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THE IMPACT OF ZOMBIE COMPANIES ON THE PERFORMANCE OF HEALTHY COMPANIES AND ECONOMIES IN SELECTED COUNTRIES OF CENTRAL AND EASTERN EUROPE

The main goal of this paper is to analyze the impact of zombie companies on the performance of healthy companies, economies, and economic sentiment (ESI) in selected countries of Central and Eastern Europe between 2008 and 2016. Zombie companies are companies whose sustainability is uncertain and whose competitiveness is very limited, and such companies can potentially transfer losses to the companies they are associated with. In this paper, they are defined as companies with negative return on assets, negative net investments and interest rates coverage below 1.5. The results of the panel model with fixed effects show that the market congestion by zombie companies has a negative effect on productivity and profit per employee, a positive impact on investments and no impact on employment growth of

healthy companies. Dynamic panel model results suggest that market congestion by zombie companies does not have a significant impact on the GDP of selected countries of Central and Eastern Europe while there is a positive relation with ESI. By analyzing the zombie companies issue in the Central and Eastern Europe countries, and their impact on ESI in general this paper contributes to the existing body of literature.

Key words: *zombie companies, panel model, productivity, profit per employee, economic sentiment indicator*

1. INTRODUCTION

World economies are striving to become more competitive in order to find themselves on the path to sustainable growth. The main long-term factor of economic growth is productivity growth. However, the productivity growth varies considerably over time (Blanchard, 2017). Over the past two decades, there has been a slowdown in the growth of potential production. In the European Union (EU), it has been slowing down by about one percentage point a year since the late 1990s. Enterprise-level research is increasingly linking declining aggregate productivity with growing differences between companies in terms of productivity, poor capital redistribution between companies, and business slowdowns (Andrews & Petroulakis, 2017). Of particular concern is the fact that companies that would normally leave a competitive market nevertheless continue their business, which affects the average productivity and potential growth reduction of all companies (Adalet McGowan, Andrews & Millot, 2017). Namely, such companies whose sustainability is uncertain and competitiveness is very limited, can transfer risks or losses to the companies with which they are associated. In addition, such companies are congesting the market by restricting the entry of new companies into the market and increasing the gap in average multifactor productivity (MFP) relative to the so-called healthy enterprises (Caballero et al., 2008). We call these companies the zombie companies.

In a perfectly competitive market, the process of creative destruction forces companies that perform poorly to exit the market or improve efficiency. However, there are indications that the process of creative destruction is slowing down and that this is where the main weakness of many countries, including the countries of Central and Eastern Europe (CEE), lies. The average share of zombie companies of selected CEE countries is 8.44% compared to the EU average of 6% (Hallak, Harasztosi & Schich, 2018). GDP per employee, which reflects the productivity of a country, indicates lower productivity of CEE countries compared to the EU

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(World Bank, 2019). This suggests that in selected CEE countries, the problem of zombie companies could be the cause of their lower productivity. A competitive economy needs a competitive business structure. This imposes the need to find policies to address this problem (Adalet McGowan et al., 2017) and highlights the importance of this research subject in both scientific and policy terms.

The aim of this paper is to analyze the impact of zombie companies on the performance of the so-called healthy companies in selected CEE countries (Bulgaria, Czech Republic, Hungary, Romania, Slovakia, Slovenia and Latvia) for the period 2008-2016 and the role of zombie companies in their economic growth, productivity growth and economic sentiment (ESI). Based on data availability, medium, large, and very large zombie and healthy companies were analyzed. Zombie companies are defined as low-performance companies that nevertheless continue their business operations and jeopardize the performance of healthy companies. Zombie companies in this paper are defined as those with a negative return on assets (ROA), negative net investments, and interest rate coverage lower than 1.5, with interest rate coverage defined as earnings after tax and interest divided by interest paid.

The first part of the analysis estimates the impact of zombie companies on the performance of healthy companies represented by employment growth rate, profit per employee, investment, and productivity. In accordance with the existing empirical literature and the results of formal testing, an econometric panel model with fixed effects is implemented, and the robustness of the initially estimated model is analyzed on a subsample of manufacturing companies. The second part of the empirical analysis estimates the impact of zombie companies on the economic performance and ESIs of the observed countries as a whole. Previous research has mostly analyzed the role of macroeconomic shocks during the crisis as a cause of economic slowdown. However, in such models, the slowdown in MFP is taken as exogenous, and cannot explain the pre-crisis slowdown in growth rates (Andrews, Criscuolo & Gal, 2016). This is why this paper analyzes the microeconomic aspect of the slowdown of the observed economies. The dynamic panel analysis is conducted on the data for the period from 2008 to 2016. Since the issue of zombie companies in the former transition CEE countries has so far been insufficiently researched in the existing literature, and the impact of zombie companies on ESI is completely unexplored, the results of the research contribute significantly to the existing literature.

The paper is structured in six chapters. The introduction is followed by a literature review. Afterwards the empirical models are presented, followed by the data and methodology description. After presenting the results of the empirical analysis, the last chapter presents a conclusion.

2. LITERATURE REVIEW

The term zombie in economics was first used by Kane (1989) to describe insolvent banks that continued to operate during the 1980s crisis in the United States (USA). However, the term is best known from a description of the situation in Japan in the 1990s after the bursting of the property price bubble. Zombie companies were hopeless insolvent companies that remained in the market thanks to loan refinancing and caused negative externalities for the economy in which they operated (Nakamura, 2016). There is no single definition of a zombie company, which implies the possibility of making mistakes while defining a company as a zombie company. An overview of the different criteria for defining zombie companies in the existing literature can be found in Table 1.

Table 1.

CRITERIA FOR DEFINING A ZOMBIE COMPANY

Criteria	Source(s)
Companies that receive subsidized loans.	Adalet Mc Gowan et al. (2017), Caballero et al. (2008), Tan et al. (2016)
Companies whose amount of interest paid is lower than the hypothetical amount of interest paid by low-risk companies.	Caballero et al. (2008)
Companies whose return on assets (ROA) of companies is negative for at least two consecutive years.*	Storz et al. (2017)
A company with negative net investments for at least two consecutive years.	Storz et al. (2017)
Companies with debt serviceability, measured as EBITDA less net financial debt, lower than 5% for at least two consecutive years.**	Storz et al. (2017)
Businesses facing debt repayment issues - unable to repay their debts in the medium term unless they reduce debt, operating costs or capital costs.	IMF (2013)
Companies that are below the critical limit of the interest rate coverage ratio for at least one year, i.e. that are not able to repay interest from their current receipts.	Fidrmuc & Siddiqui (2015)
Companies older than ten years with interest rate coverage below 1 for three consecutive years.	Andrews et al. (2017)

Criteria	Source(s)
Companies older than ten years with low debt serviceability for three consecutive years.	Andrews et al. (2017)
Companies older than ten years with a negative return on assets or negative investments in three consecutive years.	Andrews et al. (2017)
Companies that make a lower profit than the amount of the subsidized interest rate.	Fukuda & Nakamura (2011), Tan et al. (2016)
Companies that have an extremely low amount of interest paid in relation to the level of debt.	Hoshi (2006)
Companies that have an extremely low amount of interest paid in relation to the level of debt.	Hoshi (2006)

