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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

Productivity growth is diminishing among OECD countries, coupled with increased differences in productivity development among enterprises and misallocation of resources. A recent literature focuses on the role of zombie firms, defined as old firms that have persistent problems meeting their interest payments, to explain these developments. This thesis examines the extent to which zombie firms are stifling labour productivity performance. Using a rich firm-level dataset for Slovakia, we assess the role of zombies on firm dynamics. We confirm the results that prevalence of zombie firms curbs the growth of healthy firms and thus dragging aggregate productivity down. Controlling for cyclical effects, our analysis shows that zombie firms over the period 2003-2013 are significantly less productive within industries than their healthy counterparts. Furthermore, a higher share of industry capital or employment sunk in zombie firms is associated with lower labour productivity, investment and employment growth of the typical non-zombie firm, which results in less productivity-enhancing capital reallocation. These results highlight the role of public policy in addressing prevalence of zombie firms, fostering a more efficient resource allocation and enabling productivity growth.

Keywords

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

Abstrakt

Rast produktivity v krajinách OECD klesá, čo súvisí so zvýšenými rozdielmi vo vývoji produktivity medzi podnikmi a nesprávnym prerozdeľovaním zdrojov. Aktuálna literatúra sa zameriava na vplyv zombie firiem, definovaných ako staré firmy, ktoré majú pretrvávajúce problémy pri plnení svojich úrokových platieb, aby vysvetlili tento vývoj. Táto práca skúma, do akej miery zombie firmy brzdia produktivitu práce. Pomocou bohatého súboru dát slovenských firiem skúmame vplyv zombie statusu na dynamiku firiem. Potvrdzujeme výsledky, že výskyt zombie firiem obmedzuje rast životaschopných firiem a tým znižuje celkovú produktivitu. Pri kontrolovaní cyklických efektov naša analýza ukazuje, že zombie firmy v rámci odvetví v období rokov 2003-2013 sú podstatne menej produktívne ako ich zdravé náprotivky. Okrem toho vyšší podiel kapitálu alebo zamestnancov v zombie firmách je spojený s nižšou produktivitou práce, poklesom rastu investícií a rastu zamestnanosti typickej zdravej firmy, čo znamená, že kapitál zvyšujúci produktivitu je zle prerozdelený. Tieto výsledky poukazujú na úlohu verejnej politiky pri riešení výskytu zombie firiem so zameraním na efektívnejšie prerozdeľovanie zdrojov umožňujúce rast produktivity.

Kľúčové slová

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

Range of thesis: 73 102 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, 10.5.2019

Martin Bosák

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Bachelor's Thesis Proposal

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

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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Contents

INTRODUCTION	3
1. LITERATURE REVIEW	6
<i>1.1 Definition of zombies</i>	<i>6</i>
<i>1.2 Existing results on zombies</i>	<i>8</i>
2. DATA AND METHODOLOGY	12
<i>2.1 Data description</i>	<i>12</i>
<i>2.2 Methodology</i>	<i>13</i>
<i>2.2.1 Determinants of zombie firms</i>	<i>13</i>
<i>2.2.2 Zombie congestion and non-zombie firm performance</i>	<i>14</i>
<i>2.2.3 Effects of zombie firms during the pre-crisis period</i>	<i>16</i>
3. RESULTS AND DISCUSSION	17
<i>3.1 Zombie prevalence</i>	<i>17</i>
<i>3.2 Impact of zombie firms on the economy</i>	<i>21</i>
<i>3.3 Regression results</i>	<i>24</i>
<i>3.3.1 Determinants of zombie firms</i>	<i>24</i>
<i>3.3.2 Zombie congestion and non-zombie firm performance</i>	<i>25</i>
<i>3.3.3 Effects of zombie firms during the pre-crisis period</i>	<i>27</i>
<i>3.4 Discussion</i>	<i>29</i>
CONCLUSION	32
BIBLIOGRAPHY	34
APPENDICES	38

Tables

Table 1. Descriptive statistics for Slovak firm-level data	13
Table 2. Comparison of the average zombie and non-zombie firms.....	17
Table 3. Determinants of zombie firms.....	25
Table 4. Impact of zombie firms on non-zombie firms in Slovakia.....	27
Table 5. Impact of zombie firms on non-zombie firms in Slovakia before crisis	28

Figures

Figure 1. The share of zombie firms in Slovakia over time (%)	18
Figure 2. Share of zombie firms across age categories in Slovakia (2013, %)	20
Figure 3. Share of zombie firms across size categories in Slovakia (2013, %)... ..	20
Figure 4. Share of zombie firms across industry categories in Slovakia (2013, %).....	21
Figure 5. Share of zombie firms among the non-financial corporations; 10 OECD countries (2013, %)..	22
Figure 6. Counterfactual gains from reducing zombie capital share to the sample minimum (2013, %) ..	23

Introduction

The last decades have seen enormous progress in information and communication technologies, increased participation of firms in global value chains and a better than ever educated workforce (Peña-López, 2017; Jack and Lewis, 2009). These developments can be seen everywhere except in productivity statistics as aggregate data show a slowdown in global productivity growth. The slowdown in productivity in Europe over the last decade has forced us to focus 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 shortages in the field 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 performance and productivity in recent years.

The current subject of Slovakia's economic growth and convergence is the slow growth in productivity. 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 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 productivity of Slovak enterprises belongs to one of the most unequal ones. The number of highly productive enterprises is relatively small and low-productivity companies 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 within-company level has recently shown a general slowdown in growth in OECD economies with widespread performance variation in enterprises

(Andrews et al., 2016), along with the increasing misallocation of production resources (Gopinath et al., 2017). One of the sources of this decline is that there is number of companies, so-called zombie companies, defined as firms that are unable to cover debt servicing costs from current profits 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 and the potential growth of more productive companies as within a given industry, an increase in the capital stock sunk in zombie firms is associated with a decline in the ability of more productive firms to attract capital (Foster et al., 2016).

These companies are dragging down the economic growth, as the productivity of other firms is generally higher than their productivity and the resources allocated to them could be used more efficiently elsewhere. Studies also indicate that when weakly performing businesses compete for the same pool of labour and capital resources as more successful companies, profitable firms see their growth conditions diminished (Caballero et al., 2008). As a result, even a relatively low share of zombie firms can have negative effects for economic growth and productivity. In some 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 for small and medium-sized enterprises (Adalet McGowan et al., 2017).

