of zombie companies in Slovakia. Controlling for cyclical effects, this thesis reveals that zombie enterprises over the period from 2003 to 2013 were significantly less productive compared to their healthy competitors. In addition, we find out that occurrence of zombie companies curbs the growth of healthy companies and has a negative impact on the economic output overall. These results are raising several issues for public policy as it needs to mitigate this cause of performance weakness.

## **Keywords**

zombie firms, financial crisis, productivity growth, resource allocation, Slovakia

## **Abstrakt**

Podľa Konvergenčnej analýzy Slovenska z roku 2017 je súčasným predmetom slovenského hospodárskeho rastu a konvergenzie pomalý rast produktivity, keďže relatívna produktivita Slovenska k priemeru EÚ klesala v období od roku 2014 do roku 2017. Okrem toho, Slovensko je jednou z krajín s nízkou efektívnosťou využívania zamestnancov a kapitálu, čo znamená, že dochádza k nesprávnemu prerozdeleniu výrobných zdrojov. Významnou úlohou v tomto poklese podľa súčasnej literatúry môže byť výskyt zombie firiem, definovaných ako staré firmy, ktoré nemajú dostatočnú ziskovosť na pokrytie svojich úrokových výdavkov počas dlhšieho obdobia. Táto práca skúma zombie firmy a ich význam pri poklese produktivity. Vďaka bohatému dátovému súboru údajov o podnikoch na Slovensku skúmame determinanty zombie firiem na Slovensku. Pri kontrolovaní cyklických efektov, naša analýza ukazuje, že zombie firmy v rámci odvetví v období rokov 2003-2013 boli podstatne menej produktívne ako ich zdravé náprotivky. Okrem toho, výskyt zombie firiem brzdí rast zdravých spoločností a má celkovo negatívny vplyv na ekonomickú produkciu. Tieto výsledky poukazujú na úlohu verejnej politiky pri riešení výskytu zombie firiem, pretože je potrebné zmierniť túto príčinu slabého rastu produktivity.

## **Kľúčové slová**

zombie firmy, rast produktivity, prerozdelenie zdrojov, finančná kríza, Slovensko

**Range of thesis:** 81 402 symbols

## **Declaration of Authorship**

1. The author hereby declares that he compiled this thesis independently, using only the listed resources and literature.
2. The author hereby declares that all the sources and literature used have been properly cited.
3. The author hereby declares that the thesis has not been used to obtain a different or the same degree.

Prague, 31.7.2019

Martin Bosák .....

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# Bachelor's Thesis Proposal

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## Research question and motivation

The global crisis at the beginning of the 21st century had a major impact on changes in politics and the economy. The current topic of economic growth and convergence of the Slovak Republic is the weaker productivity growth, which is the result of several factors. One of them is a huge difference in productivity development among enterprises. The post-crisis development also shows that the gaps in labour productivity and total factor productivity in Slovakia are increasing. Therefore, the primary aim of this bachelor thesis will be to analyse weak post-crisis productivity growth in the Slovak Republic in a complex manner and identify impact of the zombie firms, companies that continue to operate, although they have problems repaying their commitments or are close to bankruptcy, on this growth.

## Contribution

Zombie companies employ people, who can be more productive in more effective enterprises, what means that they would create higher added value. From this point of view, the possible redistribution of the workforce from zombie firms can be perceived as one of the possibilities of increasing the growth of total state productivity. The selected time period and the use of economic analysis tools will allow for in-depth analysis, which means that it will be possible to find out how the identified zombie firms are influencing the productivity growth.

## Methodology

A statistical overview of the economic situation of selected zombie firms will be constructed based on the primary sources and the secondary sources. The study will use the correlation analysis, probit and logit estimates based on data from the post-crisis period. Subsequently, the statistical results will be analysed to assess the impact of individual companies on the economic situation in Slovakia.

## **Outline**

Abstract

1. Introduction
2. Overview of the literature
3. Theoretical part
4. Data and Methodology
5. Interpretation of results
6. Conclusion

Bibliography, appendix, tables and charts

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## **Introduction**

A gradual decrease in productivity in Europe over the last decade has forced us to target on productivity growth barriers. According to the Convergence Analysis of National Bank of Slovakia (NBS) from 2017, Slovakia is one of the countries with large shortcomings in the area of efficient and productive use of labour and capital and it is one of the reasons why Slovakia has been stagnating in its convergence of productivity performance in recent years.

The current issue in Slovak economic growth and convergence with the EU countries is the slow growth in productivity. The relative productivity of Slovakia was decreasing since 2014 (84% of the EU average) and it has decreased to 81% of the EU average in 2017 (NBS, 2018). One of the factors causing this decline is the large difference in productivity developments between enterprises, which are largely related to uneven and inefficient distribution of production resources. The post growth development of Slovakia also shows that the differences in labour productivity and total factor productivity in Slovakia are not diminishing even though their removal could bring higher productivity growth, which in the last period grew more slowly than wages (NBS, 2018).

Convergence Analysis of NBS (2017) shows that the dispersion of the productivity of Slovak enterprises belongs to one of the most unequal ones among EU countries. The number of highly productive enterprises is small in relative terms and companies with low productivity dominate on the market. In this context, it was found that there is a room for productivity improvement in Slovakia through a better within industries redistribution of factors of production, especially labour, to the benefit of more productive enterprises. This potential improvement can be support with the fact that slow productivity growth is to a large extent linked to inefficient distribution of production resources. IMF estimates from 2017 show that if total factor productivity evolved at the same pace as before the crisis, the GDP of the developed countries would now be 5% higher in real terms.

Research on the within-company level has recently shown a general slowdown in OECD economies growth with widespread performance variation in enterprises (Andrews et al., 2016), along with increasing misallocation of production resources (Gopinath et al., 2017). One of the sources of this decline is that there is a number of

companies, so-called zombie companies, generally defined as old firms that are not able to cover interest costs with their earnings over an extended period, persisting on the market, which would normally have to cease their business on the competitive market. However, they are rarely liquidated in practice. This can result in a weakening of average productivity as a higher capital sunk consumed by zombie companies is connected with a lower opportunity of healthy firms to obtain available capital (Foster et al., 2016). Studies also claim that when weakly performing businesses compete for the same pool of labour and capital resources as more profitable companies, the growth conditions of successful firms are diminished (Caballero et al., 2008). Consequently, it brings us to the hypotheses of this thesis: What are the main attributes of zombie enterprises in Slovakia? Do zombie enterprises influence the productivity growth of healthy enterprises in Slovakia? What is the impact of zombie enterprises during a recession?

These companies are dragging down the economic growth, as the productivity of other firms is generally higher than their productivity and the resources sunk at those firms could be allocated more efficiently elsewhere. Accordingly, even a relatively low share of zombie companies can have distortionary effects for economic growth and productivity. In some of the researched countries, these problems are due to a weak structural policy, high bank tolerance, expansive monetary policy, or an impaired banking system in the form of ongoing crisis support (Adalet McGowan et al., 2017).

This thesis expands the findings of worldwide literature focusing on zombie firms. We use harmonized business-level data throughout Slovakia to investigate the extent of the zombie companies, which are companies that have been active for a long time in the market and continue to operate, although they still have problems in meeting their commitments or are close to bankruptcy (Adalet McGowan et al., 2017). For their functioning, they use productive resources that could be allocated more efficiently, thereby decelerate the growth of the productivity of the whole economy. Study by Gopinath et al. (2017) has shown that the growing misallocation of capital appears to be a key reason for the productivity stagnation in some countries.

First of all, we use firm-level data to assess the presence of zombie companies in Slovakia. Thanks to this confidential database we can make a relatively large inference about the zombie share in Slovakia, which was not studied before. Secondly, descriptive statistics analysis is conducted with the comparison across years, industries, size and

age categories. Accordingly, we compare results of Slovakia to other countries studied by OECD (Adalet McGowan et al., 2017) and compute the hypothetical gains in the Slovak economy, in the case when the capital owned by the zombies is reduced to the lowest level among the analysed countries. Furthermore, we examine corporate attributes of these companies and we use equations which analyse the impact of the distortionary effects of zombie industrial prevalence on investment ratio, employment growth and labour productivity of the typical non-zombie company. Finally, we analyse the effects of zombie share on firm performance of average healthy non-zombie companies during the pre-crisis period in comparison with the subsequent recession.

According to the literature definition of zombie companies, these companies accounted for about 5.75% of non-financial firms in Slovakia in 2015. Our results show that these companies negatively influence aggregate productivity and sink resources. This curb the growth of non-zombie companies, which has an adverse impact on industrial resource allocation. Our findings also contribute to the debate about zombie firms in Slovakia, since there has been little attention to zombie characteristics and their effects, especially during the crisis. Consequently, we mention the suggestions for the policy for mitigation of negative effects of zombie firms, which would lead to better productivity growth and we suggest a variety of topics for consideration in future research.

The remainder of the thesis is constructed as follows. The next section, Section 1, is presenting the literature review on zombies, together with various types of definition of zombie company. Section 2 is including the description of the datasets with an explanation of data treatment and explains the empirical methodology used to characterize zombie firms and to find out the impact of zombie companies on the productivity of healthy enterprises. Section 3 takes stock of the attributes of zombie companies and provides descriptive statistics on zombies. This section presents a hypothetical scenario to show the potential increase of investments caused by zombie prevalence and it also discusses the results of regressions. The last section includes a summary of the results found in this thesis and provides with the ideas for future research.