Note: * The ROA shows how profitable a firm is in relation to the total assets of the firm (Investopedia, 2018c), ** Earnings before interest, taxes, depreciation and amortization (EBITDA) are obtained as operating profit plus depreciation costs and depreciation costs (Investopedia, 2018a)

Source: Authors

The way in which zombie companies affect the productivity of the economy is closely related to Schumpeter's (1942) understanding of the process of creative destruction – the development of new products and the application of more efficient production processes lead to the destruction of obsolete production techniques (Andrews & Saia, 2017). According to the process of creative destruction, profit-maximizing banks will not lend to lower-performing companies, pressuring them to either become more efficient or cease operations. Loans are thus allocated to more innovative or young companies that have the potential for growth. However, research shows that banks continue to lend to zombie companies despite their poor performance (Ridzak, 2012) and disrupt the process of creative destruction (Ahearne & Shinada, 2005). Zombie enterprise congestion reduces the profits of healthy enterprises, prevents more productive enterprises from gaining market share, and discourages entry and investment in sectors in which such enterprises are present (Hoshi, 2006), stifling a potentially important source of productivity growth for the economy as a whole. In both ways, these credit restructuring procedures (so-called evergreening or zombie lending) have negative economic consequences (Caballero, Hoshi, & Kashyap, 2008).

Historically, the impact of zombie enterprises on healthy enterprises and economies has been empirically analyzed on the example of macroeconomic stagnation in Japan during the 1990s (Andrews, Adalet McGowan & Millot, 2017). Caballero et al. (2008) used panel models with fixed effects to conclude that the increase in the number of zombie companies from 1981 to 2002 in Japan slowed down the growth of investment and employment in healthy companies and that sectors dominated by zombie companies were characterized by low productivity

growth. Imai (2016) also conducted a panel analysis with fixed effects of SMEs in Japan from 1999 to 2008 and concluded that the fact that zombie companies remained in the market was the cause of economic stagnation in Japan. Hoshi (2006), on the other hand, used a probit model to compare the characteristics of zombie companies with healthy companies from 1993 to 2002 and found higher employment growth in zombies than in healthy companies. However, he showed that as the share of zombie companies in a particular industry increases, job creation decreases, and this effect is stronger in zombies than in healthy companies. Finally, Ahearne & Shinada (2005) used enterprise- and industry-level data on Japan from 1970 to 2001, and using a descriptive analysis concluded that inefficient zombie companies in the 1990s hampered more productive companies in gaining greater market share and negatively affected the productivity growth of the entire economy.

The analysis of zombie companies has expanded from Japan to the analysis of their role in many other economies around the world. Tan, Huang & Woo (2016) analyzed Chinese companies from 2005 to 2007 using panel models with fixed effects and weighted least squares models. They found that government investment and higher concentration of state-owned banks favor the development of zombie companies. At the same time, if zombie companies left the market, they showed, the growth rate of production, the rate of capital accumulation, the growth rate of employment and the growth rate of factor productivity would be higher. Fidrmuc & Siddiqui (2015) used a dynamic panel model to analyze the similarities between the inefficient use of assets of certain European companies from 2005 to 2012 and zombie lending in Japan during the 1990s. Empirically, they confirmed that more efficient institutions, represented by the smaller role of zombie companies, were associated with more efficient use of company assets and can be considered an important prerequisite for long-term growth and per capita income. However, they concluded that the recession is not correlated with interest rate coverage, one of the criteria by which zombie companies are defined. Adalet McGowan et al. (2017) conducted a panel analysis using pooled and cross-section data for nine member countries of the Organization for Economic Co-operation and Development (OECD) from 2003 to 2013. They concluded that zombie companies hamper labor productivity growth, negatively affect the investment and employment growth rate of a typical healthy company, reduce productivity and limit the growth of young companies, and create barriers to entry for new companies. Urionabarrenetxea, San-Jose & Retolaza (2016) concluded by descriptive analysis of companies in EU countries from 2009 to 2012 that 9% of the large and medium-sized companies make up 88% of all companies with negative equity, but that there is no link between countries with weaker economic performance and a larger number of risky companies within the country. Additionally, they found that the problem of highly indebted companies is not cyclical but structural. Homar & Wijnbergen (2013) us-

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ing a panel model with fixed effects for countries that went through a banking crisis between 1980 and 2013 concluded that due to the problem of undercapitalization of the banking sector, interventions such as bank guarantees and liquidity grants lead to granting loans to companies with poor financial characteristics and hinder the recovery of the economy. Andrews & Petroulakis (2017) analyzed panel models with fixed effects on a sample of 11 European countries from 2001 to 2014 and concluded that zombie companies are associated with lenient lending and banks that perform poorly and that a higher share of zombie companies in the economy negatively affects the ability of more productive enterprises to attract capital.

The existing empirical literature clearly shows that there are zombie companies in the EU, that the problem is structural rather than cyclical, that a higher concentration of state-owned banks favors the emergence of zombie companies, that improving the health of banks on the periphery of the eurozone has enabled the more intensive lending to the zombie companies and that higher lending activity at the aggregate level did not translate into economic growth. However, the existing literature so far has not sufficiently explored the issue of zombie companies in the former transition CEE countries that are more prone to the existence of zombie companies according to the characteristics of their banking sectors (Cull, Martinez Peria & Verrier, 2018). Therefore, this paper contributes to the existing literature by analyzing the impact of zombie companies on the performance of healthy companies, but also the entire economies of the selected CEE countries. The Economic Sentiment Index (ESI) represents the sentiment of a wide range of economic participants (consumers and companies) and is generally accepted as a predictor of economic activity (European Commission, 2019; Sorić, Škrabić & Čižmešija, 2013; Erjavec, Sorić & Čižmešija, 2016). Thus, in this paper, we view ESI as a complement to the analysis of GDP and productivity and analyze how zombie companies impact it. This analysis of the impact of zombie companies on ESI is still unexplored in the existing literature, which is another significant contribution of this paper.

3. EMPIRICAL MODEL

The paper analyzes two types of models. First, the impact of zombie companies on the performance of healthy companies is analyzed. Second, the impact of zombie companies on the economic performance and economic sentiment of the observed countries is analyzed. What follows is an overview of these two groups of empirical models.

3.1. Models of the impact of zombie companies on the performance of healthy companies

The first group of models analyze how the change in capital of the average zombie company affects the performance of healthy companies in selected CEE countries. The company performance is defined as: productivity (Model 1), employment growth (Model 2), profit per employee (Model 3), and investment (Model 4). The formulation of the econometric model relies on the models of Caballero et al. (2008) and Adalet McGowan et al. (2017), and can be written as

$$Y_{isct} = \beta_1 nonZ_{isct} + \beta_2 nonZ_{isct} * Z_{sct} + \beta_3 S_{isct} + \delta_{sct} + \varepsilon_{isct} \tag{1}$$

where Y_{isct} represents performance of company i, in the industry s, country c, and at time t. Variable $nonZ_{isct}$ is a binary variable which takes on the value 1 if the company i is not a zombie company. Variable Z_{sct} represents an average change in capital of the zombie company in industry s, country c, and time t, where the term capital implies physical equipment that enables the improvement of productivity. S_{isct} is a control variable of sales. Finally, δ_{sct} represents spatially specific effect, and ε_{isct} the error term. After the main analysis conducted on the full sample of companies, the robustness analysis of the model from equation (1) is performed on a subsample of manufacturing industry.