Using a broad set of firm-level data for Slovakia, this thesis contributes to the literature on the role of zombie firms in explaining resource misallocation. We use harmonized business-level data throughout Slovakia to investigate the extent of the zombie firms, defined as firms 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 used 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 explanation for the productivity slowdown in some countries.

First of all, we employ firm-level data to assess the existence of zombie firms in Slovakia. Our use of this database allows us to make a relatively broad inference about the zombie ratio in Slovakia, which was not studied before. Secondly, descriptive statistics 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 counterfactual gains in Slovak economy, in the case when the capital owned by the zombies is reduced to the lowest level among the analysed countries. Furthermore, we explore corporate characteristics of these firms and we use equations which analyse the impact of the distortionary effects of zombie sectoral congestion on investment ratio, employment growth and labour productivity of the average non-zombie firm. Finally, we analyse effects of zombie share on firm performance of average healthy non-zombie firms during the pre-crisis period in comparison with subsequent recession.

This thesis confirms the results in the literature on the high prevalence of zombie firms in the economy, being significantly less productive than their healthy counterparts. According to the literature definition of zombie firms, these companies accounted for about 5.75% of non-financial firms in Slovakia in 2015. Our results show that these companies drag aggregate productivity down, increase the productivity dispersion and sink resources. This curbs the growth of non-zombie firms, harming the intra-sectoral resource reallocation. Our findings about these characteristics add refinement to the debate about zombie firms in Slovakia, since there has hitherto been little attention to important zombie attributes and their effects during the crisis. Consequently, we highlight the role of public policy in promoting an improved resource allocation within sectors, which would lead to better productivity growth and accordingly, we suggest issues for consideration in future research on this topic.

The remainder of the thesis is organized as follows. The next section, Section 1, reviews the literature on zombie firms, including a discussion on the quantitative criteria to define a zombie. Section 2 elaborates on the rich set of data used in the analysis and outlines the empirical methodology used to characterize zombie firms and to estimate the distortionary effects of zombie firms on non-zombie firm performance. Section 3 takes stock of the characteristics of zombie firms and provides descriptive evidence on zombie firms. This section employs a counterfactual simulation to illustrate the potential relevance of zombie congestion for a key component of potential growth and it also discusses the results of regressions. The final section offers some concluding thoughts, highlights the relevance of the findings for policy and outlines an agenda for future research.

1. Literature Review

1.1 Definition of zombies

In economic terms, a zombie is a firm that has low viability and therefore, competitive forces should compel it to exit the market or, where feasible, to restructure. In other words, a zombie firm is an unprofitable firm that continues to operate 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 during the Japan's macroeconomic revitalization (Hoshi, 2006; Caballero et al., 2008; Hoshi and Kashyap, 2011), 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 post-bubble economy demonstrated that increase of loans to highly indebted firms lowered their profitability (Sekine et al., 2003), and that industries with high ratio of zombie firms had lower productivity performance (Ahearne and Shinada, 2005), suggesting that zombie companies had negative effect on Japan's economic recovery. Studies also showed that Japanese banks' nonperforming loan problems made it more likely to provide credit to financially troubled firms, implying that zombie firms received life support in a process of "unnatural selection" that simultaneously reduced the credit available to healthy borrowers (Peek and Rosengren, 2005).

Caballero et al. (2008) dealt with inefficient firms, which due to the long-term loans survived on the market without trying to increase their profitability. As a result, the growth of healthy businesses has been limited together with increased creation of barriers for start-ups. Caballero et al. (2008) consider a firm to be a zombie if it receives financial help from their creditors to survive because of poor profitability. In practice, the authors compare the interest rate paid by the firm to a reference interest rate, that of

the highest quality borrowers. Those firms with a negative interest rate gap are receiving subsidized credit and thus are considered to be zombies. The method is very data demanding, implying detailed knowledge of each firm debt distribution. The authors focus on a sub-set of listed firms with publicly available information and for which it is possible to compute the reference rate, by relying on data for those firms with AAA-ratings. Their dataset covers the period 1981-2002, reaching, at most, 2500 firms per year. Given that the thesis relies on administrative data, the application of Caballero et al. (2008) methodology is not possible.

The Bank of Korea (2013) classifies a firm as a zombie if its operating income is less than interest costs - e.g. if the interest coverage ratio (the ratio of operating income to interest expenses) is less than 1 at least three consecutive years. In practice, it means that a company must take on additional debt to cover its interest payments. Based on the definition of The Bank of Korea, OECD work by Adalet McGowan et al. (2017) adds an age criterion - 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 among zombie companies. For example, investment usually involves a necessary trade-off between short-term costs and future productivity and profitability growth, which may cause performance metrics to significantly decline before revenue catches up. Particularly start-up companies are vulnerable to this. This study documented the extent of the presence and impact of zombie firms in selected OECD countries.¹

The three-year condition is important in addressing the pro-cyclicality concerns on the zombie status. On the criticism that by focusing only on firms older than 10 years, one ignores many firms that enter and leave the market before completing 10 years, it should be noted that the objective is not to target on unhealthy firms, but on unhealthy firms that endure in the market. Literature definition of zombie companies would currently fit the worldwide companies like electric car maker Tesla and streaming giant Netflix, as they satisfy the both conditions of the definition of zombie firm (Reid, 2018).

¹ 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 outputs.

Alternative definitions of zombie firms consider the profitability and debt ratios. According to Storz et al. (2017), a company with negative asset returns, negative investment and debt servicing capacity (EBITDA to total financial debt) less than 5% is considered as a zombie firm. Schivardi et al. (2017) defined 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%.

Considering the real availability of data on Slovak firms in this thesis, 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 interest coverage ratio is lower than one for a minimum of three consecutive years.

1.2 Existing results on zombies

Historically, the academic analysis of zombie companies originated with the Japanese macroeconomic stagnation in the 1990's (Hoshi and Kashyap, 2004; Caballero et al., 2008). Caballero et al. (2008) claim in their work that zombie firms in the Japanese economy are lowering market prices and raising wages, thereby reducing profits, weakening investment, and slowing down the expansion of healthy and new businesses. Applying the definition discussed in the previous subsection, the authors show a sharp increase of zombie prevalence in the early 1990's, stabilizing at high levels from mid-1990's to 2002, the end year of the sample. By relying on a reduced form model of spillovers of zombie congestion, the authors demonstrate that a higher share of capital sunk in zombie firms reduces the growth differential of healthy firms in relation to zombies. They found out that firms identified as zombies decreased productivity in sectors where their presence was higher and lowered their more profitable competitors' employment and investment growth by impeding human resources and reallocation of capital. These results led Caballero et al. (2008) to argue that zombie firms created deflationary pressures in the economy and probably caused some healthy firms to become zombies as well.