# 1. Literature Review

## 1.1 Definition of zombie companies

According to various studies researching the field of zombie companies, a zombie is an old company that does not have enough profitability to cover its interest payments and under normal circumstances, it should exit the market or restructure. In other words, a zombie firm is an unprofitable firm that stays on the market because of continued access to financing. For example, the bank not only rolls over the loan when the zombie firm is unable to repay the loan but also extends new loans to enable the zombie firm to service interest payments and to continue operating. Another way is to improve the sales of the zombie firm by awarding this firm a large-scale project. In fact, with government support, the insolvent zombie firm could enlarge its capacity to undertake the large project and might even take over well-performing enterprises in order to quickly increase its capacity (Vanhala and Virén, 2018). However, an important objective is to define this term in a quantitative form. The literature offers various definitions (Adalet McGowan et al., 2017).

The term zombie firm was firstly introduced after the productivity slowdown in Japan during the 1990s (Hoshi, 2006; Caballero et al., 2008; Nakamura and Fukuda, 2013), defined in the studies as a firm that hurts healthy firms and distorts market competition by discouraging investment and depressing profits. Early studies of Japan's revitalization demonstrated that increase in amount of loans to highly indebted firms decreased their profitability (Sekine et al., 2003), and that sectors with high share of zombie enterprises resulted with lower productivity performance (Ahearne and Shinada, 2005), which shows that zombie companies had a negative effect on economic recovery in Japan (Kobayashi, 2009). Literature also showed that loans of Japanese banks, which provided credit to financially weak firms, resulted in the effect called "unnatural selection" as there occurred a large reduction of the credit available to healthy firms (Peek and Rosengren, 2005).

Caballero et al. (2008) define a company as a zombie if its interest payments are lower than the risk-free interest payments, which means that its interest payment is relatively lower compared to those of other healthy firms. This definition is data demanding, which means that we would need accurate data of loans and interest

payments. Because this thesis relies on data from balance sheets and income statements of individual firms, Caballero et al. (2008) definition is not applicable.

The definition of the zombie company adopted by Adalet McGowan et al. (2017) has the first condition that operating profit (EBIT) needs to be lower than its interest expenses. Specifically, the interest coverage ratio (ICR), the ratio of earnings before interest and taxes to interest payments, is less than 1 at least three years in a row. In practice, it implies that a company has to take an additional debt to cover its interest payments. The second condition is an age criterion because companies must be older than 10 years to prevent the mistaken inclusion of young innovative businesses that are mostly at the start of their loss-making business, especially when they invest large amounts from the very beginning of their existence. Particularly start-up companies are vulnerable to this as they face a trade-off between short-term costs and future profitability growth. This study documented the extent of the presence and impact of zombie companies in selected OECD countries.<sup>1</sup>

The objective of the definition is to focus on unprofitable companies persisting in the market. The condition that interest coverage ratio needs to be lower than 1 for 3 years in a row addresses the cyclical nature of the zombie status (Gouveia and Osterhold, 2018). The second condition that the firm needs to be older than 10 years is excluding many companies, especially start-ups, which usually have low viability. Literature definition of zombie companies would currently fit worldwide companies like electric car maker Tesla and streaming giant Netflix, as they satisfy both conditions of the OECD definition of zombie firm (Reid, 2018).

Alternative definitions of zombie companies consider profitability and debt ratios. According to Storz et al. (2017), a company is considered as a zombie firm when it fulfils the following conditions at least two years in a row: negative asset returns, negative investments and debt servicing capacity (EBITDA divided by total financial debt) lower than 5%. Schivardi et al. (2017) defined the zombie firm based on a combination of two conditions: return on assets lower than the cost of the most secure borrower's capital, and the ratio of financial debt to assets exceeding 40%.

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<sup>1</sup> Their analyses are based on micro data on enterprises from the ORBIS database. Data for Slovakia and some other EU countries (or OECD countries) are not available in the ORBIS database to a sufficient extent. Therefore, the results for the countries concerned (including Slovakia) are not included in OECD output.

Considering the real availability of data on Slovak firms in this thesis, the definition of zombie companies is in line with the work of Adalet McGowan et al. (2017). In the analytical section, the focus is on enterprises older than 10 years, whose ICR is lower than one for a minimum of 3 years in a row.

## **1.2 Literature results on zombie companies**

The first results on zombie enterprises appeared after the economic slowdown in Japan in the 1990s. Caballero et al. (2008) claim in their work that zombie firms in the Japanese economy are lowering market prices and rising wages, thereby reducing profits, weakening investment, and slowing down the expansion of healthy and new businesses. They found out that firms identified as zombies lowered productivity in industries where their occurrence was larger and that they decreased employment and investment growth of their healthy counterparts by impeding human resources and reallocation of capital, in some cases even causing some healthy firms to become zombie companies as well (Caballero et al., 2008).

Recently, research studies (e.g. Borio and Hofman, 2017) have focused more on the impact of low interest rates. The results show that the ratio of weakly performing companies decreases (increases) during periods of high (low) interest rates. The share of zombie enterprises rose especially after the financial crisis. However, these periods were also identified by lower economic growth, which diminished the profitability of firms across the board and increased the probability of companies turning into zombies. Therefore, it is crucial to take into account that the sluggish economy causes weak profitability growth and not the period of low interest rates.

On the other hand, loans to zombie companies during the recession are not necessarily a bad decision to boost the economy. Providing credit to weak companies keeps the companies alive and can prevent bulk redundancies. As a result, there is a moderate slowdown in aggregate demand, which is particularly important during the times of recession (Mian et al., 2015). Therefore, according to BIS (Banerjee and Hofman, 2018), an enormous occurrence of zombie companies results in a trade-off for central bank policy. Even though lower interest rates are supposed to increase aggregate demand and employment level, the higher amount of zombie firms means higher misallocation of production resources (Reid, 2018).



Studies from the macroeconomic slowdown in Japan in the 1990s focused on long-term loans that supported inefficient firms, encouraging them to make unrealistic efforts to increase profitability. As a result, the growth of healthy enterprises has been limited, as well as the creation of barriers for start-ups (Caballero et al., 2008; Hoshi, 2006). Kwon et al. (2015) claim that loans provided to zombie firms accounted for one percentage decrease in annual aggregate productivity growth in Japan during the 1990s. A pattern of ongoing restructuring that resulted in the Japanese macroeconomic slowdown from the 1990s can be relevant in explaining current productivity developments in Slovakia.

According to the Adalet McGowan et al. (2017), banks did not stop lending to these companies for different reasons. Firstly, the long-term relationship of the bank with the firm compelled the bank to roll over the loan (Chen and Chu, 2004). Therefore, relationship banking can foster zombie lending, as compared to the whole set of companies, zombies are older on average (Peek and Rosengren, 2005). Secondly, regulatory tolerance that gave incentives for poorly capitalized banks not to make losses, which subsequently increased inefficient insolvency regimes. Hence, this observation has been referred to the ‘zombie banks make zombie firms’ theory (Okamura, 2011).

Building on the work from Caballero et al. (2008), the OECD study Adalet McGowan et al. (2017) researched attributes of zombie companies in the period from 2003 to 2013 for chosen OECD countries. The results of this research suggest that in many countries there can be seen an increase of zombie companies, which were measured as bigger companies, in terms of capital allocated in those firms. Because of the fact that there is allocated a higher amount of fixed assets or total workers, there is a higher chance for them to receive subsidies from the government to prevent the large layoffs, especially during the crisis (Gouveia and Osterhold, 2018). In the studies, this observation has been referred to the ‘too big to fail’ theory, where the largest firms, which are considered as crucial regional employers, are not allowed to exit the market because of the risk of unemployment increase.

OECD within industries analysis of chosen countries (Adalet McGowan et al., 2017) has shown that a larger share of capital invested in zombie firms has resulted in a lower level of investment and employment growth in healthier firms. Consequently, the

lower number of healthy business investments suppresses innovation and technological advances, resulting in weaker productivity growth (Adalet McGowan et al., 2017).

The analysis leads to the conclusion that corporate investment of a typical company that is not considered a zombie firm would be on average 2% higher in 2013 unless the zombie firms have increased their share since 2007. Significantly higher effects have been observed in Italy, Finland and Spain. The study also concludes that the persisting survival of zombie companies can reduce aggregate productivity and prevent potential entry into the market for new firms that have a huge innovation advantage that indirectly induces pressure on companies to improve productivity. Finally, it prevents from an effective redistribution of production resources among more successful enterprises (Adalet McGowan et al., 2017).

A document from Acharya et al. (2017) claims that an indirect subsidisation program, the Outright Monetary Transactions Program, which started in 2012 thanks to the European Central Bank, has increased the incentive for banks to provide so-called zombie loans. This study shows that the loans were provided mainly to unprofitable companies, which had longer relationships with the banks. Unfortunately, this additional credit allocated to zombie companies did not increase activity, but this behaviour has adversely affected the growth of investment and employment of healthy businesses as a result of focusing on zombie firms, which used obtained funds for cash reserves.