Based on the theoretical and empirical literature, the following signs of the estimated model coefficients are expected. First, the sign of the coefficient next to the binary variable $nonZ_{isct}$ should be positive, i.e., healthy companies are expected to perform better than zombie companies (Caballero et al., 2008). A negative sign could appear if zombie companies receive relatively high subsidies compared to healthy companies (Adalet McGowan et al., 2017). However, a positive sign is more likely in the observed group of countries.

Furthermore, the assumption that increased congestion in the zombie market is to the detriment of healthy companies is analyzed by the coefficient next to the interaction term of the binary variable $nonZ_{isct}$ and the average change in the capital of the zombie company Z_{sct}. A negative sign of the parameter β_2 is expected. Namely, if the share of zombie companies in the industry is higher, the performance of healthy companies is expected to decrease due to reduced entry of new companies into the market, reduced number of new investment ventures and as a reflection of the overall unattractiveness of doing business in an industry congested by zombie companies (Caballero et al., 2008).

3.2. *Models of the impact of zombie companies on economic activity and economic sentiment*

The impact of zombie companies on the macroeconomic performance and ESI of Bulgaria, the Czech Republic, Hungary, Romania, Slovakia, Slovenia and Latvia for the period 2008–2016 was formulated by Equation (2). The model was chosen based on the economic theory according to which the GDP growth rate in country c, and year t ($daggregate_{ct}$) is determined by the growth rate of consumption (dc_{ct}), the growth rate of investments (di_{ct}), the growth rate of government consumption (dg_{ct}), and the growth rate of net exports (dnx_{ct}). Given that the subject of interest is the impact of zombie companies on the macroeconomic performance of the economies of selected countries as well as on the ESI, the growth rate of zombie companies ($dzombi_{ct}$) is also included in the model. The GDP growth rate (Model A), the GDP growth rate per capita (Model B) and the GDP growth rate per employee as a measure of productivity (Model C) were chosen as macroeconomic performance indicators and used as the dependent variables. Given the good predictive capabilities of ESI with respect to the aforementioned dependent variables, we also include ESI as one of the dependent variables (Model D).

$$daggregate_{ct} = \beta_0 + \beta_1 dc_{ct} + \beta_2 di_{ct} + \beta_3 dg_{ct} + \beta_4 dnx_{ct} + \beta_5 dzombi_{ct} + \theta_t + \varepsilon_c \qquad (2)$$

In the Equation (2) θ_t is spatially specific effect, and ε_c is the error term.

According to economic theory, a positive sign is expected for the growth rate of consumption, the growth rate of investment, the growth rate of government consumption and the growth rate of net exports, given that these variables positively affect the GDP growth rate and the rest of the dependent variables. On the other hand, a negative sign is expected for the growth rate of zombie companies because it is assumed that zombie companies are suffocating the economy as a whole and thus negatively affecting the performance of the observed economies. If consumers and businesses are aware of the problem of the congestion of market by the zombie companies, the relationship between the economic sentiment and zombie companies is expected to be negative. However, it is more likely that due to the myopia of economic agents this relationship will be positive since the preservation of existing jobs in zombie companies will have a positive response of the involved parties as well as the public.

4. DATA AND METHODOLOGY

4.1. Data

Data used in the first part of the empirical analysis cover 16,424 companies in the selected CEE countries (Bulgaria, Czech Republic, Hungary, Romania, Slovakia, Slovenia and Latvia) from 2008 to 2016. This group of countries is interesting for the analysis of zombie companies considering its banking sector characteristics make it more prone to the existence of problems of zombie companies (Cull et al., 2018). Data were gathered from the Amadeus database. The variables used in the analysis are shown in Table 2.

Table 2.

VARIABLES AND DATA SOURCES OF MODELS 1-4

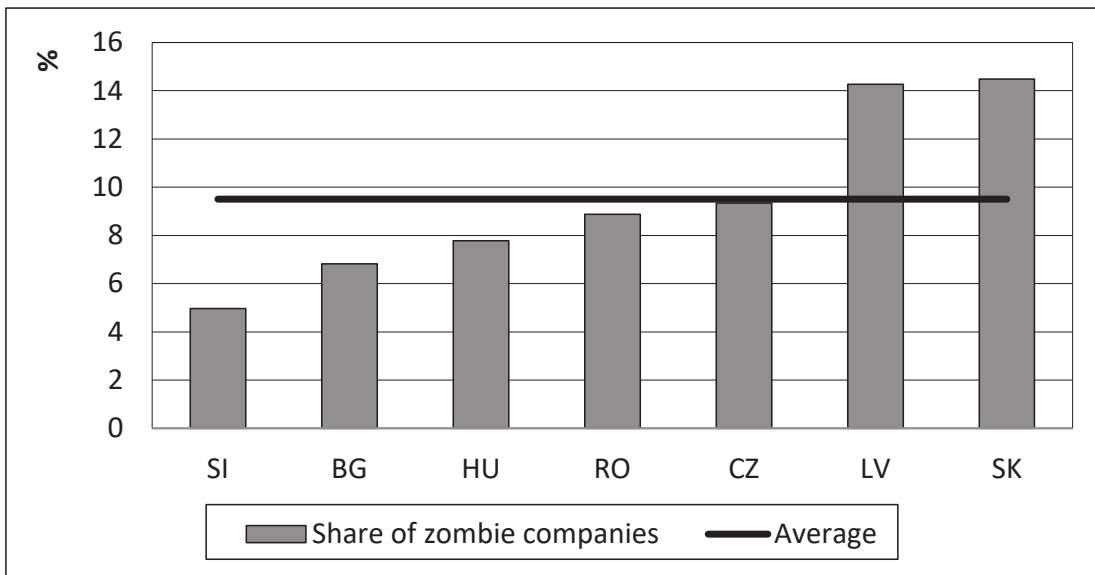| Variable	Notation	Description	Source / calculation method
Productivity	y_product	A measure of the efficiency of a company's production process (%).	Amadeus, authors' calculation following Caballero et al. (2008): ln (sales) – 1/3 ln (capital) – 2/3 ln (employment)
Employment growth	y_n	Growth in the number of employees of each individual company (%).	Amadeus
Investment	y_i	Change in fixed assets (%).	Amadeus
Profit per employee	y_ppe	The ratio of company profits to the number of employees (%).	Amadeus
Dummy of non-zombie companies	nonZ	Binary variable, takes the value 1 if the company is not a zombie.	Authors' calculation based on Amadeus data
Average capital change of zombi companies	Z	Average change in capital of zombie companies by year, industry and country (%).	Amadeus
Sales	S	Control variable, expressed in thousands of euros.	Amadeus
Time	T	It takes values from 1 (for 2008) to 9 (for 2016).	Authors' calculation

Source: Authors

In this paper, the definition of a zombie company encompasses three criteria. The first two, following Storz et al. (2017), define zombie companies as companies whose return on assets (ROA) is negative and whose net investments are negative for at least two consecutive years. This classification ensures that zombie companies are only those that are not profitable or that do not invest above their depreciation value, and it is ensured that young companies are not misdefined as zombie companies. The third criterion, according to Adalet McGowan et al. (2017), states that the interest rate coverage should be less than 1.5 for a company to be considered a zombie. Interest coverage ratio is defined as the ratio of earnings before interest and taxes (EBIT) of the company and the interest paid by the company in the same observed period. This indicator shows how easily a company can pay interest on the remaining debt. Lower interest rate coverage means a higher debt repayment burden for the company. A value of 1.5 is commonly considered to be the critical value at which creditors are very likely to refuse to grant cash to a company as it is considered high risk (Investopedia, 2018b). The advantage of this criterion is its comparability between countries, less endogeneity in the model with productivity as dependent variable than it would be with the criterion of negative profits, and the fact that it comprises channels besides subsidized loans that allow zombie companies to stay in the market, such as loan refinancing (Adalet McGowan et al., 2017).

