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THE EFFECTS OF ZOMBIE COMPANIES ON THE ECONOMY: AN APPLICATION ON TÜRKİYE

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Abstract

Zombie companies are defined as the ones that are unable to cover interest payments from current profits and that manage to survive with various supports even though they should have exited the market under normal conditions. By holding scarce resources, these companies hinder the reallocation of resources to healthy companies that can use them more efficiently, thus threatening economic growth. This study aims to examine the existence of zombie companies in Türkiye and their effects on the performance of healthy companies operating in the same industry. In this context, the study describes estimates of zombie companies' existence using company-level data for the period 2006-2021 obtained from the Enterprise Information System (EIS) database, which contains several datasets of all businesses of Türkiye and analyses their economic effects using a panel model with fixed effects. According to the empirical findings, the prevalence of zombie companies has generally risen since the beginning of the analysis period, and an increase in the share of capital sunk in zombies in an industry reduces investment rate and employment growth of healthy companies in that industry and increases the multi-factor productivity gap between zombie and healthy companies. The results show that zombie companies in Türkiye reduce growth opportunities of the healthy companies. Based on the results, it is recommended that policymakers take measures to reduce the prevalence of zombies for economic growth. This paper is the first study to use the EIS database for the analysis of zombie companies. In addition, a new method not used in the literature in advance was developed and used to identify zombie companies.

Keywords: *interest coverage ratio, resource reallocation, zombie companies*

JEL: *D24, E22, G32*

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1. INTRODUCTION

Under competitive conditions, weakly performing companies should be restructured as a merger or division or exit the market by bankruptcy (Goto and Wilbur 2019, p. 105). Thus, resources would be reallocated to innovative companies with growth potential and used more efficiently and it could be possible for the market to regain its dynamism (Logarusic and

Kristic 2022, p. 161). However, some companies insist on managing to continue operating over an extended period despite their weak performance (Beer, Ernst, and Waschiczek 2021, p. 35). It is known that these companies, which are referred to as "zombie companies" in the literature, undermine the creative destruction process that would take place if they withdrawn from the market and create an unfair competition environment for healthy companies by holding resources (Caballero, Hoshi, and Kashyap 2008, p. 1946).

In economics, the term zombie was first used by Edward J. Kane (1987) to describe a bank on the verge of bankruptcy but kept alive during the credit and savings deposit crisis of the 1980s in the United States. Later, the term zombie company, which journalists used to refer to over-leveraged companies in Japan in the late 1990s, became an essential topic for scholars and policymakers in the 2000s (Goto and Wilbur 2019, p. 105). In the pioneering studies of the literature, the definition of zombie companies was extended to include dead companies that were subsidized by banks and other institutions and fed by healthy companies, despite their weakness to make profits and even cover interest payments from current profits (Caballero, Hoshi, and Kashyap 2008, p. 1949; McGowan, Andrews, and Millot 2017, p.15).

In some studies, zombie companies are referred to as "low-quality companies", "inoperative companies" or "troubled companies" (Yamada et al. 2023, p. 4). In a broader definition, zombies are companies that have a weak financial record (Silva and Gonçalves 2022, p. 2), have very low profitability and productivity, have persistent difficulties in meeting their interest payments, should exit in a competitive market under normal conditions (without an exceptional recession or a systemic crisis) (Rodano and Sette 2019, p. 6), but continue operating owing to various financial supports (Altman, Dai, and Wang 2022, p. 2).

The increasing concern of policymakers in recent years is based on the interest that the existence of these companies damages the overall economy as a result of diverting resources away from more profitable and productive companies (Cella 2020, p. 9). Researchers draw attention to the potential role of zombie companies in slowing economic growth (McGowan, Andrews, and Millot et al. 2017, p. 6; Banerjee and Hofmann 2018, p. 77). Because, zombie companies absorb financial resources at rates unfairly low given their riskiness, preventing healthy companies from obtaining bank financing. Thus, healthy companies are forced to contract loans at higher rates. As a result of excessive increases in costs, these companies have to refrain from undertaking new investments. A similar mechanism is observed in the labour markets. Zombie companies increase wages to retain their workforce, thus crowding out healthy companies from the labour market (Hallak, Harasztosi, and Schich 2018, p. 11).