Peek and Rosengren (2005) claim that banking regulation is part of the mechanics behind the zombie sensation. Using a sample of loans provided to Japanese listed firms during the Japanese 1990's recession, the authors obtain the results that banks with capital ratios close to regulatory thresholds were more inclined to refinance

loans to weakly performing companies at unusually low interest rates compared to banks with stronger capital ratios. The authors refer to the phenomenon as bank forbearance, whereby banks rollover debt in order to avoid reporting losses, which in turn might trigger expensive regulatory recapitalization. This phenomenon is often considered to be a main factor explaining the Japanese economic stagnation of the 1990's, i.e. the growing occurrence of so-called zombie firms. Given the confidentiality of data, research considering loans cannot be applied in this thesis.

More recently, the literature (e.g. Adalet McGowan et al. 2017) has focused on the possible impact of low interest rates. The effects when credit subsidies are provided to insolvent firms in the form of lower interest rate margins has already been studied in relation to Japan's economic recession in the 1990s (e.g. Caballero et al. 2008). The results show that the proportion of weakly profitable firms decreases (increases) during periods of high (low) interest rates. The proportion of zombie firms rose especially after the financial crisis. However, these periods were also characterised by lower economic growth, which diminished profitability of firms across the board and increased the probability of companies turning into zombies. However, it is important to bear in mind that low interest rates do not cause weak earnings growth, it is the sluggish economy that diminishes the profitability of firms.

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 recession (Mian et al., 2015). The prevalence of zombie firms results in a difficult trade-off for central bank policy, according to BIS (Banerjee and Hofman, 2018). While lower rates should help to boost aggregate demand in the economy and raise employment, more zombie companies mean more misallocation of resources (Reid, 2018).

Studies from the Japanese macroeconomic stagnation period in the 1990s (Caballero et al., 2008, Peek and Rosengren, 2005, Hoshi, 2006) 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 businesses has been limited, as well as the creation of barriers for start-ups. A pattern of ongoing restructuring that resulted in Japanese macroeconomic stagnation in the 1990s may be relevant to understanding current productivity developments in Slovakia.

In this case, banks continued to lend to these firms for two reasons. Firstly, long-term interconnection of the bank with the borrower, causing undue ex-ante incentives on the part of the borrowers, forcing the bank to continue to provide loans (Chen and Chu, 2003; Nishimura and Kawamoto, 2004). Relationship banking, therefore, can foster zombie lending, as 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 attributed to the ‘zombie banks make zombie firms’ theory (Okamura, 2011).

Building on the work from Caballero et al. (2008), OECD workstream closely examined zombie phenomenon for a sample of OECD countries over the period 2003-2013. Adalet McGowan et al. (2017) show that the share of zombie companies has increased in several OECD countries which, together with the fact that zombies are, on average, larger than non-zombies, translates into high shares of capital sunk in zombie firms. Gopinath et al. (2017) find that capital is allocated to companies with higher net worth, not necessarily to the more productive ones. Being larger in terms of employment also implies large social costs from bankruptcy, which, as claimed by Adalet McGowan et al. (2017), may make them more likely to receive government subsidies or support in order to limit potential employment losses, especially during recessions. In the literature, this observation has been attributed to the ‘too big to fail’ theory: large firms, which may be seen as indispensable regional employers, are not allowed to collapse due to the threat of higher unemployment.

The increased zombie prevalence is a widespread phenomenon, particularly among European countries, mainly because of a steady decline in interest rate coverage ratios since 2011, despite the low interest rate environment (IMF, 2017; Mahtani et al., 2018). 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 intra-industry productivity growth (Cooper et al., 1999; 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 continued survival of zombie firms can directly reduce aggregate productivity and prevent potential entry into the market for new firms that have a huge innovation advantage that indirectly induce pressure on companies to improve productivity. Finally, it prevents from effective redistribution of production resources among more successful businesses.

Document from Acharya et al. (2017) shows that the Outright Monetary Transactions (OMT) program, an indirect subsidisation of European banks launched by the European Central Bank in 2012, has increased the incentive for banks to provide so-called zombie loans. The authors find that banks, which benefited from the program, increased their overall loan supply. However, this supply was mostly targeted towards low-quality firms with pre-existing lending relationships with these banks. In addition, this additional credit for zombie firms did not directly increase actual activity, but the misallocation of credit has adversely affected the growth of investment and employment of healthy businesses as a result of focusing on zombie firms.

The theoretical literature suggests that there are three means through which zombie firms can contribute to low aggregate labour productivity growth. Firstly, zombie firms themselves show low levels of labour productivity. Secondly, zombie companies crowd-out investment by the typical non-zombie company and finally, zombie firms hamper efficient resource allocation and MFP growth, by either preventing more productive firms from gaining market share, or new and more dynamic firms from replacing inefficient incumbents mainly because of low prices and high wages of zombie firms (Cooper et al., 1999).

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

2. Data and Methodology

2.1 Data description

This thesis relies on a two comprehensive sets of firm-level data provided by Council for Budget Responsibility (CBR) and National Bank of Slovakia (NBS).² Firstly, we use 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 2004 to 2015, and balance sheets for the period 2011 to 2013.

To address further issues rising from underrepresentation of small and young firms in CBR, we also align the CBR firm sample with the harmonized firm-level data from the National Bank of Slovakia collected by the Statistical Office of the Slovak Republic (SO SR). 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 made in accordance with the Statistical Classification of Economic Activities in the European Union, Revision 2 (NACE Rev. 2).

A number of adjustments to the dataset are needed to ensure the robustness of the results. Observations with negative values for the variables turnover, tangible assets, interest expenses and age are dropped. Furthermore, the sample is restricted to the non-financial business sector (NACE Rev.2 codes excluding 64-66). After data treatment, the unbalanced panel dataset includes 281,602 observations from CBR database and 50,956 observations from 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 firms, we report the corresponding statistics for zombie and non-zombie firms separately in the Section 3.1.

² 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 for Slovak firm-level data

	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 years in order to allow for a meaningful comparison with the data on zombies.

2.2 Methodology

2.2.1 Determinants of zombie firms

We present a series of econometrics 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 given industry and year. In our analysis, we use the panel data of Slovak firms from the non-farm non-financial business sector in the period 2003 to 2013.