A publication by Lopez-Garcia et al. (2015) claims that the division of productivity among Slovak enterprises is one of the most unequal ones in comparison with other EU member countries. The amount of highly productive enterprises is relatively small and low-productivity businesses dominate on the market. This thesis provides a closer examination of the particular problem and also suggests potential policy solutions.

## 2. Data and Methodology

### 2.1 Data description

This thesis relies on two comprehensive sets of firm-level data provided by the Council for Budget Responsibility (CBR) and the National Bank of Slovakia (NBS).<sup>2</sup> Firstly, we use a dataset from the Council for Budget Responsibility (CBR) based on balance sheets and income statements submitted by companies as part of tax returns. It covers the entire population of Slovak firms, including income statements for the period from 2004 to 2015, and balance sheets for the period from 2011 to 2013.

Mainly because of the availability of the balance sheets for the firms we use the harmonized firm-level data from the National Bank of Slovakia collected by the Statistical Office of the Slovak Republic (SO SR), which also deals with the underrepresentation of small companies in the CBR database. Dataset is provided for the period 2001 to 2013 and it covers Slovak firms with 20 or more employees, including income statements and balance sheet data. The classification of industries in both cases is assigned according to the Statistical Classification of Economic Activities in the EU, Revision 2 (NACE Rev. 2).

Before proceeding to the results, there was a necessity to provide adjustments to the data to guarantee the robustness of the outputs. Observations, which had negative amounts for the variables age, interest expenses, turnover and tangible assets were dropped from the samples. Furthermore, the datasets were restricted to the non-financial industry codes (NACE Rev.2 codes 10-63 or 67-83). After data treatment, the panel dataset obtains 281,602 observations from the CBR database and 50,956 observations from the SO SR database.

Table 1 presents the average, standard deviation, minimum and maximum of main financial variables for all firms from the SO SR database after data treatment. To facilitate comparison between zombie and non-zombie companies, we report the corresponding statistics for zombie and non-zombie enterprises separately in Section 3.1.

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<sup>2</sup> Given the fact that firm-level data are not easily available because of the preservation of confidentiality, the whole analysis needed to be realised indirectly. It means that a developed code in statistical program was sent to Council for Budget Responsibility and National Bank of Slovakia, where it was run on the datasets and the output was sent back with preserved confidentiality.

**Table 1. Descriptive statistics of Slovak firms**

	Mean	Std. Dev.	Min.	Max.
Turnover	15128	114861	0	7533750
Total workers	143	550	20	46813
Tangible Assets	12249	123749	0	7623911
EBIT	766	18479	-221219	4553031
Interest	145	1786	0	155670
Age	12	7	0	67

*Source: Own calculations based on SO SR data.*

*Note: This Table is conducting SO SR dataset, which is restricted to firms with 20 or more total workers, which will give us a more reasonable comparison.*

## 2.2 Methodology

### 2.2.1 Determinants of zombie firms

We present a series of econometric models that relate some firm characteristics to the probability that a firm is classified as a zombie. The models try to explain the probability of becoming a zombie as a function of the firm's profitability, size, financial structure and type of the firm. The profitability and size variables are lagged once when included in the regression equation to avoid the endogeneity problem. Each model also includes industry, according to 1-digit classification NACE1, and year dummies to control for the aggregate factors that are common to all the firms for the particular sector and year. In our analysis, we use the panel data of Slovak firms from the non-agriculture, non-mining and non-financial sectors in the period from 2003 to 2013.

This thesis considers an equation to assess the determinants of zombie firms with the following specification inspired by Lam et al. (2017) and Hoshi (2006):

$$Z_{it} = \beta_1 roa_{it} + \beta_2 neg\_profit_{it} + \beta_3 lnfix\_assets_{it} + \beta_4 dlnlabour_{it} + \beta_5 equity\_share_{it} + \beta_6 soe_{it} + \beta_7 fdi_{it} + \beta_8 age_{it} + FE_{st} + \varepsilon_{ist} \quad (1)$$

where  $Z$  denotes a dummy variable with the value of 1 if a company  $i$  is a zombie firm in year  $t$ . Regarding the independent variables, two measures related to profitability are

considered. Variable *roa* is calculated as the current operating profit divided by the total assets of the firm; *neg\_profit* is a dummy variable that equals to one when the current profit is negative. For the proxies of firm size, we consider the natural logarithm of fixed assets and the log time difference in employment denoted as *lnfix\_assets* and *dlnlabour*, respectively. To control the financial structure, we use the share of equity to total assets labelled as *equity\_share*. To analyse the type of firms that are considered as zombies, we applied dummies for state-owned enterprises and international firms denoted as *soe* and *fdi*, respectively. Finally, we added variable *age* as another firm characteristic, thus we can observe how the age of the firm is related to the probability of zombie status. We included separate industry and year fixed effects and use robust standard errors. The robustness of the outcome is tested by three types of econometric models (Linear Probability Model, Logit and Probit).

### **2.2.2 Effect of zombie companies on non-zombie companies**

The productivity of zombie firms is lower compared to their non-zombie competitors as they capture a significant proportion of fixed assets and total workers, which is indicating the misallocation of resources. In the research studies (e.g. Caballero et al 2008), it has been noticed that the survival of zombie enterprises may distort competition and lower efficiency in the market. Their occurrence results in higher wages and lower prices of products, which diminish growth conditions for potential firms.

To verify the hypothesis in this thesis, we use the panel data of Slovak firms from the non-agriculture, non-mining and non-financial industries (NACE Rev.2 codes 10-63 or 67-83) in the period from 2003 to 2013. Following the specifications in studies Caballero et al. (2008), Adalet McGowan et al. (2017) and Hallak et al. (2018), we research the impact of the occurrence of zombie companies on the productivity performance of non-zombie companies with the subsequent fixed effects model (Wooldridge, 2010):

$$\text{Firmperformance}_{it} = \beta_1 \text{nonZ}_{it} + \beta_2 \text{nonZ}_{it} * \text{Zshare}_{st} + \beta_3 \text{Firmcontrols}_{it} + \text{FE}_{st} + \varepsilon_{ist} \quad (2)$$

where Firmperformance denotes 3 variables representing the performance of company  $i$  in a 2-digit NACE2 industry  $s$  in year  $t$ . The first indicator is the investment ratio measured as the log difference in total fixed assets. The second indicator captures the employment growth of the company and it is defined as the log difference in the total number of workers. The third performance indicator is labour productivity, which equals the logarithm of the value added divided by the total amount of workers in a given firm.

The independent variable nonZ is a dummy variable with a value of 1 if a company is a non-zombie company. Zshare equals the sector resources sunk in a given year in zombie firms, which, is measured either in the form of capital or labour, with the amounts ranging between 0 and 1. The share of fixed assets in zombie companies compared to total fixed assets of all firms calculated separately in every NACE2 industry is denoted as capital sunk. The employment sunk is measured as the share of total employees in zombie companies divided by a number of workers in all companies in the given industry. Firm controls include the age of the company and dummies for company size categories (20-49, 50-249 and 250+). We included separate year and sector fixed effects in the model to control for unseen time and industrial aggregate shocks (Schivardi et al., 2017). We use robust standard errors.

In Section 3.3.2 we will focus on the coefficient  $\beta_1$ , which is showing the relative difference in the performance of zombie and non-zombie company. However, the main focus will be on the  $\beta_2$  coefficient, which is capturing the effect between resources allocated in zombie companies and the relative productivity performance of non-zombie companies.

### **2.2.3 Effects of zombie companies during the pre-crisis period**

The main purpose of this part is to examine to what extent the effects of zombie share on growth and productivity differ in the pre-crisis period (2003-2007). Adalet McGowan et al. (2017) restricted the dataset on the period from 2003 to 2007 and their

outcomes show that resource misallocation occurred already before the financial crisis. As a result, they conclude that the structural dimension was the driver of the persistence of zombie companies on the market. Therefore, to examine this statement, we extend Equation (2) to get modified Equation (3), which includes the pre-crisis period dummy in two interactions, and it provides an answer for the last hypothesis in this thesis:

$$\begin{aligned} \text{Firmperformance}_{it} = & \beta_1 \text{nonZ}_{it} + \beta_2 \text{nonZ}_{it} * \text{pre-crisis}_t + \beta_3 \text{nonZ}_{it} * \text{Zshare}_{st} + \quad (3) \\ & + \beta_4 \text{nonZ}_{it} * \text{Zshare}_{st} * \text{pre-crisis}_t + \beta_5 \text{Firmcontrols}_{it} + \\ & + \text{FE}_{st} + \varepsilon_{ist} \end{aligned}$$

Compared to Equation (2), we create the dummy variable pre-crisis that is equal to 1 if the observation is from the period before the crisis (2003-2007). Consequently, we add two interaction variables. Firstly, nonZ \* pre-crisis, a dummy that captures the difference in healthy firm performance compared to zombie company in the period from 2003 to 2007. Secondly, nonZ \* Zshare \* pre-crisis, an interaction which denotes non-zombie companies from the pre-crisis period interacted with the zombie ratio in the particular sectors. Especially, in this case we would like to know how the zombie ratio influences the performance of non-zombie companies in the pre-crisis period, which means that we are mainly interested in the interpretation of coefficient  $\beta_4$ .

### 3. Results and Discussion

#### 3.1 *Zombie prevalence*

This subsection focuses on the descriptive statistics of attributes of zombie companies in Slovakia. Data from SO SR are available from 2001, which means that the first year of our measurements will be 2003 because it is the first year when a company could fulfil the interest coverage ratio condition as it takes two lagged years into account.