Sample includes active medium, large and very large enterprises in CEE countries (defined according to the OECD) for which data are available in the Amadeus database. According to Fidrmuc & Siddiqui (2015), only companies that are not listed on the stock exchange are included in the analysis, because they are more dependent on bank financial resources, and do not have the possibility of financing by issuing shares. This criterion also reflects the characteristics of the domestic capital market of CEE countries that are underdeveloped and the reach of international capital is limited (Fidrmuc & Siddiqui, 2015). According to Storz et al. (2017), excluded are all enterprises belonging to sectors that are generally considered to differ significantly in their characteristics from other sectors, in particular by capital structure – primary sector (NACE 01 – 09), financial sector (NACE 64 – 66), public administration, defense and security (NACE 84) and extraterritorial organizations (NACE 99). Sectors are defined according to the NACE (Rev. 2) classification. Furthermore, companies whose credit indebtedness in the last three observed years (2014-2016) equals at least one euro are included, i.e. companies that are not dependent on bank lending are excluded. The last criterion for including a company in the sample is at least one employee in the last three observed years. Following Caballero et al. (2008) in order to avoid atypical values, the upper and lower 2.5% of observations ranked according to the average change in capital of zombie companies (Z) were excluded from the sample.

A descriptive analysis of the data used shows that the average share of zombie companies in the total number of companies in the selected CEE countries was 8.44% from 2008 to 2016 (Graph 1). Also, a higher share of zombie companies is among companies with a larger number of employees (Graph 2). This can be explained by the fact that large companies are more likely to receive government subsidies as there is a common interest in preventing job losses. Also, banks have an interest in keeping large companies in the market during crises (Agostino, Silipo & Trivieri, 2008). Furthermore, most zombie companies are younger than 5 and older than 41, and the fewest are 6 to 10 years old (Graph 3). And finally, the average productivity of healthy companies compared to zombie companies is higher in all observed countries (Graph 4). In theory, a positive change in the capital of zombie companies can hamper the productivity and growth of healthy companies (Adalet McGowan et al., 2017). The question arises as to how a change in the capital of a zombie company will affect the performance of healthy companies, to which the answer is sought in the chapter on empirical analysis.

Graph 1.

SHARE OF ZOMBIE COMPANIES IN THE TOTAL NUMBER OF COMPANIES BY SELECTED COUNTRIES, 2008 – 2016 AVERAGE

Source: Amadeus, authors' calculation

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Graph 2.

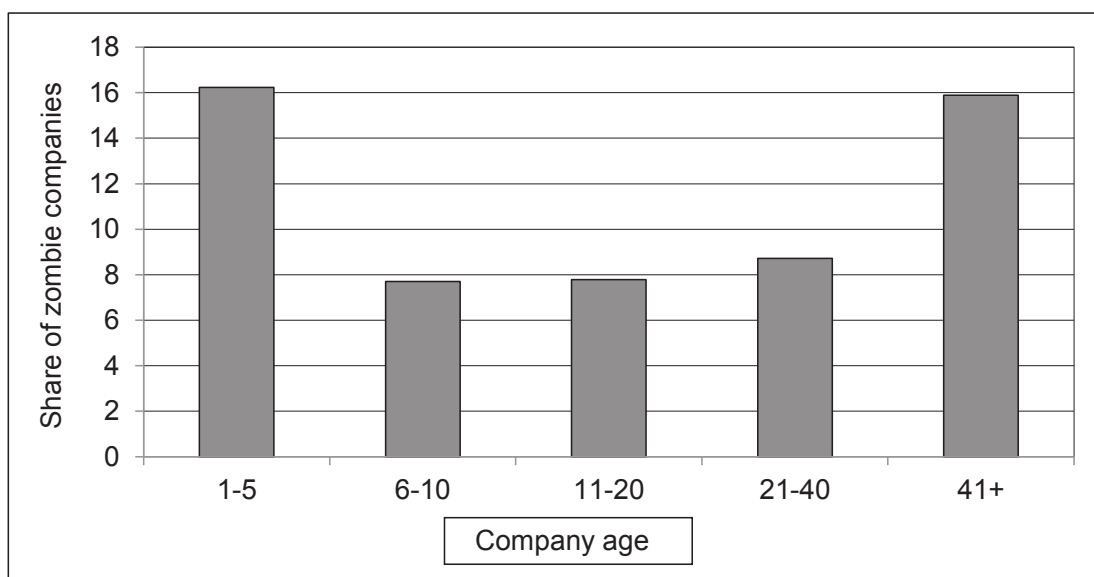## SHARE OF ZOMBIE COMPANIES IN THE TOTAL NUMBER OF COMPANIES BY THE NUMBER OF EMPLOYEES, 2008 – 2016 AVERAGE
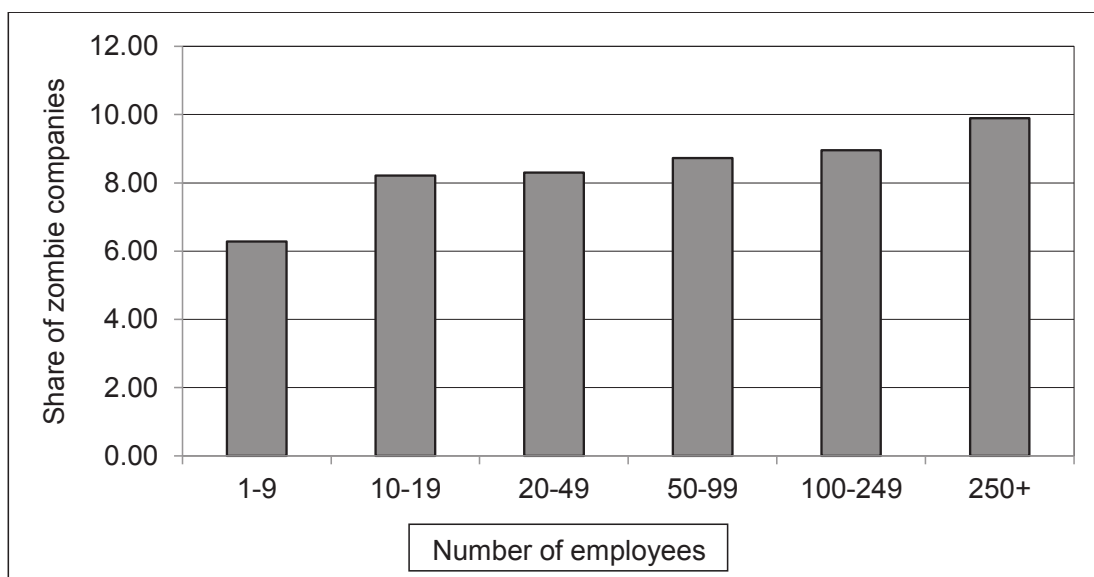
Source: Following Adalet McGowan et al., 2017; Amadeus, authors' calculation

Graph 3.