This paper considers an equation to assess the determinants of zombie firms with the following specification (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 equal to 1 if a firm 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 takes value of one when the current profit is negative. As proxies of firm size, we consider natural logarithm of fixed assets and the log time difference in employment denoted as lnfix_assets and dl labour, 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 which are considered as zombies, we applied dummies for state-owned enterprises and for international firms denoted as soe and fdi, respectively. Finally, we added variable age as another firm characteristics, thus we can observe how the age of the firm is related with the probability of zombie status. We include separate industry and year fixed effects and use robust standard errors. The robustness of the baseline empirical results is tested by using three types of econometrics models (Linear Probability Model, Logit and Probit).

2.2.2 Zombie congestion and non-zombie firm performance

Productivity of zombie firms is lower compared to their non-zombie counterparts and they capture a non-negligible part of capital and labour, providing evidence of misallocation of resources towards healthy firms. Therefore, it is necessary to understand the possible negative effects of zombie congestion on healthy firms' growth and on intra-sectorial resource allocation.

In the literature (e.g. Caballero et al 2008; Adalet McGowan et al. 2017), it has been observed that the survival of zombie firms may weaken market efficiency and distort competition. Healthy markets are characterised by a process of creative destruction, where unprofitable or insolvent companies reduce their share of labour and successful companies invest and create new jobs. When zombies participate in the market, they raise demand for labour and increase competition for market share. This has the consequence of increasing wages and lowering product prices, effectively congesting growth conditions for more promising firms.

By evaluating not only firm-specific data but also estimates of the sectoral decomposition of zombie shares, we can attempt to quantify the impact that zombies have on production and employment growth. The use of sectoral estimates is based on the notion that if a large share of any given sector's capital or labour is held by zombie firms, this will negatively impact the performance of the entire sector and especially weaken growth conditions for healthier companies. To verify this phenomenon, we use

the panel data of Slovak firms in the non-farm non-financial business sector (NACE Rev.2 codes 10-83, excluding 64-66) in the period 2003 to 2013. Following the specification in Caballero et al. (2008), Adalet McGowan et al. (2017) and Hallak et al. (2018), we investigate the effects of the incidence of zombie firms on the performance of non-zombies with the following empirical model of firm performance:

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

where Firmperformance denotes one of three indicators capturing the performance of firm i in a 2-digit industry s in year t . The first performance indicator is investment ratio, which equals the difference in the natural logarithm of total fixed assets between two years. The second indicator measures the employment growth of the firm and it is defined as the log difference in the number of employees. The third indicator is labour productivity measured by the natural logarithm of the ratio of the value added of the firm compared to the number of its employees.

The independent variable nonZ is a dummy equal to 1 if a firm is a non-zombie firm. Variable Zshare is a measure of industry resources sunk in a given year in zombie firms, which, depending on the specification, is measured either in form of capital or labour, taking values between 0 and 1. Capital represents the share of fixed assets of zombie firms as a fraction of fixed assets of all firms in each 2-digit sector. The share of total workers employed in zombie firms as a fraction of all workers employed in the sector is denoted as employment sunk. Firm controls include the age of the firm and dummies for firm size categories (20-49, 50-249 and 250+). We include separate industry and year fixed effects to control for sectorial aggregate shocks as they impact both resources sunk and firm growth (Schivardi et al., 2017). We use robust standard errors.

Our econometric specification is designed with fixed effect structure that controls for unobserved time and industry varying specific shocks, including the overall (un)attractiveness of operating in an industry together with economic conditions in a given year. The fixed effects structure suggests that the absolute effect of resources sunk cannot be estimated, as it is absorbed by the sectorial and year dummy structure. A

negative β_2 implies that more resources sunk in zombie companies, representing higher misallocation of capital and labour, negatively affects the relative performance of non-zombie companies. Hence, in the discussion of the results in Section 3.3.2, we concentrate on the coefficient of the interaction term of the non-zombie dummy and the industry zombie shares (β_2).

2.2.3 Effects of zombie firms during the pre-crisis period

The main purpose of this part is to investigate 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 sample period between 2003 and 2007 and their results suggest that resources sunk in zombie companies was a policy issue even before the recession and further support the view that there is a structural dimension to the conjecture that the continued survival of weak firms is stifling labour productivity performance. In order to investigate the hypothesis, we modify Equation (2) to obtain Equation (3) that controls for the pre-crisis period:

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

Compared to Equation (2), we create the dummy variable pre-crisis that is equal to 1 if observation is from the pre-crisis period (2003-2007). Consequently, we introduce two interaction variables. Firstly, nonZ * pre-crisis, a dummy that captures difference in healthy firm performance compared to zombie firm in the period 2003-2007. Secondly, nonZ * Zshare * pre-crisis, an interaction which denotes non-zombie firms from the pre-crisis period interacted with the share of zombie firms in their given industries. Specifically, in this case we are interested in the impact of the share of zombies within the sectors on the growth and productivity of non-zombie firms in the pre-crisis period, which means that we are mainly interested in interpretation of coefficient β_4 .

3. Results and Discussion

3.1 *Zombie prevalence*

This section provides an overview of the patterns of zombie prevalence, dispersion over time and characteristics of zombie firms. Data from SO SR are available as of 2001, hence the zombie definition can be applied from 2003 onwards, the first year in which a firm could possibly trespass the "three consecutive years" condition.

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, what make them more prone to get access to credit, as it is more likely for them to have longer relations with banks. As illustrated in Table 2, the zombie firms are on average smaller in terms of employment, turnover and fixed assets, which is consistent with the findings in Japanese study (Nakamura, 2017). This is presumably because very large firms are less likely to require financial assistance. If one expects that big troubled firms 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. Comparison of the average zombie and non-zombie firms

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.