Results from Table 2 suggest that zombie companies tend to underperform as they have lower value added on average. Another feature of zombie firms is that they are older on average, which can cause easier access to credit because there is a higher probability that they have longer relations with banks. As illustrated in Table 2, the zombie enterprises are on average smaller in terms of employment, turnover and fixed assets, which is in line with the findings in a Japanese study (Nakamura, 2017). This is presumably because of the fact that there is a lower probability for very large companies to require financial assistance. If one expects that big troubled companies are more likely to be protected compared to small troubled firms, this result may be puzzling. This feature is closely examined in Hoshi (2006).

**Table 2. Differences between zombie and non-zombie companies**

Variables	Employees	Turnover	Fixed Assets	Value Added	Age
Non-Zombie	179.66	23469.44	23824.14	8874.46	13.93
Zombie	149.48	8513.38	16707.43	2331.24	18.24
Total	177.94	22617.09	23418.56	8501.56	14.18

*Source: Own calculations based on SO SR data.*

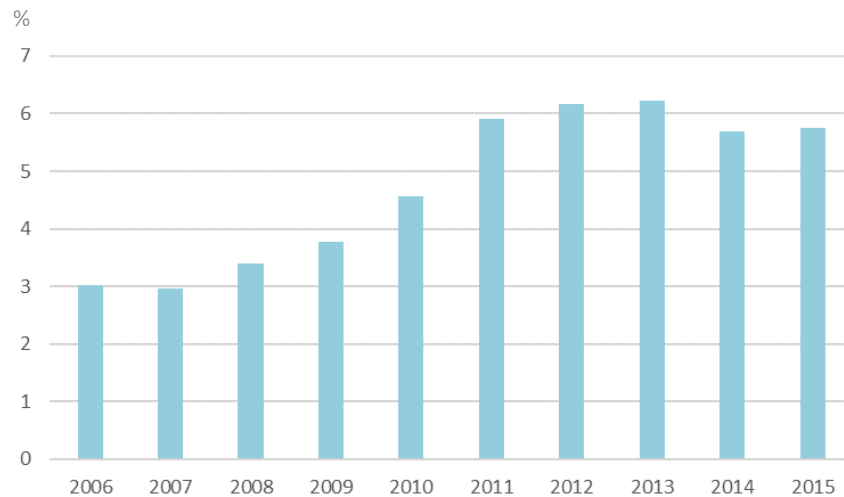
*Note: This Table is conducting SO SR dataset, which is restricted to firms with 20 or more total workers, which will give us a more reasonable comparison. Zombie firms are defined as non-financial enterprises older than 10 years with an ICR lower than 1 for 3 years in a row.*

From the analysis based on CBR, during 2006 and 2015, the share of zombie companies in Slovakia was approximately 5% of the total number of enterprises. Our calculations show that in 2013 the proportion of zombie companies in Slovakia has



reached its highest value and has decreased in the following years.<sup>3</sup> Figure 1 shows that zombies were around 3% of all Slovak firms in 2006, increasing steadily to 6.2% in 2013. In Slovakia, the proportion of zombie enterprises has increased during the period from 2007 to 2013. This trend was also observed within the OECD countries, e.g. Italy, Belgium, Spain (Adalet McGowan et al., 2017) and Finland (Vanhala and Virén, 2018). Consequently, the relative amount of zombie companies declined to around 5.75% from 2013 to 2015. An almost identical development trend was recorded by Adalet McGowan et al. (2017) in Italy, where the proportion of zombie companies roughly doubled between 2007 and 2013.

**Figure 1. Share of zombie companies in Slovakia over time (%)**



*Source: Own calculations based on CBR data.*

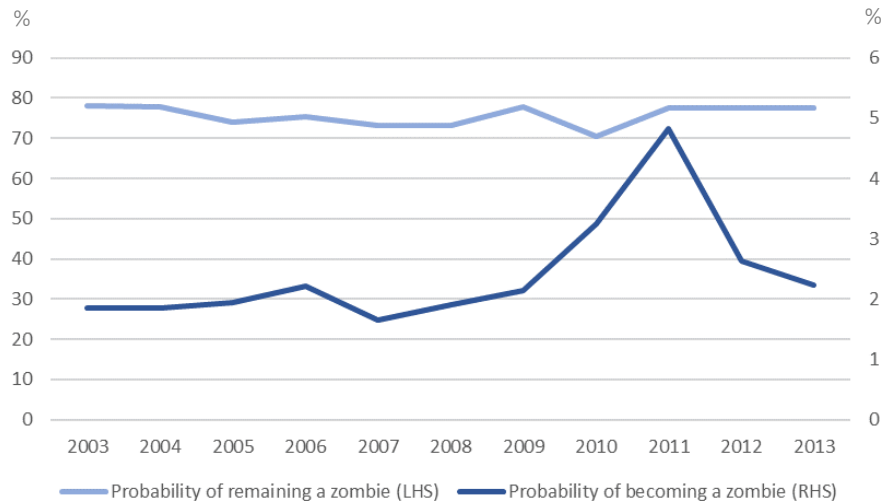
*Note: Zombie firms are defined as non-financial enterprises older than 10 years with an ICR lower than 1 for 3 years in a row.*

Zombie outcomes propose that the share of zombie companies has increased mainly since 2009 as showed in Figure 1. Their becoming rate, the probability of a non-zombie becoming a zombie in the following year, rose from around 2% in 2009 to 4.8% in 2011 as it is showed in Figure 2. The increase was not steady as the upward shift was linked to the economic downturn during the Great Financial Crisis (GFC). Adalet McGowan et al (2017) have shown that the zombie share has increased significantly in the wake of the GFC across advanced economies more generally. The rise of zombie

<sup>3</sup> Data for other OECD countries are only available until year 2013. Therefore, it is not clear whether the proportion

firms has been also driven by companies with persisting zombie status for a longer time period, rather than recovering or exiting the market. Specifically, the probability of a zombie firm remaining a zombie in the following year fluctuated around 75% during the time period from 2003 to 2013 (Figure 2).

**Figure 2. Rise and survival of zombie companies (%)**



Source: Own calculations based on SO SR data.

Note: Zombie firms are defined as non-financial enterprises older than 10 years with an ICR lower than 1 for 3 years in a row.

Secondly, we will focus on the occurrence of zombie companies across variables age, size and industry in 2013,<sup>4</sup> but in case of age categories, we do not apply age condition.<sup>5</sup> A simple analysis of the zombie firms in Slovakia shows that the largest proportion of zombie enterprises is among the oldest enterprises, as it is shown in Figure 3. The share of zombie firms with increasing age is gradually declining from the very beginning. The lowest proportion of zombie enterprises among all age categories is among enterprises with age from 10 to 20 years. In the older age categories, the share of zombie firms again higher reaching a peak of 32.5% at category above 41 years.<sup>6</sup> A

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of zombie companies in the next period has stabilized in other countries as well.

<sup>4</sup> We present values for 2013 (for enterprises with data for three consecutive years 2011-2013) due to the possibility of comparison of results with other analyses.

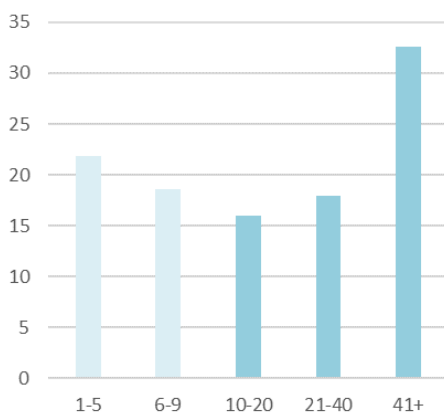
<sup>5</sup> Unlike in OECD study (McGowan et al., 2017), where the results were based on data that was insufficiently covered with small businesses, we deal with all non-financial businesses in Slovakia in our descriptive analysis. It means that some differences in the main findings could stem from a different input data structure.

<sup>6</sup> It is important to note that in the sample is relatively small number of companies older than 40 years. During the period 2006-2015 only 318 observations of old firms in the last category occurred, while the share of zombie firms reached the value of 21.7% during the given period.

higher percentage of companies operating with low interest coverage ratio in the first group is demonstrating that many start-ups take several years to be in the black. On the other hand, the latter part of U-shape of Figure 3 can be explained by the fact that old and or large companies are more likely to receive state funding as a mean of preventing unemployment, especially during the crisis period. This is consistent with empirical research in Taiwan by Chen and Chu (2004), which explains that old companies are more likely to be protected and subsequently they become zombie firms because of a long-term relationship with banks, which cause incentives for a bank to continue with providing loans, also known as bank forbearance.