SHARE OF ZOMBIE COMPANIES BY COMPANY AGE, 2008 – 2016 AVERAGE

Source: Following Adalet McGowan et al., 2017; Amadeus, authors' calculation

Graph 4.

AVERAGE PRODUCTIVITY OF ZOMBIE AND HEALTHY COMPANIES IN SELECTED COUNTRIES IN 2010, 2013 AND 2016
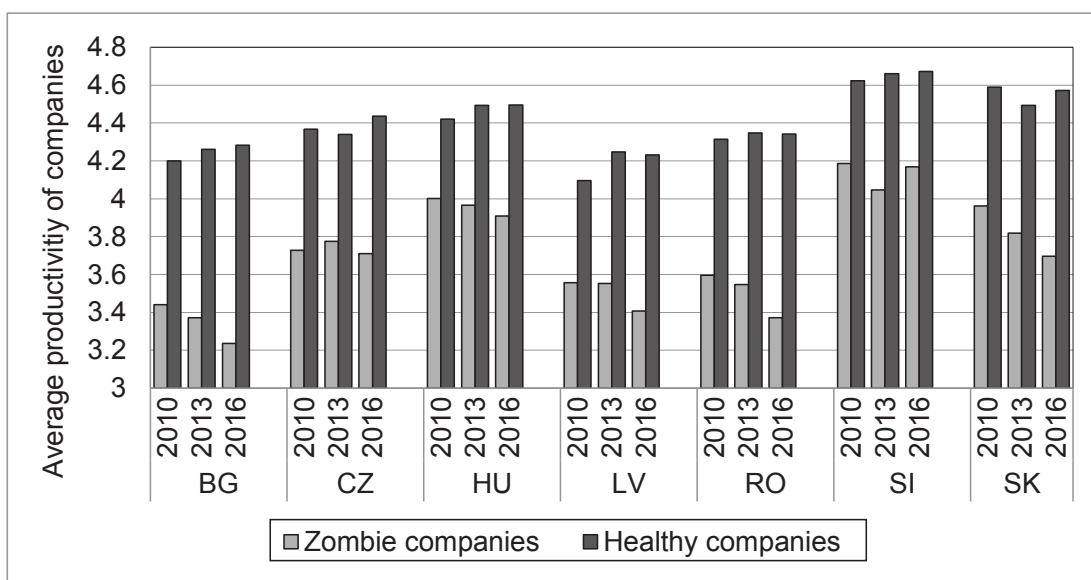
Source: Amadeus, authors' calculation

In addition to the analysis at the enterprise level, the second part of the empirical analysis investigates the impact of the share of zombie companies on the performance of economies and economic sentiment of the observed countries from 2008 to 2016. Namely, GDP per employee indicates lower productivity of the observed countries compared to the EU (Graph 5). This suggests that in selected countries, the problem of zombie companies could be the cause of their lower productivity and consequently lower economic growth, as suggested by Graphs 6 and 7.

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Graph 5.

GDP PER EMPLOYEE (PPP $) IN THE OBSERVED COUNTRIES AND THE EU
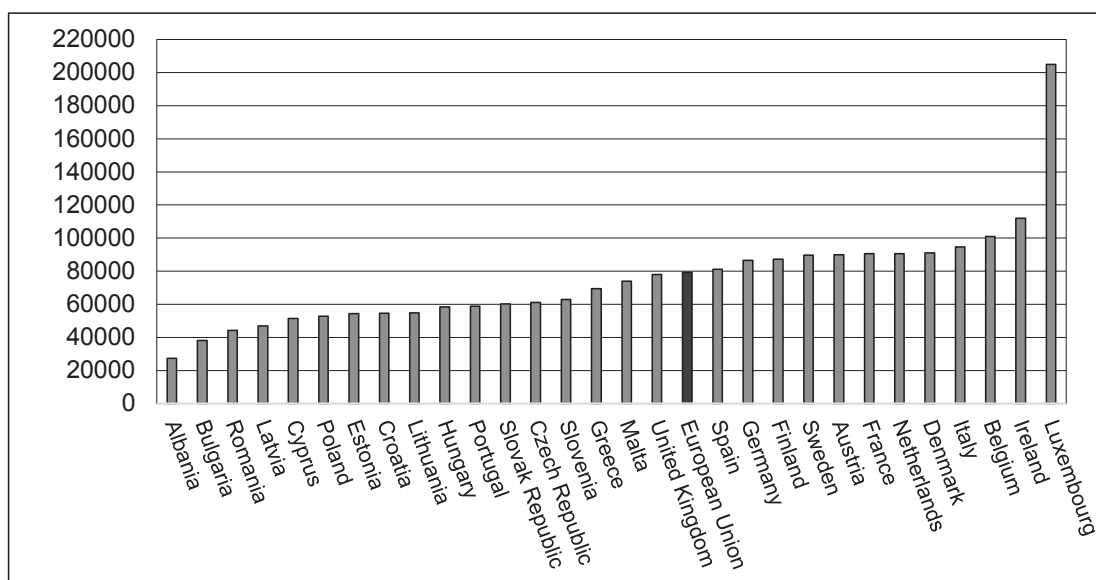
Source: World Bank (2019)

Graph 6.

ZOMBIE COMPANIES AND GDP GROWTH RATES
IN SELECTED COUNTRIES
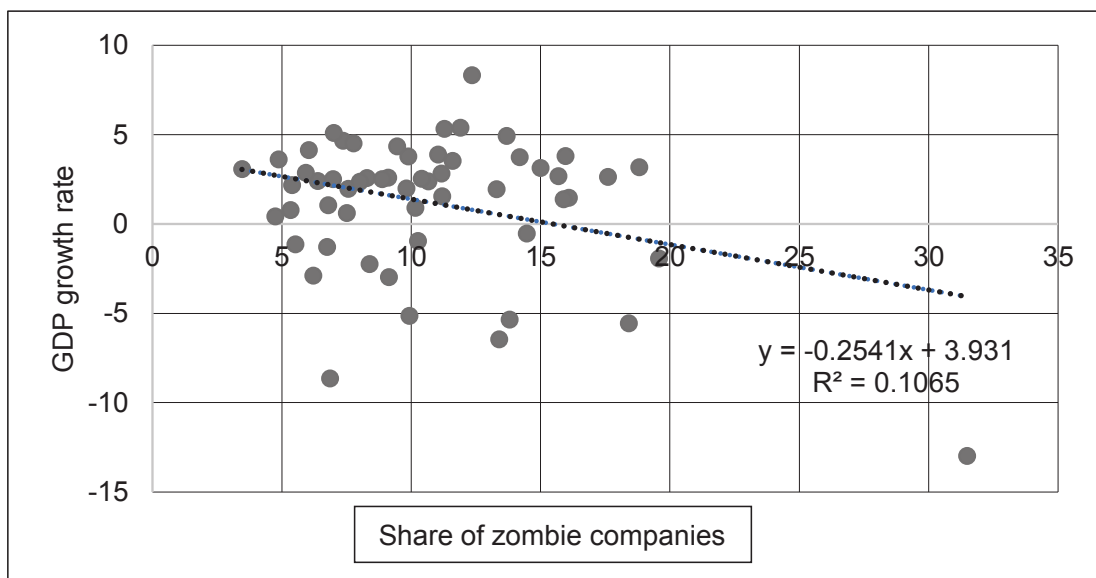
Note: Each point on the graph represents one country in one year

Source: World Bank (2019), authors' calculation

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Graph 7.