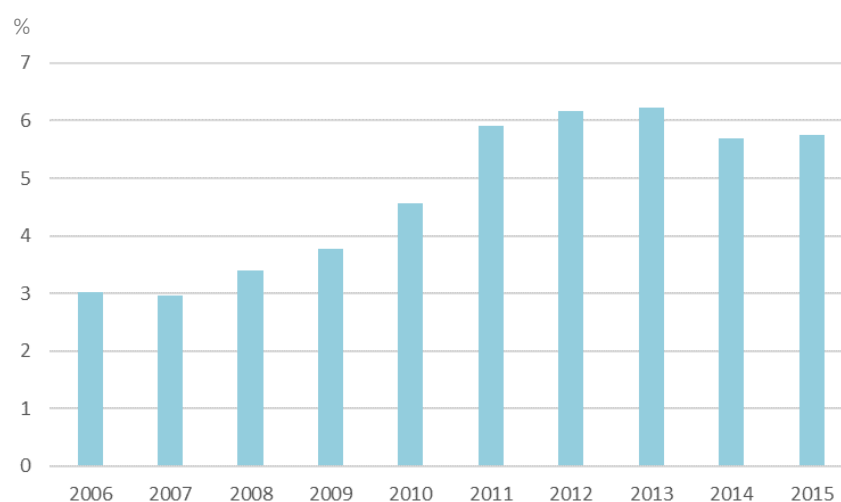
Note: This Table is conducting SO SR dataset, which is restricted to firms with 20 or more years in order to allow for a meaningful comparison with the data on zombies. Zombie firms are defined as non-financial enterprises older than 10 years with an interest coverage ratio less than 1 for three consecutive years.

From the analysis based on CBR, during 2006 and 2015, the share of zombie firms 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.³ Figure 1 shows that

³ Data for other OECD countries are only available until year 2013. Therefore, it is not clear whether the proportion of zombie companies in the next period has stabilized in other countries as well.

zombies were around 3% of all Slovak firms in 2006, increasing steadily to 6.2% in 2013. In Slovakia, the proportion of zombie firms has increased over the years 2007-2013 as part of a wider trend observable within the OECD countries, such as Spain, Belgium, Italy (Adalet McGowan et al., 2017) and Finland (Vanhala and Virén, 2018). Since 2013, the relative number of zombies decreased to close to 5.75% in 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. The share of zombie firms 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 interest coverage ratio less than 1 for three consecutive years.

Zombie measures suggest that the prevalence of zombies has increased significantly 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 the 2009 to 4.8% in 2011 (Appendix 1). The increase was not steady as upward shift was linked to economic downturn during the Great Financial Crisis (GFC). Adalet McGowan et al (2017) have shown that the prevalence of such companies as a share of the total population of non-financial companies (the zombie share) has increased significantly in the wake of the GFC across advanced economies more generally. The rise of zombie firms has been also driven by firms staying in the zombie state for longer time period, rather than recovering or exiting through bankruptcy. Specifically, the probability of a

zombie remaining a zombie in the following year fluctuated around 75% during the time period 2003-2013 (Appendix 1).

Secondly, we will focus on the prevalence of zombie firms across age, size and industry in 2013.⁴ A firm is identified as a zombie firm if it has an interest coverage ratio less than one for three consecutive years (2011-2013) together with age criterion of 10 years, but in case of age categories, we place no restriction on firm age.⁵

A simple analysis of the zombie firms in Slovakia shows that the largest share of zombie firms is among the oldest enterprises, as it is shown in Figure 2. The share of zombie firms with increasing age is gradually declining from the very beginning. The lowest share of zombie firms 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 the peak of 32.5% at category above 41 years.⁶ Higher percentages 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 the Figure 2 can be explained by the fact that large old firms are more likely to receive state funding as a mean of preventing unemployment, especially during the crisis period. This is consistent with corporate-based records in Japan, where large companies are more likely to be protected and subsequently become zombie firms (Hoshi, 2006).

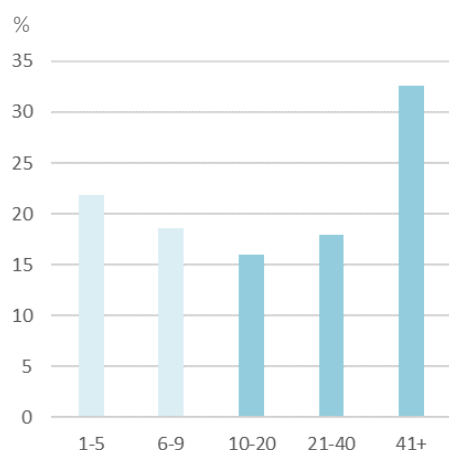
Findings regarding the size of the zombie firms in Slovakia in Figure 3 do not confirm the results for selected OECD countries, indicating that there is a significantly higher proportion of enterprises amongst large enterprises that have the problem of paying their interest expenses. Large companies 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 share for zombie firms does not grow with the size significantly as in the research paper Adalet McGowan et al. (2017) for selected OECD countries.

⁴ 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.

⁵ 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.

⁶ 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.

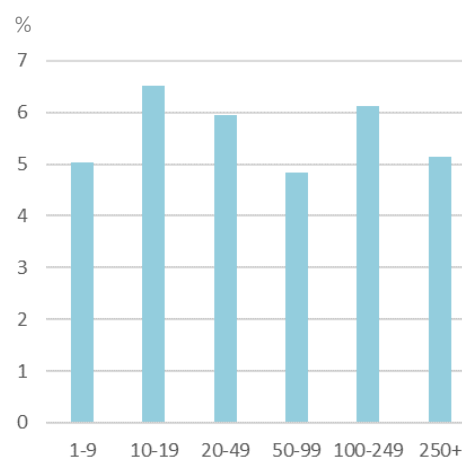
Figure 2. Share of zombie firms across age categories in Slovakia (2013, %)



Source: Own calculations based on CBR data.

Note: Zombie firms are defined as non-financial enterprises older than 10 years with an interest coverage ratio less than 1 for three consecutive years. The lighter part of the graph covers companies that do not satisfy age criterion.

Figure 3. Share of zombie firms across size categories in Slovakia (2013, %)

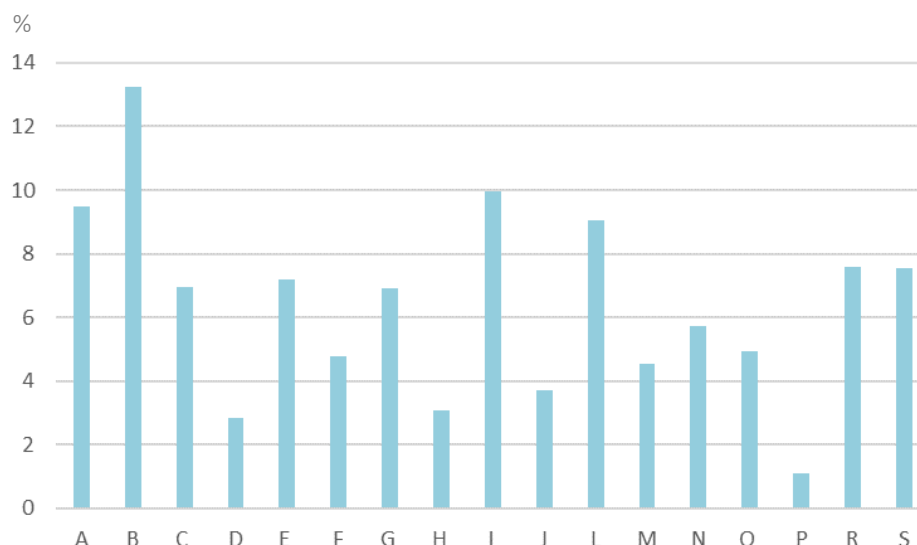


Source: Own calculations based on CBR data.