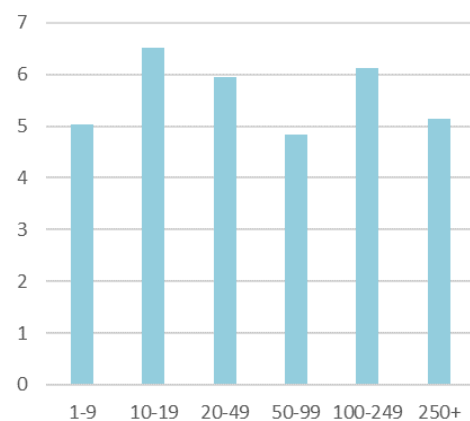
Findings regarding the size of the zombie firms in Slovakia in Figure 4 do not confirm the results for selected OECD countries, indicating that there is a significantly higher proportion of enterprises amongst large enterprises that have the problem of paying their interest expenses. Large companies with over 250 employees have a slightly higher share of zombie firms than companies with fewer than 10 employees, but the difference between those categories is negligible and the proportion of zombies does not grow with the size significantly as in the research paper Adalet McGowan et al. (2017) for selected OECD countries.

**Figure 3. Share of zombie companies across age categories in Slovakia (2013, %)**



Source: Own calculations based on CBR data.  
 Note: Zombie firms are defined as non-financial enterprises older than 10 years with an ICR lower than 1 for 3 years in a row. The lighter part of the graph covers companies that do not satisfy the age criterion.

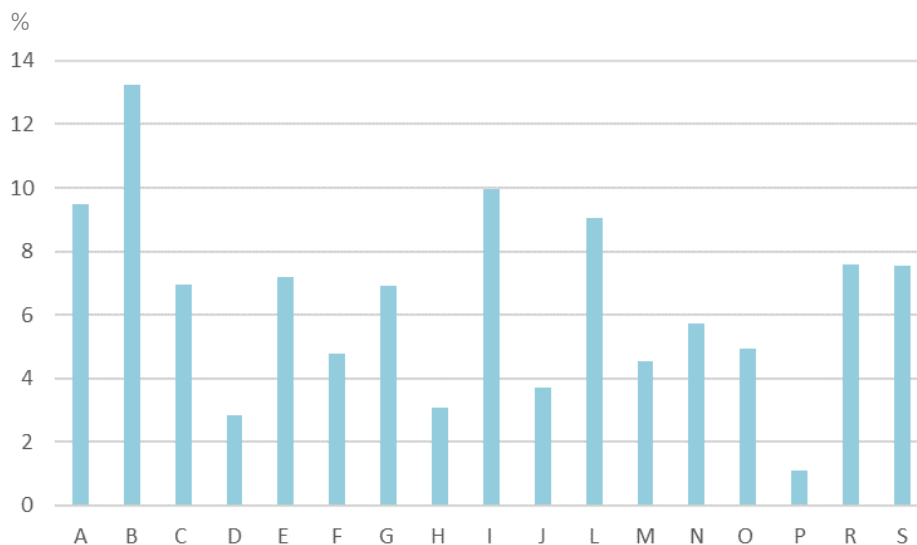
**Figure 4. Share of zombie companies across size categories in Slovakia (2013, %)**



Source: Own calculations based on CBR data.  
 Note: Zombie firms are defined as non-financial enterprises older than 10 years with an ICR lower than 1 for 3 years in a row. The size categories are based on the number of employees.

Given industrial heterogeneity (Caballero et al., 2008), Figure 5 presents the percentage of zombie firms across the industries for the year 2013.<sup>7</sup> Significant differences can be observed in within industries segmentation. The proportion of zombie firms in 2013 across industries ranged between 1% and 13%. Sectors of services, apart from accommodation, catering and real estate activities, generally have a lower proportion of zombie firms than the average for the whole non-financial sector. According to available data, the construction sector together with the electricity and gas sector also have a low share of zombies, which is in line with the study concerning Portugal firms (Gouveia and Osterhold, 2018). In the manufacturing sector, the proportion of zombie firms is slightly higher than the general average of non-financial corporations, which is inconsistent with the findings in Caballero et al. (2005), where the result shows that zombies are more prevalent in non-manufacturing industries. Most enterprises with weak financial results are in the mining and quarrying sector.

**Figure 5. Share of zombie companies across industry categories in Slovakia (2013, %)**



Source: Own calculations based on CBR data.

Note: Zombie firms are defined as non-financial enterprises older than 10 years with an ICR lower than 1 for 3 years in a row. NACE1: A - Agriculture, forestry and fishing; B - Mining and quarrying; C - Manufacturing; D - Electricity, gas, steam and air conditioning supply; E - Water supply, sewage, refuse and waste management and remediation activities; F - Construction; G - Wholesale and retail trade, repair of motor vehicles and motorcycles; H - Transportation and storage; I - Accommodation and catering services; J - Information and communication; L - Real estate activities; M - Professional, scientific and technical activities; N - Administrative and support service activities; O - Public administration and defence; compulsory social security; P - Education, Q - Healthcare and Social Assistance Section, R - Arts, Entertainment and Recreation Section, S - Other Activities.

<sup>7</sup> For presentational purposes, we aggregate data according to NACE1 letter code, whereas in the analytical part that follows (Section 3.3.2 and 3.3.3) we use the more detailed 2-digits breakdown.

### **3.2 Impact of zombie firms on the economy**

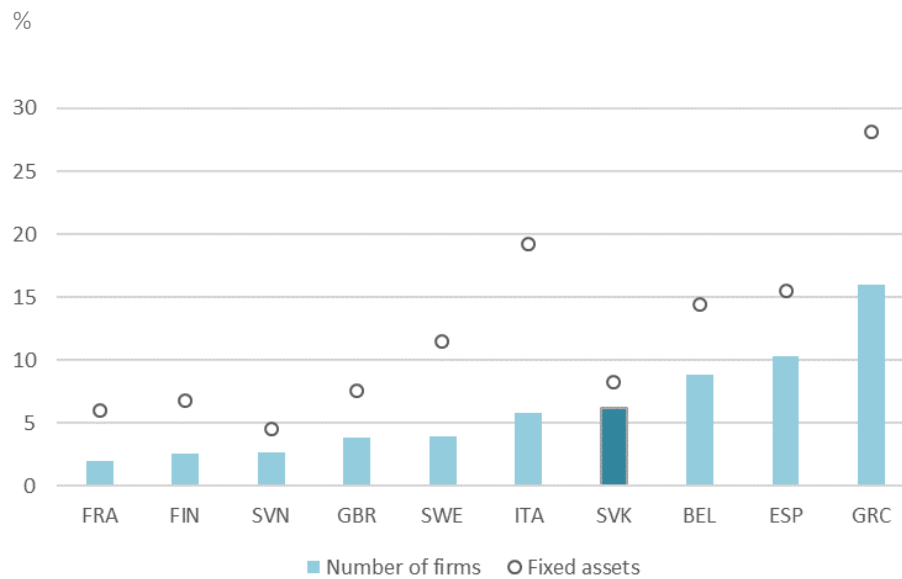
According to our calculations based on CBR, the share of zombie companies in Slovakia in 2013 was approximately 6.2% of the total number of enterprises (firms with required financial data for 2011-2013).<sup>8</sup> In the EU countries, according to the OECD study (Adalet McGowan et al., 2017), the proportion of zombie companies in that year ranged between 2% and 16% in chosen countries. However, focusing only on the proportion of zombies is not fully showing their impact on the economy, as their presence is outweighed by the number of resources (i.e. capital and labour) sunk into them. Therefore, in the following part, we will focus also on the sunk of fixed assets in zombie enterprises.

As shown in the following chart, Figure 6, which combines data of zombie firms from OECD (2017) for the year 2013 with the values we have calculated for Slovakia, there are significant differences between the selected European countries in the ratio of zombie companies and their possible impact on the economy.<sup>9</sup> In Slovakia, in 2013, more than 6% of companies were classified as zombies, whereas the proportion of fixed assets (capital sunk) belonging to the zombie companies was around 8%. In Italy, the proportion of zombie companies was almost the same, but the capital sunk in zombie companies was approaching 20%. The proportion of zombies has the second highest value in Spain (10%). The lowest level was observed in France with an amount of 2%, which is in line with the study Cahn et al. (2017) which mentions that zombie lending to firms is relatively rare in France. Greater impact on the domestic economy had zombie firms from a corporate investment point of view in Greece where, according to information available about zombie companies, the capital sunk was 28% and the proportion of zombie companies in the total number of companies was 16%. The lowest share of investments allocated to zombie companies in 2013 was reported in Slovenia (4.5%).

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<sup>8</sup> In non-financial enterprises without enterprises in the agriculture, forestry and fishing, mining and quarrying the share of zombie firms reached the value of 5.9% in 2013.

<sup>9</sup> Data for available European OECD countries comes from a research study by Adalet McGowan et al. (2017) and the OECD Economic Review for Greece (Barkas and Pisu, 2018). The OECD research is conducting countries: Belgium (BEL), Finland (FIN), France (FRA), Greece (GRC), Italy (ITA), Slovenia (SVN), Spain (ESP), Sweden (SWE) and the United Kingdom (GBR).