To ensure efficiency in resource allocation, encourage the transformation from traditional industries to emerging industries, increase total factor productivity and thus promote economic growth, detecting the existence of zombie companies and their negative effects on the economy are issues that academic researchers and policymakers should focus on (Rashid et al. 2022, p. 2). Based on this idea, the existence of zombie companies in Türkiye and their effects on the economy are examined from 2006 to 2021 in this study. In this framework, by understanding the prevalence and consequences of zombie companies, it will be possible to shed light on one of the potential driving forces behind the economic problems in Türkiye. In this way, the findings of this study can assist policymakers in developing policies to ensure a stable environment for economic growth.

This study differs from previous similar studies in many aspects. First of all, the use of the Enterprise Information System (EIS) database, which contains various datasets of all businesses in Türkiye, is an important difference. Considering that the pioneering studies in the literature (such as Caballero, Hoshi, and Kashyap 2008; McGowan, Andrews, and Millot 2017; Banerjee and Hofmann 2020) mainly focused on listed companies with fewer observation opportunities, it can be said that the findings obtained in this study, which analyses more observations, have a higher ability to represent the reality of the Turkish economy. Likewise, the observation years cover a long and near-to-day process, especially the pandemic period (the years 2020-2021), whose financial results are suspicious. This study also provides a methodological contribution to the definition of zombie companies. The zombie classification used by McGowan, Andrews, and Millot (2017) is followed, but the criticism that this method only focuses on the past performance of the companies is overcome by the investment criterion. Thus, the growth criterion, which was easily calculated by the Tobin Q ratio for only listed companies by Banerjee and Hofmann, can be measured in different way for all listed and non-listed companies. In this way, young companies and growing companies are prevented from being incorrectly classified as zombies.

This study consists of four sections. In the next section, there is a review of similar studies on different countries' economies to show why the issue of zombie companies should be investigated. Section 3 describes the database used in the analyses and outlines this study's empirical strategy and analyses the

prevalence of zombie companies over the years and their impact on the performance of healthy companies. In the last section, the empirical findings are summarized and their reflections on the Turkish economy are discussed.

2. LITERATURE REVIEW

Studies on the existence of zombie companies and their negative effects on their healthy competitors started to take place in the literature with studies on the role of banking activities in the prolongation and depth of the macroeconomic recession in the years following the collapse of the bubble in asset prices in Japan in the 1990s. The research of Caballero, Hoshi, and Kashyap (2008), which found that Japanese banks continued to give new loans to companies that would have gone bankrupt if additional funds had not been provided, in order not to incur losses and fall below capital standards, is considered the beginning of research on zombie companies. In that study, which analysed the companies traded on the Tokyo stock exchange between 1981 and 2002, it was determined that the prevalence of zombie companies increased sharply from the mid-1990s and remained at high levels until 2002, the last year of the sample. Besides, the effect of these companies on the performance of healthy companies was analysed empirically, and it was observed that the growth of healthy companies measured in terms of employment and investment in industries with a higher share of zombie companies was more crowded-out, and the productivity gap between these two types of companies increased. In another study examining the data of companies traded on the Tokyo stock exchange, Fukuda and Nakamura (2011) obtained similar results that the prevalence of zombie companies increased continuously during the 1995-2004 period. In the study using data from Japanese small and medium-sized companies for 1999-2008, Imai (2016) found that funds provided by banks in Japan were allocated to unproductive and unprofitable investments of zombie companies rather than investments in healthy companies.