ZOMBIE COMPANIES AND GDP PER EMPLOYEE
IN SELECTED COUNTRIES

Note: Each point on the graph represents one country in one year

Source: World Bank (2019), authors' calculation

The Table 3 shows the variables as well as the corresponding data sources used in the aggregate production model.

Table 3.

DEFINING VARIABLES AND DATA SOURCES OF MODELS A – D

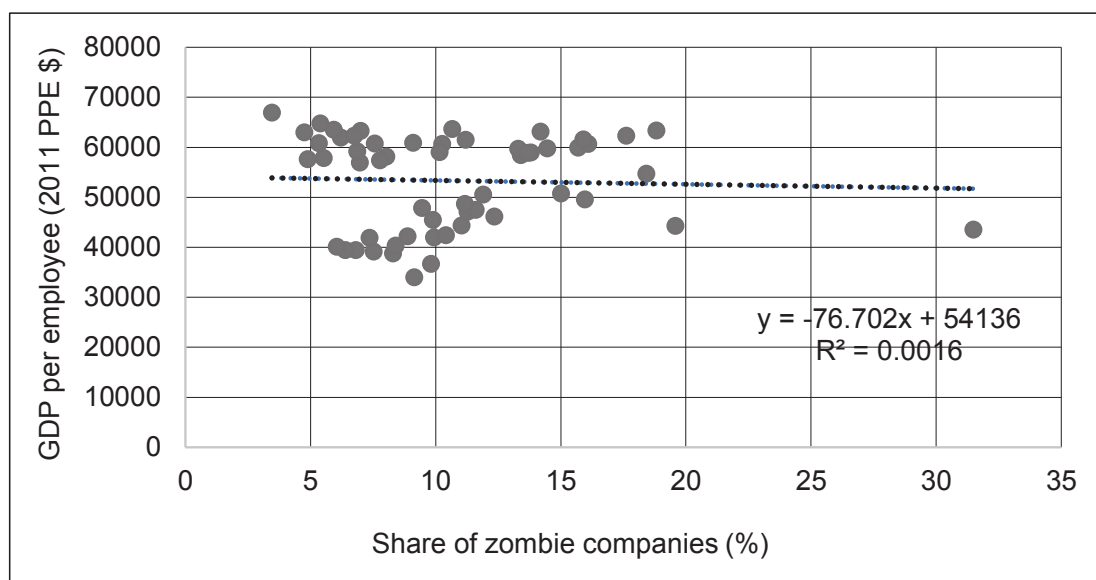| Variable	Label	Measuring unit	Source / calculation method
GDP	GDP	Constant dollars from 2010, growth rate	World Bank (2019)
GDP per capita	GDPpc	Constant dollars from 2010, growth rate	World Bank (2019)
GDP per employee	GDPppe	Constant dollars from 2010, growth rate	World Bank (2019)
ESI	ESI	Index points	European Commission (2019)
Consumption	C	Constant dollars from 2010	World Bank (2019)
Investments	I	Constant dollars from 2010	World Bank (2019)
Government spending	G	Constant dollars from 2010	World Bank (2019)
Net exports	Nx	Constant dollars from 2010	World Bank (2019), authors' calculation
Share of zombie companies	Zombie	%	Amadeus, authors' calculation

Source: Authors

4.2. Methodology

Given the temporal and spatial dimension of the data, panel analysis is used in the paper. In the microeconometric analysis, the underlying model is static, and the choice is between a model with fixed or random effects (Cameron & Trivedi, 2010). The decision whether to use a static panel model with fixed or random effects is made based on the Hausman test (Hausman, 1978) and the modified Hausman test (Hoechle, 2007) in which the null hypothesis assumes a more appropriate random effects model. The model of the impact of zombie companies on the performance of healthy companies is estimated by a static panel model with fixed effects, in accordance with the results of the Hausman test and corresponds to the existing empirical literature on the subject. The equation of the fixed effects model is shown below.

$$Y_{it} = \beta_1 X_{it} + \alpha_i + u_{it} \tag{3}$$

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Here α_i represents a constant for every group, Y_{it} is dependent variable at time t, for group i, X_{it} is a vector of independent variables, and u_{it} an error term (Torres-Reyna, 2007).

According to Stock and Watson (2011), economic theory can rarely justify the assumption of homoskedastic errors. That is, it is assumed that the errors of the relation are heteroskedastic until the opposite can be proved. Due to that, the errors in the model of the impact of zombie enterprises on the performance of healthy enterprises are corrected, i.e. robust standard errors are used (White, 1980). Auto-correlation is tested by the Arellano-Bond test. The null hypothesis of the test claims that there is no autocorrelation in the first differences of errors. If the errors are serially uncorrelated, then the test will show a correlation of the first order, but not a correlation of the second and higher orders (Cameron & Trivedi, 2010).

The model of the impact of zombie companies on the macroeconomic performance of economies is estimated by a dynamic panel model due to the existence of circular links in the economy. A Blundell-Bond (1998) 2SLS (two stage least squares) estimator is used. Endogeneity testing was performed using the Sargan test (Sargan, 1958). The null hypothesis of the Sargan test states that all instruments (dependent variables with time lag) used in the model are justified, i.e. that there is endogeneity in the model that needs to be taken into account using a dynamic panel model (Sargan, 1958). The Sargan test is based on the assumption of homoskedasticity of errors.

In order to determine the stationarity of the variables before conducting the empirical analysis, unit root tests were performed. Of the existing unit root tests suitable for panel data, the paper performs the Fisher test (Choi, 2001) with one lag included and Im-Pesaran-Shin (2003) since it is a micro panel, and the data are unbalanced (Torres-Reyna, 2007). The null hypothesis of the test assumes the existence of a unit root in all panels.

5. EMPIRICAL ANALYSIS

5.1. *The impact of zombie companies on the performance of healthy companies*

First, Fisher unit root test was conducted for all variables. The results indicate the stationarity of all variables with a level of statistical significance of 1% (Table 4).

Table 4.

FISHER UNIT ROOT TEST RESULTS

VARIABLE	**Without constant term or trend**	**Constant term**	**Constant term and trend**
Productivity	-91.4065***	-93.3264***	-97.1665***
Employment growth rate	-236.3497***	-241.5514***	-185.9060***
Investment	-204.8781***	-204.4852***	-166.5749***
Profit per employee	-141.4860***	-149.7927***	-137.8106***
Capital change	-205.4053***	-333.0229***	-391.8238***
Sale	-51.7445***	62.0094	-240.0576***

Note: ***, ** and * refer to 1%, 5% i 10% levels of significance.