Note: Zombie firms are defined as non-financial enterprises older than 10 years with an interest coverage ratio less than 1 for three consecutive years. The size categories are based on the number of employees.

Given important sectorial heterogeneity (as also described by Caballero et al., 2008), Figure 4 presents percentage of zombie firms aggregated by main sector of activity in 2013.⁷ Significant differences can be observed in within industries segmentation. From that point of view, 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 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 manufacturing sector, the proportion of zombie firms is slightly higher than general average of non-financial corporations, which is inconsistent with the findings in Caballero et al. (2005), where result shows that zombies are more prevalent in non-manufacturing industries. The most enterprises with weak financial results are in the mining and quarrying sector.

⁷ 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.

Figure 4. Share of zombie firms 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 interest coverage ratio less than 1 for three consecutive years. 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.

3.2 Impact of zombie firms on the economy

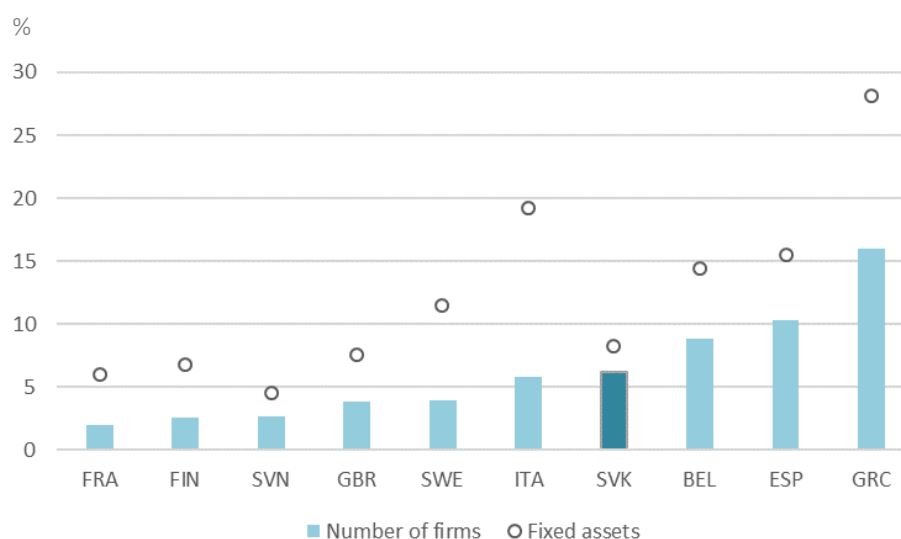
According to our calculations based on CBR, the share of zombie firms in Slovakia in 2013 was approximately 6.2% of the total number of enterprises (firms with required financial data for 2011-2013).⁸ In the EU countries, according to the OECD study (Adalet McGowan et al., 2017) the proportion of zombie companies in that year ranged between 2% and 16% in chosen countries. However, focusing too heavily on the proportion of zombies belies their economic impact, as their ubiquity is far outweighed by the amount 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 firms.

As shown in the following chart, Figure 5, 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 share of

⁸ 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.

zombie firms and their possible impact on the economy.⁹ 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 firms was approaching 20%. The proportion of zombies is the second highest in Spain (10%) and the lowest in France at 2%, which is consistent with the analysis that suggests that zombie lending to firms is not expanded in France (Avouyi-Dovi et al., 2016). 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 firms in 2013 was reported in Slovenia (4.5%).

Figure 5. Share of zombie firms among the non-financial corporations; 10 OECD countries (2013, %)



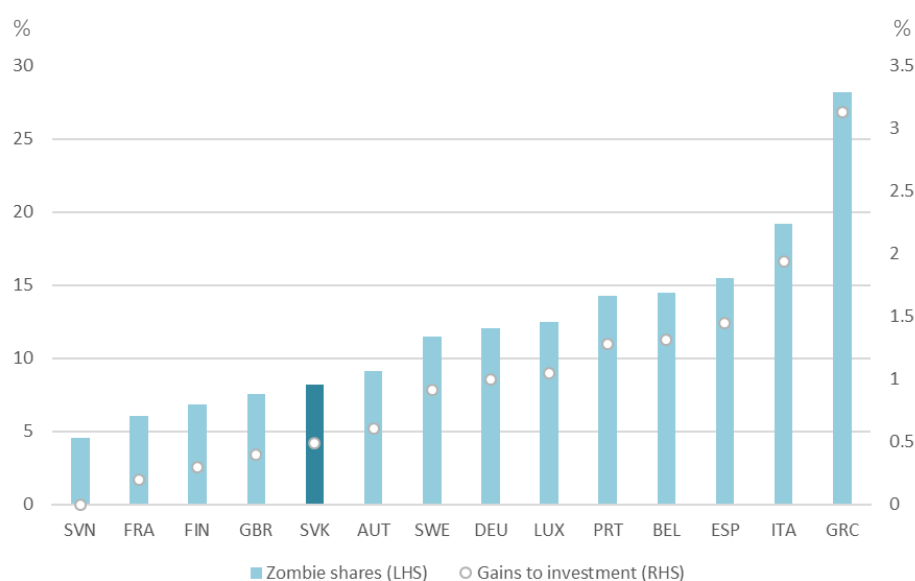
Source: Own calculations based on CBR, OECD (2017).

Note: Zombie firms are defined as non-financial enterprises older than 10 years with an interest coverage ratio less than 1 for three consecutive years. Number of firms and fixed assets refer to the share of number of firms and fixed assets in zombie firms.

⁹ 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).