The zombie company issue gained popularity in the literature with studies showing the increase in the prevalence of zombie companies as possible reasons for the slowdown in output growth and economic recovery in most developed countries after the global financial and sovereign debt crises. With the increasing interest of policymakers, it was agreed that zombie companies were a potential threat to other economies outside of Japan and, therefore their prevalence should be prevented, and zombie companies turned into an international study topic. McGowan, Andrews, and Millot (2017) examined the existence of zombie companies in 13 OECD countries during the 2003-2013 period and found that there was an increase both in terms of the number of zombie companies and for two size-weighted measures: the share of industry labour and capital sunk in zombie companies. In their analysis by developing the econometric model used by Caballero, Hoshi, and Kashyap (2008), they obtained results that support their findings that a higher share of industry capital sunk in zombie firms tended to crowd out the growth – measured in terms of investment and employment – of the healthy companies. They also found that zombie companies created barriers to entry and thus new entrants needed to clear a higher productivity threshold to compensate for the low profitability caused by congestion, increasing the productivity gap between zombie and healthy companies.

Following the pioneering study of McGowan, Andrews, and Millot (2017), studies using the data from many countries were conducted comparatively. In their study including 14 developed country economies using publicly traded company data, Banerjee and Hofmann (2018) found that zombie prevalence increased from the late 1980s to 2016. The study also confirmed that zombie companies created a market bottleneck, hindering the growth of healthy companies, both in terms of investment and employment, and thus hurting overall economic performance. In their study including 19 European countries, Hallak, Harasztosi, and Schich (2018) found that the prevalence of zombies increased between 2010 and 2013, especially in countries affected by sovereign debt crises. It was also confirmed that the higher the prevalence of zombies in a country, the lower the growth of healthy companies. In the study conducted by Acharya et al. (2019) on 11 European countries, on the other hand, it was deduced that the average investments were lower in markets with more zombie companies, and healthy companies competing in the same market with them were negatively affected in maintaining their market share.

In addition to country comparisons, studies were explicitly conducted for different country economies. As an example of these studies, Wang, Kong, and Shi (2022) documented the negative effects of zombies by using a sample from China Industrial Enterprises database over the period 2003-2013. They found that an increase in the share of zombie companies reduced the investment of healthy companies. Similarly, analysing the Chinese company data, Tan, Huang, and Woo (2016) showed that the increase in public support supplied to zombie companies in the 2005-2007

period decreased the investment rate of healthy companies. In the analysis made by Hoshi and Kim (2012) on Korean companies for the period 2000-2010, it was concluded that as the number of zombie companies in the industry increased, healthy companies were discouraged from increasing employment and investment, and the productivity gap between these two company groups widened. Using data on US companies, Acharya et al. (2022) found that zombie companies negatively affected employment growth and capital expenditures of healthy companies.

It is also possible to come across studies in the literature that could not obtain evidence supporting the findings of pioneering studies. In a study examining the company data of six selected Central and Eastern European countries for the period 2008-2016, Logarusic and Kristic (2022) found that zombie companies did not negatively affect the investment and employment growth of healthy companies. The reason which lies beneath that result is that zombie companies might not have a crowding effect, since these countries' economies had not reached full capacity yet. Similarly, using data from Portuguese companies, Silva and Gonçalves (2022) concluded that the increase in resources in zombie companies did not adversely affect the employment growth of healthy companies.

There are studies investigating the existence of zombie companies in Türkiye. In their study which analysed the data of manufacturing enterprises traded on Borsa Istanbul, Kaplanoğlu and Yukcu (2020) classified 62 of 109 companies as zombies during the 2008-2018 period. In the study using the data of the largest 1,000 industrial establishments (ISO 1,000), Şahin (2021) classified 32 companies as zombie in the 1993-2019 period. However, in both studies, only the existence of zombie companies was detected, and the effects of these companies on the economy were not empirically examined. Unlike these two previous studies, this study may fill the gap in the literature on the economic results of Turkish zombie companies by including the analysis of the effects of zombie companies identified by using a larger sample on the growth of healthy companies.

3. METHODOLOGY

In this section, the data set used in the analysis and the method developed for identifying zombie companies are mentioned. It also explains the econometric model and variables used to analyse the economic effects of zombie companies.