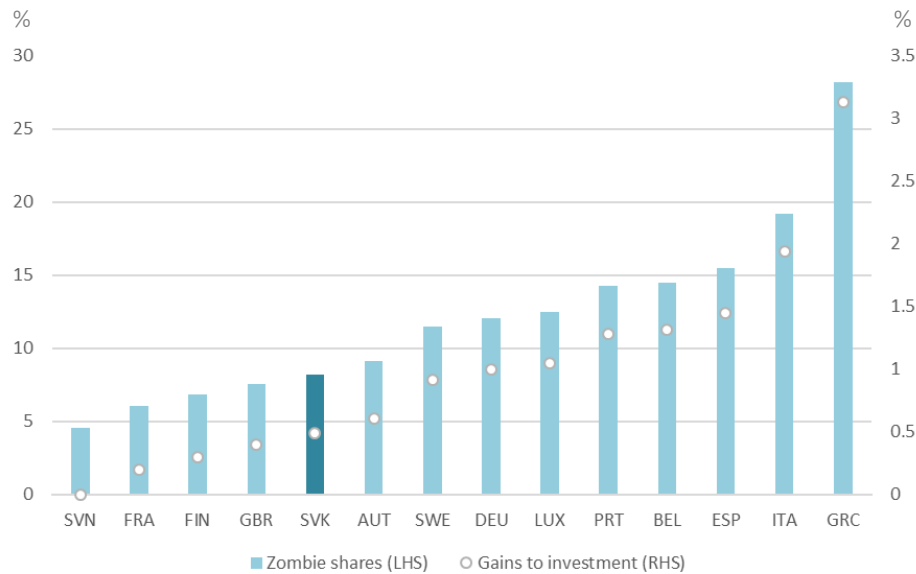
**Figure 6. Share of zombie companies compared to 9 OECD countries (2013, %)**

Source: Own calculations based on CBR, OECD (2017).

Note: Zombie firms are defined as non-financial enterprises older than 10 years with an ICR lower than 1 for 3 years in a row. The number of firms and fixed assets refer to the share of the number of firms and fixed assets in zombie firms.

In addition to a detailed analysis of the presence of zombie companies in OECD economies, Adalet McGowan et al. (2017) also gave an estimate of the impact of zombie companies on other firms. They confirmed the statistically and economically significant negative within industries impact of zombie companies on the investment of healthy companies. Figure 7, based on the results of OECD study, illustrates the hypothetical scenario of investment increases in individual countries, assuming that the capital owned by the zombies is reduced to the lowest level among the analysed countries (i.e., to 4.5%). A reduction in zombie firms to the lowest level in 2013 could increase investment in OECD countries by between 0.2 and 3.1 pp. Given the relatively low proportion of fixed assets in zombie companies, a possible reduction of zombie firms in Slovakia could lead to a slight increase in investment for a regular firm (approximately 0.5 pp).<sup>10</sup>

<sup>10</sup> To quantify the impact on Slovakia, we have used our estimates of the zombie capital industry's share. The growth rate of investment attributable to the decline in the share of zombie firms to the level of Slovenia (4.5%). This decline is accordingly multiplied with coefficient, which stems from Table 1 of the research study Adalet McGowan et al. (2017). Its magnitude is -0.13257. The coefficient of the same model conducted in this thesis reaches the value of -0.021 (Table 3, Column 1).

**Figure 7. Hypothetical investment increase from reduction of zombies (2013, %)**

Source: Own calculations based on CBR, OECD (2017).

Note: This graph presents the hypothetical scenario of reduction of the zombie ratio to the sample minimum (Slovenia) and the outcome is a hypothetical increase in investment of a regular healthy company. Zombie shares are calculated by the capital sunk in zombie companies, which are defined as non-financial enterprises older than 10 years with an ICR lower than 1 for 3 years in a row.

### 3.3 Regression results

#### 3.3.1 Determinants of zombie firms

We present a series of estimations, that relate some firm characteristics to the probability that a firm is classified as a zombie – as shown in Table 3. Each column reports the coefficient estimates and their standard errors for a particular model. Almost all coefficients in each model are statistically significant.

The coefficients of the profitability variables assumed a significantly negative estimate for return on assets and significantly positive estimate on negative income dummy, which means that if a firm has just experienced negative income or it has a low return on assets ratio, the probability of being a zombie is higher. For example, a one percentage point increase in the return to assets ratio would decrease the likelihood of having a zombie status by about 0.11 pp on average in the Linear Probability Model. Recall that our identification scheme of zombie firms does use profitability information in relation to interest payments. Thus, there is a mechanical reason to expect that

zombies have low profitability. The same effect we can observe in the case of coefficient on age, which are positive and statistically significant.

In this specification, a larger amount of the total assets increases the probability of becoming a zombie significantly. However, it is important to note that the magnitude of this coefficient has a lower value compared to other coefficients, which is due to the higher volatility across firms. In addition, the coefficient of variable controlling for size growth is negative, which suggests that reducing the number of employees is more characteristic for non-zombie companies.

The coefficient on the equity ratio is negative and statistically significant. Thus, firms with a lower fraction of equity are more likely to be zombies. This is consistent with the findings in Hoshi (2006). The regression results also suggest that international firms are more likely to be zombies, the dummy variable representing state-owned companies resulted as non-significant.

The almost identical methodology was used in the previous studies (Lam et al., 2017 and Hoshi, 2006), where zombie firms had similar attributes compared to the ones in this thesis. The robustness check in Lam et al. (2017) was constructed by applying the same methodology on 4 various zombie definitions. Because definitions used in the paper require data on interest rates or government subsidies, the robustness check of findings was conducted with 3 different econometrics models, where the outcomes were similar regardless of the model used.

Overall, the coefficients of the model are comparable to world literature (Lam et al., 2017 and Hoshi, 2006). It suggests that zombie companies across the world have similar main attributes, e.g. low return on assets ratio and higher amount of assets compared to healthy companies. Considering that the methodology was used on the rich sample of Slovak firms and R-squared measure obtains value around 20% in three different models, we assume that our results are robust.



**Table 3. Characteristics of zombie companies**

	zombie dummy		
	(1)	(2)	(3)
L.roa	-0.1182*** (0.031)	-1.3336*** (0.3454)	-0.8233*** (0.1859)
L.neg_profit	0.264*** (0.0121)	1.8978*** (0.0964)	1.0361*** (0.0503)
L.lnfix_assets	0.0111*** (0.0027)	0.1519*** (0.0305)	0.0796*** (0.0162)
L.dlnlabour	-0.0972*** (0.0208)	-1.0128*** (0.2065)	-0.5623*** (0.1148)
equity_share	-0.0821*** (0.0131)	-0.5888*** (0.1237)	-0.3157*** (0.0566)
soe	-0.0094 (0.0206)	-0.2794 (0.2461)	-0.118 (0.131)
fdi	-0.0403*** (0.0075)	-0.468*** (0.0806)	-0.2714*** (0.0431)
age	0.0077*** (0.0006)	0.0683*** (0.0054)	0.0381*** (0.003)
Control variables	Industry Year	Industry Year	Industry Year
Observations	9,167	9,167	9,167
R <sup>2</sup> (*)	0.196	0.224	0.226
Model	LPM, 2003-2013	Logit, 2003-2013	Probit, 2003-2013

Source: Own calculations on data for non-financial enterprises with 20 or more employees, SO SR.

Note: Zombie firms are defined as enterprises older than 10 years with an ICR lower than 1 for 3 years in a row., considered to be from a non-financial corporate sector (NACE Rev. 1, Sections C-N, excluding F). \*\*\* is denoting the 1% statistical significance level, \*\* is denoting the 5% statistical significance level, \* is denoting the 10% statistical significance level.

(\*) Pseudo R<sup>2</sup> is reported in the case of Logit and Probit model.

### 3.3.2 Effect of zombie companies on non-zombie companies

Table 4 shows the results of the estimation of Equation (2) for investment ratio, employment growth and labour productivity, respectively. The capital sunk term denotes fixed assets and the employment sunk denotes labour share of zombie firms multiplied by the non-zombie dummy variable. Controls are dummy variables for different years and sectors according to classification NACE2. The panel data from the SO SR database are used and FE stands for fixed effects.

Estimates based on more detailed data on Slovak non-financial corporations with 20 or more employees show that financially weak enterprises also influence investment rate, employment growth and labour productivity in non-zombie companies in Slovakia.<sup>11</sup> As can be seen in Table 4, the coefficient corresponding to the non-zombie dummy is positive and strongly statistically significant in all cases. It means that non-zombie companies achieve higher investment ratio, employment growth and labour productivity than zombie companies. The impact of zombie companies on non-zombie companies in the industry is measured by the variable that links the non-zombie dummy with the within-industry fixed asset sunk or employment sunk in zombie companies. The interaction term is negative in all cases (at different levels of significance depending on the particular model), meaning that the relative investment, employment growth and labour productivity of the regular non-zombie company, within the industry, is adversely influenced with increasing fixed assets or total workers allocated in zombie companies.

The impact of zombie share indicates a small and statistically insignificant impact in case of investment rate. If we measure the impact of zombie companies on non-zombie companies within the sectors on employment growth (in case of employment sunk) and labour productivity, we see a negative impact, which is statistically significant at 1% level. Our estimates of the sample of the corporations from selected industries with 20 or more employees confirm the negative impact of zombie companies on non-zombie companies within the industries. The identified differences between zombie companies and non-zombie companies are smaller, and the impact of zombie sunk on non-zombie companies is weaker in case of investment and stronger in case of employment growth compared to estimates made by Adalet McGowan et al. (2017) on a sample of several EU countries. Moreover, consistently with European research study Hallak et al. (2018), healthy companies usually have higher productivity of workers compared to zombies and the effects of the occurrence of zombies resulted in larger magnitude in the case of Slovak firms.