In addition to a detailed analysis of the presence of zombie companies in OECD countries, 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 6, based on 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 capital sunk in zombie firms, a possible reduction of zombie firms in Slovakia could lead to a slight increase in investment for a regular firm (approximately 0.5 pp).¹⁰

Figure 6. Counterfactual gains from reducing zombie capital share to the sample minimum (2013, %)



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

Note: This figure shows the counterfactual gains to investment of a typical non-zombie firm from reducing the share of zombies to the sample minimum level (i.e. Slovenia in 2013). Zombie shares refer to the share of capital sunk in zombie firms, defined as non-financial enterprises older than 10 years with an interest coverage ratio less than 1 for three consecutive years.

¹⁰ 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).

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 showed in Table 3. Each column reports the coefficient estimates and their standard errors for a particular model. The data set covers the entire period from 2003 to 2013, except if the data is unavailable. Almost all coefficients in each model resulted as 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 being a zombie firm 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 with interest payments. Thus, there is a mechanical reason to expect that zombies have low profitability. The same effect we can observe in case of coefficient on age, which resulted as 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 is negligible. In addition, the coefficient of variable controlling for size growth is negative, which suggests that reducing the number of employees is more typical for non-zombie companies.

The coefficient on the equity ratio is negative and statistically significant. Thus, firms with lower fraction of equity are more likely to be zombies. This is consistent with the findings in Hoshi (2006).

The regression results suggest strongly that international firms are more likely to be zombies. The dummy variable indicating state-owned enterprises resulted as non-significant, which is in contrast with study provided on companies in China, where zombie firms, strongly linked to state-owned enterprises, are not only less productive than the other companies, but are also a significant part of the rising level of corporate debt (Lam et al., 2017).

Table 3. Determinants of zombie firms

	zombie dummy		
	(1)	(2)	(3)
L.roa	-0.1182*** (0.031)	-1.3336*** (0.3454)	-0.8233*** (0.1859)
L.neg_progit	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 ² (*)	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 interest coverage ratio less than 1 for three consecutive years., considered to be from a non-financial corporate sector (NACE Rev. 1, Sections C-N, excluding F). *** denotes statistical significance at the 1% level, ** significance at the 5% level, * significance at the 10% level.

(*) Pseudo R² is reported in case of Logit and Probit model.

3.3.2 Zombie congestion and non-zombie firm performance

Table 4 presents 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 SO SR database are used and FE stand for fixed effects.

The model predicts that β_2 will be negative for the all regressions, since zombie congestion reduces the incentives or ability for non-zombie firms to grow. The coefficient on the non-zombie dummy (β_1) is difficult to interpret. It could be negative if zombie firms receive large subsidies. On the other hand, it could be positive if zombie firms are not in a position to spend as much as healthy firms.

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.¹¹ As can be seen in Table 4, the coefficient corresponding to the non-zombie dummy variable 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 firms. As an illustration, these results mean that the labour productivity within industries differential between a non-zombie and a zombie is 0.185 pp lower for a zombie company. The impact of zombie companies on non-zombie companies in the industry is measured by the variable that links the non-zombie dummy variable with the within-industry capital sunk or employment sunk in zombie firms. The interaction term is negative in all cases (at different levels of significance depending on the particular model), meaning that the investment, employment growth and labour productivity of the typical healthy firm in relation to that of non-zombies within a sector is negatively affected by the resources (capital and labour) sunk in zombies.

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 non-farm and non-financial corporations with 20 or more employees confirm the negative impact of zombie firms on non-zombie firms within the industries. The identified differences between zombies and non-zombie firms are smaller, and the impact of zombie share on non-zombie firms is weaker in case of investment and stronger in case of employment growth compared to estimates made by Adalet McGowan et al. (2017) on sample of several EU countries. Moreover, consistently with European research study Hallak et al.

¹¹ 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.

(2018), non-zombie firms tend to have a higher labour productivity compared to zombie firms and the effects of the incidence of zombies resulted in larger magnitude in case of Slovak firms.

Table 4. Impact of zombie firms on non-zombie firms 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
R ²	0.015	0.015	0.019	0.019	0.057	0.058
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 interest coverage ratio less than 1 for three consecutive years., 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. *** denotes statistical significance at the 1% level, ** significance at the 5% level, * significance at the 10% level.

3.3.3 Effects of zombie firms 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 and zombie firms in productivity growth during the pre-crisis period. The impact of the share of zombies within the sectors on the performance of non-zombie firms is negative overall 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 show that an increase in the zombie share at the industry

level was associated with lower labour productivity, investment and employment growth for the average non-zombie firm 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 firms during the pre-crisis period. These results suggest that the economic downturn was one of the main drivers of the distortionary effects of zombie firms.

Table 5. Impact of zombie firms on non-zombie firms 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
R ²	0.016	0.016	0.016	0.016	0.052	0.053
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 interest coverage ratio less than 1 for three consecutive years., 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. *** denotes statistical significance at the 1% level, ** significance at the 5% level, * significance at the 10% level.

3.4 Discussion

This thesis provides evidence that the prevalence of financially weak firms, that survive on the market despite their non-viability, is suppressing productivity growth. Summarizing the results from the analysis above, zombie firms are more likely to be found in manufacturing industries and among the oldest and international companies. They tend to have low profitability and low equity to asset ratios. Consequently, we apply the framework from the research study of zombie firms in Japan (see Caballero et al., 2008) together with recent OECD research (Adalet McGowan et al., 2017) to a sample of Slovakia's firms and show that a higher percentage of industry capital sunk in zombie firms is associated with lower investment rate, employment growth and labour productivity of a typical non-zombie firm. Besides limiting the expansion possibilities of healthy incumbent firms, market congestion generated by zombie companies can also worsen productivity dispersion, create barriers to entry and constrain the post-entry growth of young firms. Finally, we find that an increase in the capital stock or employment sunk in zombie firms during the period of recession was associated with less productivity-enhancing capital reallocation, measured as the decline in the productivity of the average healthy firm.

Taken together, estimates in this thesis shows that zombie companies might be a significant barrier to the recovery in potential output, through their negative effects on capital deepening. In turn, this raises several issues for policy as it needs to mitigate this source of productivity weakness. In addition, it depends to what extent is policy responsible for the increase in zombie congestion as indicated in the OECD study (Adalet McGowan et al., 2017). For example, in the early stages of the crisis, some crisis-induced policies such as low interest rates and government loan guarantees may have been useful in facilitating credit and preventing company exit that would lead to large layoffs. However, given the length of the crisis, the persistence of some of these policy initiatives may now be harmful to productivity growth by distorting credit supply, especially given asymmetric information problems making it difficult to classify zombie firms, and postponing the potentially positive contribution of exit.