3.1. Data and Variables

The company-level data used in this study were obtained from the Enterprise Information System (EIS) database provided by the Ministry of Industry and Technology of the Republic of Türkiye. The EIS contains balance sheet, income statement, goods imports and exports information, employment, production capacity, actual production amounts and several other datasets of all businesses in Türkiye. Also, at the time of preparation of this study, data were available for the period 2006-2021.

A number of adjustments were applied to the data set in order to make the data set suitable for analysis following the literature. In this context, companies with zero interest payments as they did not have any credit relationship with banks and observations with missing values in the items used in the calculation of the variables shown in Table 1, were deducted (Gouveia and Osterhold 2018, p. 17; Storz et al. 2017, p. 13). On the other hand, since the criteria for the identification of zombie companies must be held for three consecutive years, observations of companies with less than three years of data were also removed.

The classification of industries in which the companies operate was made a two-digit level according to the Statistical Classification of Economic Activities in the European Community (NACE Rev. 2). All companies belonging to industries with significantly different characteristics such as company's financial and capital structure were excluded from the data set (Storz et al. 2017, p. 13; McGowan, Andrews, and Millot 2017, p. 14). The industries are manufacturing, energy, construction, wholesale and retail trade, real estate and service activities with codes 10-83, excluding 64-66. Table 1 includes the variables and explanations of them used in identifying zombie companies and analysing their economic impacts.

After data treatment, the final sample turned into an unbalanced panel of 3,997,423 observations. As the pioneering studies (such as Caballero, Hoshi, and Kashyap 2008; Banerjee and Hofmann 2020) focused mainly on publicly traded companies, which tended to be large businesses, and ignored small and medium-sized businesses that were more likely to be zombie companies, there were concerns that the prevalence of zombies in these economies could be higher than expected (Goto and Wilbur 2019, p. 107). In this context, since the database used in this study includes both public and non-public company data, it is expected that the results of this study will have a high ability to represent the reality of the Turkish economy.

Table 1. Definitions of Variables

Variable	Notation	Description	Source
Identification of Zombie Companies			
Interest coverage ratio	ICR	Earnings before interest and tax / Interest payments	McGowan, Andrews, and Millot (2017)
Company age	Age	The difference between the year of report and the year of company's incorporation	McGowan, Andrews, and Millot (2017)
Investment rate	I/K	The ratio of investment in fixed assets to beginning of period stock of fixed assets (measured at book value)	Storz et al. (2017)
Fixed asset	K	The sum of land, buildings, machinery and equipment, vehicles, furniture and fixtures, machinery, equipment, vehicles, construction in progress, advances given, rights, special costs	-
The effects of zombie companies on the economy			
Investment rate	ln(I/K)	The difference in the natural logarithm of fixed assets between two years	Hallak, Harasztosi, and Schich (2018), Goveria and Osterhold (2018)
Employment growth	dlnemp	The difference in the natural logarithm of number of employees between two years	McGowan, Andrews, and Millot (2017), Hallak, Harasztosi, and Schich (2018)
Multi-factor productivity	MFP	ln(sales) – 1/3 ln(fixed assets) – 2/3 ln(employees) (following the Cobb-Douglas production function approach)	McGowan, Andrews, and Millot (2017), Caballero, Hoshi, and Kashyap (2008)
Non-zombie (healthy) company	NonZ	Dummy variable, equal to one if the company is not a zombie	McGowan, Andrews, and Millot (2017), Caballero, Hoshi, and Kashyap (2008)
Zombie share (the share of capital sunk)	Z	The share of fixed assets of zombie companies as a fraction of total fixed assets of all companies in each industry	Caballero et al. (2008) Banerjee and Hofmann (2018)
Age	young	Control variable, equal to one if the company is six years or younger	McGowan, Andrews, and Millot (2017)
Size	size	Control variable, number of full-time employees (1-10, 11-19, 20-49, 50-99, 100-249 and 250+)	McGowan, Andrews, and Millot (2017)
Industry	s	two-digit level according to NACE Rev. 2 classification code (Industry codes 10-83, excluding 64-66)	McGowan, Andrews, and Millot (2017)

3.2. Identification of Zombie Companies

Although there was an agreement in previous studies that zombie companies managed to survive by getting support from banks or other institutions despite their weak performance (Yamada et al. 2023, p. 3), it was seen that there was no consensus on turning this into a quantitative definition. Caballero, Hoshi, and Kashyap (2008) focused on companies that received subsidized bank loans to survive despite the low probability of recovery. In their study, the actual interest payments of the companies were compared to estimated interest payments based on the interest rate applied by the banks to the most creditworthy customers. When a company paid interest below this lower boundary, it meant that a subsidized loan was used, in other words, it received loans at a lower cost than the most creditworthy customers and was therefore identified as a zombie company.