An important thing to mention is that the measure of R-squared deals with the explanatory power of the model on the dependent variable, which is not the priority in this thesis as the main focus is on the coefficient of interaction which explains the effect

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<sup>11</sup> Available data on small firms in Slovakia does not contain the required employment details and balance sheet data are only available for an insufficient number of years.

between zombie share and productivity of the non-zombie company. As it can be seen, in OECD studies and the paper of European Commission R-squared measure resulted similarly with the low values (see Adalet McGowan et al., 2017; Hallak et al., 2018; Gouveia and Osterhold, 2018).<sup>12</sup> Other reasons for this outcome are the usage of the fixed effects model and high volatility of data. Despite the fact, that this model controls for the main characteristics of the firm, the whole population of Slovak firms records huge dispersion, which could be also noticed in Table 1 from the standard deviations of the variables from which the dependent variables were constructed.

**Table 4. Impact of zombie share in Slovakia**

	dlncapital		dlnemp		lnlabprod	
	(1)	(2)	(3)	(4)	(5)	(6)
non-zombie dummy	0.047*** (0.0172)	0.0513*** (0.0176)	0.0211*** (0.008)	0.0268*** (0.0081)	0.1825*** (0.0247)	0.1905*** (0.0249)
non-zombie dummy x capital sunk	-0.021 (0.0772)		-0.0488 (0.0312)		-0.1669*** (0.0621)	
non-zombie dummy x employment sunk		-0.0967 (0.1047)		-0.1424*** (0.0444)		-0.2906*** (0.0882)
Control variables	Age	Age	Age	Age	Age	Age
	Size	Size	Size	Size	Size	Size
	Industry	Industry	Industry	Industry	Industry	Industry
	Year	Year	Year	Year	Year	Year
Observations	22,437	22,437	27,758	27,758	29,084	29,084
within R <sup>2</sup>	0.076	0.076	0.111	0.111	0.164	0.164
Model	FE panel, 2003-2013	FE panel, 2003-2013	FE panel, 2003-2013	FE panel, 2003-2013	FE panel, 2003-2013	FE panel, 2003-2013

Source: Own calculations on data for non-financial enterprises with 20 or more employees, SO SR.

Note: Zombie firms are defined as enterprises older than 10 years with an ICR lower than 1 for 3 years in a row., considered to be from a non-financial corporate sector (NACE Rev. 2, Sections 10 to 83, excluding 64-66). Dlncapital means a logarithmic change in the fixed assets of a company, dlnemp indicates a logarithmic change in the company's employment and lnlabprod is calculated as logarithm of the value added divided by the number of employees in a given firm. \*\*\* is denoting the 1% statistical significance level, \*\* is denoting the 5% statistical significance level, \* is denoting the 10% statistical significance level.

Robustness check in Adalet McGowan et al. (2017) was tested with a cross-section model conducted on 13 countries in the year 2013. Since this thesis explores

<sup>12</sup> Overall R-squared in case of dependent variable investment ratio with the same structure as Equation (2) resulted similarly with amount of 0.02 in the OECD studies (Adalet McGowan et al., 2017; Gouveia and Osterhold, 2018).

results on zombie firms only in one country, this robustness test cannot be done as the amount of data is not sufficient. Secondly, Adalet McGowan et al. (2017) deals with robustness by testing the methodology on the definition from Caballero et al. (2008), where coefficients have identical signs and almost the same magnitudes compared to outcomes of the study and this thesis. Because robustness tests conducted in the previous literature cannot be provided in this thesis, the robustness check is done by testing the same methodology with the Linear Probability Model (Appendix 1), which obtains comparable outcomes and high explanatory power of independent variables.

### **3.3.3 Effects of zombie companies during the pre-crisis period**

The estimates of Equation (3) are reported in Table 5. We do not find evidence of significant differences between non-zombie companies and zombie companies in productivity growth during the pre-crisis period. Zombie sunk, within the industries, adversely influences the productivity of non-zombie companies as in the previous case, which is in line with OECD results for the pre-crisis period (Adalet McGowan et al., 2017). However, positive coefficients of the interactions of the pre-crisis period with zombie share and non-zombie dummy suggest that an increase of the zombie sunk within the sector was connected with lower labour productivity, investment and employment growth for the regular non-zombie company in the period of recession. The coefficients are statistically significant for the employment growth and labour productivity, coupled with large magnitudes, which illustrate the minimum impact of zombie share on non-zombie companies during the pre-crisis period. These results suggest that the economic downturn was one of the main drivers of the distortionary effects of zombie companies.

As mentioned in Section 2.3.3, this outcome was analysed before in the OECD study (Adalet McGowan et al., 2017), where they observed the effect of zombie companies in 9 countries in the sample during the pre-crisis period. Working with administrative data for all Slovak companies, this thesis increases the robustness of papers that conduct only listed companies. To verify the robustness of our outcomes, the identical methodology was tested with the Linear Probability Model (Appendix 2) – similarly as in the previous subsection. Although this thesis works with adjusted administrative data and the R-squared measure is almost identical in comparison with

Adalet McGowan et al. (2017), the outcome of the regression serves just as an issue for the future research because further tests of residuals would be required to confirm the results from this subsection.<sup>13</sup>

**Table 5. Impact of zombie share in Slovakia before crisis**

	dlncapital		dlnemp		lnlabprod	
	(1)	(2)	(3)	(4)	(5)	(6)
non-zombie dummy	0.043*** (0.0134)	0.0426*** (0.0149)	0.0264*** (0.0063)	0.0346*** (0.0069)	0.1605*** (0.0184)	0.1732*** (0.0194)
non-zombie dummy x pre-crisis	0.0096 (0.0196)	0.004 (0.0209)	0.0051 (0.0098)	-0.001 (0.0101)	-0.0267 (0.0245)	-0.0489** (0.0257)
non-zombie dummy x capital sunk	-0.0305 (0.0726)		-0.0645** (0.0297)		-0.237*** (0.0594)	
non-zombie dummy x capital sunk x pre-crisis	0.0573 (0.0727)		0.0601** (0.0295)		0.2763*** (0.0606)	
non-zombie dummy x employment sunk		-0.0212 (0.0825)		-0.1227*** (0.0353)		-0.3055*** (0.0749)
non-zombie dummy x employment sunk x pre-crisis		0.1047 (0.0861)		0.1014*** (0.0364)		0.4381*** (0.0846)
Control variables	Age	Age	Age	Age	Age	Age
	Size	Size	Size	Size	Size	Size
	Industry	Industry	Industry	Industry	Industry	Industry
	Year	Year	Year	Year	Year	Year
Observations	22,675	22,675	28,022	28,022	28,413	29,413
within R <sup>2</sup>	0.074	0.074	0.113	0.114	0.167	0.168
Model	FE panel, 2003-2013	FE panel, 2003-2013	FE panel, 2003-2013	FE panel, 2003-2013	FE panel, 2003-2013	FE panel, 2003-2013

Source: Own calculations on data for non-financial enterprises with 20 or more employees, SO SR.

Note: Zombie firms are defined as enterprises older than 10 years with an ICR lower than 1 for 3 years in a row., considered to be from a non-financial corporate sector (NACE Rev. 2, Sections 10 to 83, excluding 64-66). Dlncapital means a logarithmic change in the fixed assets of a company, dlnemp indicates a logarithmic change in the company's employment and lnlabprod is calculated as logarithm of the value added divided by the number of employees in a given firm. \*\*\* is denoting the 1% statistical significance level, \*\* is denoting the 5% statistical significance level, \* is denoting the 10% statistical significance level.

<sup>13</sup> The further tests could not be done in this thesis because of limited access to the data.

### **3.4 Discussion**

This thesis confirms the results of the worldwide literature (e.g. Hallak et al., 2018) that zombie companies, which survive on the market despite their non-viability, are suppressing productivity growth. Summarizing the results from the analysis above, zombie enterprises are more likely to be found among the oldest and international companies, and their share varies across the industries. They tend to have low profitability and low equity to asset ratios. Consequently, we used the methodology from the research papers focusing on zombie companies (Caballero et al., 2008; Adalet McGowan et al., 2017) to the rich dataset of firms in Slovakia. The outcome of the empirical research shows that a higher capital share of zombie companies, in terms of fixed assets and total workers, is connected with lower investment rate, employment growth and labour productivity of a regular healthy firm. Therefore, the higher zombie share limits the growing opportunities of potential non-zombie companies. Adalet McGowan et al. (2017) suggest that zombie sunk also negatively influences productivity dispersion and creates barriers to entry. The analysis shows that during the period of recession this effect was even stronger. Robustness analysis of the mentioned results was mainly conducted with respect to previous literature as access to datasets was limited. It means that specifications used in this thesis were tested in previous studies, which provide this thesis with a sufficient comparison of the results.

Taken together, estimates in this thesis show that zombie companies are with high probability negatively affecting the output of the economy. This outlines the importance of public policy as it needs to mitigate this source of productivity weakness. In addition, it depends how much can public policy influence this recent trend in zombie congestion. As indicated in the Adalet McGowan et al. (2017), the popular policy actions at the beginning of any recession as a decrease of interest rates and loan guarantees prevent a large number of companies from exiting, which would cause large layoffs. However, the persistence of these policies can diminish economy growth by an inefficient allocation of resources and consequently, it postpones the exit of zombie companies.