The finding that zombie firms adversely impact their healthy counterparts confirms the results of study that a better functioning exit margin can provide a significant scope to boost labour productivity. It motivates future empirical research to explore how a range of structural, macroeconomic and financial policies can directly

shape aggregate productivity along the exit margin through their impact on two key channels (see Adalet McGowan and Andrews, 2016). Firstly, the strength of market selection, which increases in the economy's ability to dispose of zombie firms and make possible the restructuring of healthy firms, is key for boosting within-firm productivity growth in the future. Secondly, the speed and scope at which scarce resources consumed by unhealthy firms can be reallocated to more productive companies are essential to establish a strong contribution of firm reallocation to aggregate productivity (Adalet McGowan et al., 2017).

Furthermore, reallocation-friendly policy initiatives such as those facilitating labour mobility or job turnover will also be crucial in allowing more productive firms to expand with resources released from the exiting firms. Since the exit of low productivity firms implies more labour market churn, policy would need to cover the costs of worker displacement and to ensure efficient worker reallocation through well-designed active labour market policies (Andrews and Saia, 2016). While the exit of zombie firms may initially mean a decrease in aggregate employment, over time the costs to displaced workers will be mitigated by two factors. First, the elimination of the zombie congestion results in higher non-zombie employment growth, especially among young firms which contribute to aggregate job creation (Haltiwanger et al., 2013; Criscuolo, et al., 2014). Second, the exit of zombie firms makes scope for some displaced workers to be reallocated to a job that better suits their skill, which is significant given evidence that highly skilled labour is trapped in relatively low productivity firms in many OECD countries (Adalet McGowan and Andrews, 2015). A better matching of skills to jobs makes workers more productive, implying scope for higher wages, and reduces the risk that under-utilised skills will quickly depreciate.

Finally, the evidence shows that there are additional policy complementarities that need to be addressed. For instance, administrative barriers to entry are positively associated with higher zombie congestion and lower exit (Monteiro et al., 2017; Aghion et al., 2017). There is also scope for improvements in human capital, mainly at managerial level, as it is a key to potential firm-level growth (Bloom et al., 2012; Pellegrino and Zingales, 2017). To different degrees, all these elements, taken together, explain the country level developments. Therefore, a successful policy agenda must tackle these challenges in a coherent manner.

To sum up, while the knowledge of the consequences of zombie congestion is crucial, effective policy action depends on a deeper understanding of the nature of zombie firms and how they are related to existing institutional features. Important questions in this case is if these zombie firms are inherently unviable or if they become zombies ex-post due to bad shocks or due to a regulatory setting that does not enable them to strive and grow. While there is evidence that ex-ante heterogeneity across firms is a key determinant of ex-post growth (e.g. Pugsley et al., 2017), it is necessary to better understand what those ex-ante factors are and what drives dynamics of zombie companies. Moreover, as the margin of improvement in exit and restructuring barriers decreases, there is need to better understand what can be done to further encourage the exit of zombies, the growth of potential incumbents and the entry of dynamic firms, which can be the key to boost employment and productivity (e.g. Haltiwanger et al., 2013).

Conclusion

The outlook of the economy is often evaluated with instruments such as aggregate values and averages, while the objects which affect the health of the economy actually happen beneath the surface. The rise of unprofitable firms is one such example. In the future, it might lead to lower productivity growth and various disturbances 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. Policymakers should therefore become careful regarding prolonged periods of weak corporate sector profitability. There is widespread evidence of resource misallocation across OECD countries, harming productivity growth. By making use of a comprehensive set of firm-level data for Slovakia, we contribute to the literature on the role of zombie firms in explaining resource misallocation 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. According to the literature, older firms whose operating profit (EBIT) does not cover their interest costs for at least three consecutive years are defined as zombie firms, 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. Estimates in this thesis confirm the results in the literature on the prevalence of zombie firms, being significantly less productive than their healthy counterparts. 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 intra-sectoral resource reallocation. 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.

These results point out the role of public policy in addressing zombies' prevalence and thus in encouraging productivity growth. While there is an evidence of high-skill labour sunk in firms with low productivity (Adalet McGowan and Andrews,

2015), suggesting large gains from a more efficient reallocation, there is need to minimize social costs during the transition, also for those with lower skills. However, the reallocation of employment is not only important from a social perspective, but it is also determinant for positive aggregate effects on potential output, as otherwise the stock of human capital is reduced. Therefore, a flexible education system and effective active labour market policies have a particular role to play (Andrews and Saia, 2016). Finally, it would be crucial to understand better the employment dynamics, both in terms of type of contract (permanent vs. temporary vs. contract work) and level of skills in order to better inform policy makers.

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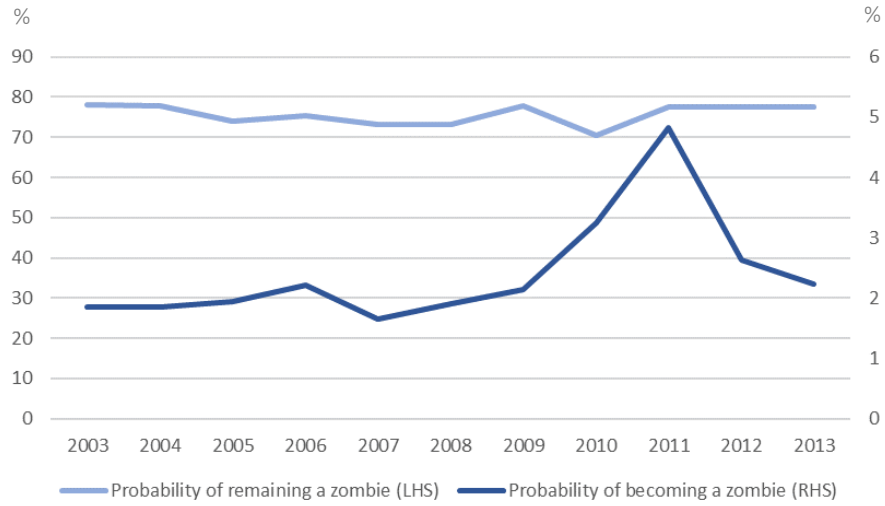
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Appendices

Appendix 1: Rise and survival of zombie firms (%)



Source: Own calculations based on SO SR data.

Note: Zombie firms are defined as non-financial enterprises older than 10 years with an interest coverage ratio less than 1 for three consecutive years.