Source: Authors' calculation

Furthermore, according to the results of the Hausman test and the modified Hausman test, panel model with fixed effects was applied. The results of the performed tests are shown in Table 5.

Table 5.

HAUSMAN TEST AND MODIFIED HAUSMAN TEST

Model	**Hausman test**	**Modified Hausman test**
Model 1	-	9.2e+05***
Model 2	148.65***	-
Model 3	94.13***	-
Model 4	62.06***	-

Note: ***, ** and * refer to 1%, 5% i 10% levels of significance.

Source: Authors' calculation

The estimated models are based on Equation (1), where the dependent variable of Model 1 is productivity, Model 2 employment growth, Model 3 profit per employee, and Model 4 investment. According to the results of the Hausman test, and the modified Hausman test, the assumption that a panel model with random effects is suitable is rejected and a panel model with fixed effects is applied.

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The results of the empirical analysis show that if the average change in the capital of zombie companies increases by 1 percentage point, the productivity of healthy companies will decrease by an average of 0.027 percentage points (Model 1). On the other hand, contrary to initial expectations, the results of Model 2 imply that employment growth in healthy companies will increase by 0.016 percentage points on average if the average change in the capital of zombie companies increases by 1 percentage point. Model 3, on the other hand, suggests that with a level of statistical significance of 5% due to the average capital increase of zombie companies by 1 percentage point, a decrease in profit per employee of healthy companies by 0.807 percentage points can be expected. Finally, unlike Caballero et al. (2008) and Adalet McGowan et al. (2017), according to the results of Model 4, there is a positive relationship between the change in the capital of zombie companies and the investments of healthy companies in the observed countries.

Table 6.

PANEL MODELS WITH FIXED EFFECTS OF THE IMPACT OF ZOMBIE COMPANIES ON THE PERFORMANCE OF HEALTHY COMPANIES

	Model 1 y_product	**Model 2** y_n	**Model 3** y_ppe	**Model 4** y_i
nonZ	0,227*** (0,006)	0,067*** (0,000)	9,789*** (0,000)	0,277*** (0,000)
nonZ#c.Z				
0	-0,012 (0,021)	0,008 (0,628)	-2,469*** (0,001)	0,012 (0,471)
1	-0,029*** (0,005)	0,017*** (0,001)	-0,654* (0,076)	0,020*** (0,005)
s	0,000*** (0,000)	0,000** (0,019)	0,000*** (0,009)	0,000 (0,922)
t	0,003*** (0,001)	0,000 (0,446)	0,051 (0,397)	-0,001** (0,011)
_cons	4,060*** (0,009)	-0,042*** (0,000)	-2,912*** (0,000)	-0,197*** (0,000)
R2	0,035	0,004	0,006	0,024
N	146537	131392	147811	130627
dy/dx	-0,027*** (0,006)	0,016*** (0,001)	-0,807** (0,020)	0,019*** (0,005)

Note: ***, ** and * refer to 1%, 5% i 10% levels of significance.

Source: Authors' calculation

The robustness of the obtained results is checked by changing the sample, i.e. analyzing only the companies in the manufacturing industry. Table 7 shows how the impact of zombie companies on productivity and earnings per employee of healthy companies in selected CEE countries is robustly negative (Model 1ind, Model 3ind). Their positive impact on investment is also robust (Model 4ind). However, the robustness test did not confirm the positive impact of zombie companies on employment (Model 2ind).

Table 7.

ROBUSTNESS TEST RESULTS OF MODELS 1 – 4

	Model 1ind y_product	**Model 2ind** y_n	**Model 3ind** y_ppe	**Model 4ind** y_i
nonZ	0,185*** (0,000)	0,074*** (0,000)	8,173*** (0,000)	0,203*** (0,000)
nonZ#c.Z				
0	-0,108*** (0,000)	0,012 (0,205)	-0,561** (0,048)	0,009 (0,184)
1	-0,137*** (0,000)	0,007 (0,028)	-0.317** (0,037)	0,054*** (0,000)
s	0,000** (0,021)	0,000 (0,396)	0,000*** (0,000)	0,000 (0,646)
t	0,019*** (0,000)	0,003*** (0,000)	0,267*** (0,000)	0,002** (0,011)
_cons	3,675*** (0,000)	-0,061*** (0,000)	-5,261*** (0,000)	-0,145*** (0,000)
R2	0,045	0,006	0,011	0,021
N	45915	45931	45931	45806
dy/dx	-0,134*** (0,000)	0,008** (0,013)	-0,342** (0,012)	0,050*** (0,000)

Note: ***, ** and * refer to 1%, 5% i 10% levels of significance.

Source: Authors' calculation

5.2. *The impact of zombie companies on economic activity and economic sentiment*

The results of the stationarity analysis of the variables from the model based on Equation (2) are shown in Table 8. The original data was transformed using logarithmic transformation and then differentiation, that is, we converted them into

growth rates. The exception is the variable net exports which assumes negative values, and the growth rates were hence generated as the ratio of the difference of net exports and the absolute value of the lagged variable. Fisher and Im-Pesaran-Shin (IPS) unit root tests were performed as the data is unbalanced. Following the obtained results, variables were included in the model as growth rates.

Table 8.

UNIT ROOT TEST RESULTS FOR VARIABLES IN MODELS A-D

VARIA-BLE	IPS			ADF		
	w-t-value			z-value		
	Without constant term or trend	Constant term	Constant term and trend	Without constant term or trend	Constant term	Constant term and trend
lnGDP	4.5324	-5.5562***	-7.3045***	2.6306	-10.613***	-7.5881***
dGDP	-3.9720***	-7.0721***	-3.0455***	-12.242***	-6.2621***	-5.1845***
lnGDPpc	-5.0168***	-14.3066***	-27.7562***	-6,2216***	-7.4099***	-16.4822***
dGDPpc	-30.8055***	-20.3583***	-28.0917***	-7.8746***	-15.3314***	-13.1605***
lnGDPppe	0.5785	-0.8533	-2.9636***	-0.4224	0.0504	-1.4944*
dGDPppe	-5.9886***	-4.6352***	-1.1876	-7.9619***	-2.4455***	-1.5940*
lnESI	-3.0868***	-6.1935***	-2.3829***	1.1175	-1.7507**	0.3367
dESI	-4.4681***	-4.9248***	-4.0168***	0.0240	-2.2475**	0.2101
lnc	2.5676	-1.8702**	-0.9505	1.8897	-0.8786	-0.2776
dc	-0.1524	-2.4286***	-0.7947	-5.3101***	-4.8159***	-2.8644***
lni	-4.3350***	-4.0692***	-4.2501***	-5.6894***	-4.0144***	-4.2462***
di	-4.3702***	-4.1240***	-5.7710***	-5.5378***	-5.3849***	-6.2468***
lng	0.2907	-4.1240***	-9.3277***	-0.3396	-2.9549***	-8.2927***
dg	-5.5255***	-9.8681***	-6.0243***	-8.2178***	-10.661***	-6.2895***
nx	-4,3337***	-3,2318***	-3,1901***	-0,4104	-1,4230*	-2,5241***
dnx	-5,3423***	-4,1816***	-3,0197***	-3,9141***	-2,0166**	-0,6507
lnzombie	-0.5326	-0.2317	2.9235	-2.3818***	-1.0775	-0.6873
dzombie	-1.9933**	-0.6714	-4.2711***	-2.2111**	-5.4329***	-6.8926***

Note: For the IPS unit root test, the number of lags is taken according to the Akaike Information Criterion (AIC), while for the ADF test one lag is taken.