The finding that zombie firms adversely impact their healthy competitors confirms the results of Gouveia and Osterhold (2018) that a better operating exit margin can significantly boost performance productivity. Therefore, it suggests to forthcoming research to explore short-term and long-term policies to mitigate this distorting effect.

From the short-term perspective, Gouveia and Osterhold (2018) show that intervention may take the form of price ceilings, price floors or tax subsidies together with the decrease of administrative barriers to entry as those policies are positively connected with higher zombie share.

The literature deals also with the long-term perspective, Andrews and Saia (2016) claim that the effective active labour market policies minimizing social expenses of transition, e.g. policies promoting job turnover or mobility of labour, would be helpful for healthy firms to attract the released capital from exited zombie firms sooner, which would decrease the costs caused from workers displacement. Important effects, which need to be taken into account, are initial costs of decline in aggregate employment caused by the exit of zombie enterprises (Adalet McGowan et al., 2017). However, in the long-term perspective, there would be expected adverse increase of employment, as it would be anticipated that the majority of released workers from zombie companies would be employed in healthy firms and potential start-ups, which would result in more efficient reallocation (Adalet McGowan et al., 2017). Another helpful factor from the long-term perspective would be a flexible education system proposed by Gouveia and Osterhold (2018). Last but not least, after setting reasonable conditions for the exit of zombie firms, there would be a necessity to focus on the policy encouraging the entry of potential companies and the growth of potential start-ups, which is also connected to the topic of zombie companies (Gouveia and Osterhold, 2018).

Based on the results analysed above, the end of this subsection will elaborate on the possible extensions of this topic for future research. First of all, the very crucial feature of zombies is that its staying ratio is fluctuating around 75% (Figure 2). Thanks to the simple calculation we obtain that in 2013 two thirds of zombie share were companies that had a zombie status also in the previous year. Therefore, an important further step would be to find out the way how zombies can turn to non-zombie status or exit the market in the following year. This methodology was studied in the past (Lam et al., 2017; Fukuda and Nakamura, 2011), where they observed the zombie companies which turned to non-zombie status the following year using various independent variables. As the most significant ones were variables representing deleveraging, as reduction of the debt burden can improve the repayment capacity. Secondly, the variable representing asset change, which indicated a case of asset reduction or asset

injection, showed that selling assets or getting financial help from parent company can help zombie companies to obtain a non-zombie status again. Finally, the ownership change coefficient together with labour force reduction coefficient also resulted as statistically significant. Another approach would be to research the ways why healthy companies become zombies. In the case of definition from Adalet McGowan et al. (2017), the research questions should be focused on a decrease in sales or increase of costs, together with controlling for a level of interest payments.

Furthermore, literature (Banerjee and Hofman, 2018) shows that congestion of zombies is associated with low interest rates. This can be the case in Slovakia, as the measured correlation of 2 years lagged short-term interest rates provided by OECD<sup>14</sup> and zombie share (Figure 1) in the period from 2006 to 2015 resulted with an amount of -0.878, which means that lower short-term interest rate is associated with an increase of zombie share in 2 years. However, because of the small amount of data, it was not presented in results, but it serves only as a possible topic for future research.<sup>15</sup>

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<sup>14</sup> Link on the website with the description: <https://data.oecd.org/interest/short-term-interest-rates.htm>

<sup>15</sup> All mentioned methodologies were previously supposed to be included in this work, but an indirect access to database did not allow for the complex examination of the particular methods.



## Conclusion

The outlook of the economy is often evaluated with aggregate indicators, while the objects which affect the health of the economy actually happen beneath the surface. The increase of unprofitable companies is one such example. In the future, it might lead to lower productivity growth and different disruptions on the financial markets. Convergence analysis of Slovakia in 2017 shows that Slovakia's convergence to the EU's average productivity is hampered by the high share of low-effective enterprises, among which are also those that do not have sufficient viability. Therefore, policymakers should become careful regarding prolonged periods of low corporate industry profitability. In this thesis, the large datasets of companies in Slovakia were used and we contribute to the literature with the findings of the occurrence of zombie firms in Slovakia.

This thesis extends the findings on the occurrence and impact of financially weak companies, so far published only for selected European OECD countries, with the results for Slovakia. Older firms whose operating profit (EBIT) does not cover their interest costs for at least 3 years in a row accounted for about 5.75% of non-financial firms in Slovakia in 2015. These companies use production resources that can be better utilized in more productive firms. Summarizing the outcome of the descriptive analysis, the highest proportion of zombie companies is among the oldest companies and their share varies across the industries.

Estimates in this thesis confirm the outcomes of the studies (Adalet McGowan et al., 2017; Gouveia and Osterhold, 2018) focusing on zombie companies, which have lower productivity compared to their non-zombie competitors. In addition, these companies have a negative impact, especially during the period of recession, on productivity and employment of non-zombie enterprises within industries, therefore, reducing overall productivity growth in Slovakia. This suppresses the growth of healthy firms, hence harming a more efficient industrial resource allocation. However, the benefits of a possible redistribution of capital and labour from zombie companies to non-zombie companies would probably be relatively low, especially when compared to some EU countries where zombie firms absorb a significantly larger proportion of fixed assets. Specifically, according to our calculations, Slovakia could lead to a slight increase of about 0.5 pp in investment for a regular firm.

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## Appendices

### Appendix 1. Impact of zombie share in Slovakia

	dlncapital		dlnemp		lnlabprod	
	(1)	(2)	(3)	(4)	(5)	(6)
non-zombie dummy	0.0814*** (0.0125)	0.0854*** (0.0129)	0.0629*** (0.0061)	0.0668*** (0.0063)	0.517*** (0.0256)	0.5467*** (0.0262)
non-zombie dummy x capital sunk	-0.0662 (0.0634)		-0.066** (0.0266)		-0.2421** (0.1018)	
non-zombie dummy x employment sunk		-0.131 (0.0861)		-0.1266*** (0.0358)		-0.7581*** (0.1426)
Control variables	Age	Age	Age	Age	Age	Age
	Size	Size	Size	Size	Size	Size
	Industry	Industry	Industry	Industry	Industry	Industry
	Year	Year	Year	Year	Year	Year
Observations	22,437	22,437	27,758	27,758	29,084	29,084
R <sup>2</sup>	0.056	0.056	0.07	0.071	0.56	0.56
Model	LPM, 2003-2013	LPM, 2003-2013	LPM, 2003-2013	LPM, 2003-2013	LPM, 2003-2013	LPM, 2003-2013

Source: Own calculations on data for non-financial enterprises with 20 or more employees, SO SR.

Note: Zombie firms are defined as enterprises older than 10 years with an ICR lower than 1 for 3 years in a row., considered to be from a non-financial corporate sector (NACE Rev. 2, Sections 10 to 83, excluding 64-66). Dlncapital means a logarithmic change in the fixed assets of a company, dlnemp indicates a logarithmic change in the company's employment and lnlabprod is calculated as logarithm of the value added divided by number of employees in a given firm. \*\*\* is denoting the 1% statistical significance level, \*\* is denoting the 5% statistical significance level, \* is denoting the 10% statistical significance level.

**Appendix 2. Impact of zombie share in Slovakia before crisis**

	dlncapital		dlnemp		lnlabprod	
	(1)	(2)	(3)	(4)	(5)	(6)
non-zombie dummy	0.0535*** (0.0107)	0.0524*** (0.0116)	0.0553*** (0.005)	0.0607*** (0.0054)	0.3383*** (0.0223)	0.3675*** (0.0245)
non-zombie dummy x pre-crisis	0.0205 (0.0158)	0.0152 (0.0165)	0.0027 (0.0084)	0.0004 (0.0088)	0.0455 (0.0352)	0.0201 (0.0368)
non-zombie dummy x capital sunk	-0.0771 (0.0616)		-0.082** (0.0253)		-0.5062*** (0.0915)	
non-zombie dummy x capital sunk x pre-crisis	0.1027* (0.0614)		0.0746*** (0.0255)		0.5058*** (0.0916)	
non-zombie dummy x employment sunk		-0.0558 (0.0672)		-0.1227*** (0.0286)		-0.6655*** (0.1145)
non-zombie dummy x employment sunk x pre-crisis		0.1423* (0.0728)		0.0802*** (0.0312)		0.6449*** (0.1188)
Control variables	Age Size Industry Year	Age Size Industry Year	Age Size Industry Year	Age Size Industry Year	Age Size Industry Year	Age Size Industry Year
Observations	22,675	22,675	28,022	28,022	28,413	29,413
R <sup>2</sup>	0.074	0.074	0.071	0.072	0.559	0.559
Model	LPM, 2003-2013	LPM, 2003-2013	LPM, 2003-2013	LPM, 2003-2013	LPM, 2003-2013	LPM, 2003-2013

Source: Own calculations on data for non-financial enterprises with 20 or more employees, SO SR.

Note: Zombie firms are defined as enterprises older than 10 years with an ICR lower than 1 for 3 years in a row., considered to be from a non-financial corporate sector (NACE Rev. 2, Sections 10 to 83, excluding 64-66). Dlncapital means a logarithmic change in the fixed assets of a company, dlnemp indicates a logarithmic change in the company's employment and lnlabprod is calculated as logarithm of the value added divided by number of employees in a given firm. \*\*\* is denoting the 1% statistical significance level, \*\* is denoting the 5% statistical significance level, \* is denoting the 10% statistical significance level.