***, ** and * refer to 1%, 5% i 10% levels of significance.

Source: Authors' calculation

The diagnostics of models A-D is shown in Table 9. According to the p-value of the Sargan test, the null hypothesis about the adequacy of the instruments in the model cannot be rejected. The Arellano-Bond autocorrelation test showed no auto-

correlation in the estimated model. The dynamic 2SLS panel model was evaluated by the Blundell-Bond estimator and is shown in Table 10.

Table 9.

MODEL A-D DIAGNOSTICS

Diagnostic test	Test statistics			
	Model A	Model B	Model C	Model D
Sargan test	6.9601	8.467	8.7516	14.2859
Arellano–Bond autocorrelation test	-0.7298	-1.4985	1.0141	0.0456

Note: ***, ** and * refer to 1%, 5% i 10% levels of significance.

Source: Authors' calculation

Table 10.

A DYNAMIC PANEL MODEL OF THE IMPACT OF ZOMBIE COMPANIES ON THE ECONOMIC PERFORMANCE AND ECONOMIC SENTIMENT OF SELECTED COUNTRIES

Variable	Model A	Model B	Model C	Model D
depend L1	0.1255*	0.1258*	0.0382	-0.5096***
dc	0.4576**	57.9516***	0.2956**	11.9828*
di	0.0757*	7.4297*	-0.0108	-5.1913***
dg	0.1678	12.9660	0.2127	-0.4985
dnx	0.0006*	0.0471*	0.0003	-0.0418***
dzombie	-0.0024	-0.3537	-0.0012	0.4851*
t	-0.0017	-0.2926**	-0.0041	-0.2825**
cons	0.0224***	3.1192***	0.0362**	1.4408**

Note: ***, ** and * refer to 1%, 5% i 10% levels of significance.

Source: Authors' calculation

The estimated model analyzes the impact of zombie companies on GDP growth rate, GDP growth rate per capita, productivity growth and ESI. According to the results of Models A, B, and C (Table 10), the growth rate of zombie com-

panies does not have a significant impact on economic performance while it has a positive impact on ESI (Model D). According to these results, zombie companies still do not significantly congest the economies of the observed countries. This is possibly due to the fact that economic agents are not aware of the problem of zombie companies, which is reflected in their positive impact on the ESI. By increasing the economic sentiment, they impact positively the expectations which in turn neutralizes their negative impact on economic activity.

6. CONCLUSION

The aim of the study was to analyze the impact of zombie companies on the performance of healthy companies and the economic performance and economic sentiment of selected CEE countries (Bulgaria, Czech Republic, Hungary, Romania, Slovakia, Slovenia and Latvia) for the period from 2008 to 2016. A panel model with fixed effects was used in the microeconometric analysis of their impact on healthy companies. The analysis showed, corresponding to the findings by Adalet McGowan et al. (2017), that zombie companies in selected countries negatively affect the productivity and profit per employee of healthy companies. But contrary to expectations, the impact of zombie market congestion on investment and employment growth is not negative as initially assumed (Caballero et al., 2008). The robustness of the negative impact of zombie companies on productivity and profit per employee, and the positive impact on investments of healthy companies was confirmed by the analysis of a manufacturing industry subsample. The positive impact of zombie companies on the employment of healthy companies has not been confirmed by the robustness check. Hoshi (2006) also finds a positive impact on employment, but only until the industry becomes "overcrowded" with zombie companies – then the positive effect disappears. Our results thus suggest that the manufacturing industry of the observed countries might be more congested with zombie companies compared to the average of the entire economy.

The impact of zombie companies' growth rate on macroeconomic performance of selected countries was estimated using a dynamic panel analysis which showed that, contrary to the conclusions of Ahearne & Shinada (2005) and Fidrmuc & Siddiqui (2015), this impact is not significant in selected CEE countries. The results are consistent with the conclusions of Urionabarrenetxea et al. (2016).

Considering that selected countries are on average economies with lower GDP than the EU average, they are mainly recipients of various forms of support for their production, both at the national and European levels. Thus, contrary to the theoretical expectations of the existing literature, negative impact of zombie mar-

ket congestion on productivity and profit per employee of healthy companies does not reflect on their investment and employment, and consequently on the economy of CEE countries. Additionally, the analysis of economic sentiment suggests that economic agents are not aware of the existing problem of zombie companies. The positive impact of zombie companies on economic sentiment potentially neutralizes the negative effects of zombie companies on the entire economy.

Further research should focus on the mechanisms behind the results obtained, such as the role of subsidized interest rates, state aid or European funds, which are not the subject of this research. Although the limited availability of data for CEE countries is a major limitation of the research, this is the first paper that comprehensively analyzes the impact of zombie companies on the performance of healthy companies as well as the entire economies of these CEE countries. Additionally, this is the first study examining the impact of zombie companies on economic sentiment which represents another significant contribution of the paper to the existing scientific literature. Finally, the paper contributes to the policy makers of the analyzed countries, warning of the harmful impact of zombie companies on productivity and profits per employee of healthy companies that would need to be regulated before the negative effects begin to manifest at the macroeconomic level. Primarily, stricter regulation of banks in terms of granting subsidized loans to zombie companies and regulation of company operations is advised.

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UTJECAJ ZOMBI PODUZEĆA NA PERFORMANSE ZDRAVIH PODUZEĆA I GOSPODARSTAVA ODABRANIH ZEMALJA SREDNJE I ISTOČNE EUROPE

Sažetak

Cilj ovog rada je analizirati utjecaj zombi poduzeća na performanse zdravih poduzeća te gospodarstava i ekonomskog sentimenta (ESI) odabranih zemalja srednje i istočne Europe od 2008. do 2016. godine. Zombi poduzeća su poduzeća čija je održivost neizvjesna i konkurentnost vrlo ograničena te potencijalno mogu prenijeti gubitke poduzećima s kojima su povezana. U radu su definirana kao poduzeća s negativnim povratom na imovinu, negativnim neto investicijama te pokrivenošću kamatnih stopa nižom od 1,5. Rezultati panel modela s fiksnim efektima pokazuju kako zagušenost tržišta zombi poduzećima negativno utječe na produktivnost i profit po zaposlenome, a pozitivno na investicije dok na rast zaposlenosti zdravih poduzeća nema utjecaja. Rezultati dinamičke panel analize sugeriraju da zagušenost tržišta zombi poduzećima nema značajan utjecaj na BDP odabranih zemalja srednje i istočne Europe, dok postoji pozitivna veza s ESI. Istraživanjem problematike zombi poduzeća u zemljama srednje i istočne Europe te analizom njihova utjecaja na ESI općenito, rad doprinosi postojećoj literaturi.

Ključne riječi: zombi poduzeća, panel, performanse poduzeća, gospodarski rast, indeks ekonomskog sentimenta