Focusing on companies using only subsidized bank loans, regardless of their financial performance, the approach of Caballero, Hoshi, and Kashyap (2008) has been criticized that healthy companies that can obtain low-interest rates due to long-term relationships with banks could be wrongly identified as zombies. For this reason, different versions have been developed by Fukuda and Nakamura (2011), Hoshi and Kim (2012) and Imai (2016) with some additional criteria added.

In the approach of McGowan, Andrews, and Millot (2017), which is a pioneering study focusing on financial performance in the identification of zombie companies, mature companies whose current profits could not cover the interest payments but which were kept alive with financial supports are classified as zombies. According to the approach, for a company to be defined as a zombie company, the interest coverage ratio, calculated as the ratio of operating profit to interest payments, must be less than one for three consecutive years and the company must be ten years old or older. The three consecutive years condition is important in addressing the pro-cyclicality concerns on the zombie status. The age restriction prevents young companies that have not yet made a profit from being classified as zombies (Tuuli 2023, p. 3).

McGowan, Andrews, and Millot's (2017) approach focuses on low profitability in the past and mature companies with high growth potential in the future may make losses now. Therefore, Banerjee and Hofmann (2020) added the requirement that Tobin Q ratio (the ratio of the company's assets' market value to its assets' book value) should be below the median within industry. On the other hand, they removed the age restriction, thinking that this ratio would be sufficient to help prevent misclassification as zombies for young companies that needed time to make a profit and were expected to be profitable in the following years. Based on the idea that age restrictions might cause misidentifications, in another study, Storz et al. (2017) introduced the criterion of net investments which should be negative two consecutive years in order to exclude young and growing healthy companies.

In the definition of zombie companies in this study, the subsidized loan approach proposed by Caballero, Hoshi, and Kashyap (2008) cannot be applied due to the fact that real interest payments for different debt types cannot be observed in EIS and it is difficult to determine an appropriate reference interest rate for different scaled companies. In addition, in Turkish banking system, low-interest loans are given to companies with high credibility instead of unhealthy companies, and companies that have difficulty in paying the principal and interest of their existing loans are given loans mostly by adding a risk premium to the market interest rates. Therefore, the lack of a clear linear relationship between being a zombie company and receiving subsidized credit is also effective in not implementing this approach.

The zombie company identification method to be used in this study is the method by McGowan, Andrews, and Millot (2017), which was also widely used in previous studies. However, not only in the first years of their establishment but also in the growth and maturation periods of their lives, companies have to invest in order to be able to compete, so their interest expenses increase temporarily and operating profit may be insufficient. Thus, the interest coverage ratio may be below one. Therefore, both the exclusion of the possibility of zombies that companies under the age of ten and the recognition that older companies that make losses cannot have high growth potential constitute the disadvantage of this method. For this reason, the ten-age threshold is not considered sufficient to distinguish between healthy and zombie companies.

In the method Banerjee and Hofmann (2020) used, the ten-age threshold was removed by considering the Tobin Q ratio. However, it is not possible to calculate the Tobin Q ratio with the EIS. Hence, following Storz et al. (2017), the investment criterion is added in order to prevent erroneously classifying growing companies as zombies. In addition, companies need to be older than three-year, so as to avoid starts-up from being classified as zombies by mistake. On the other hand, companies that invest and amortize a lot are more likely to be classified as zombies because their ICRs have decreased. For this reason, it is also argued that profit before interest, depreciation and tax should be used as operating profits (Rodano and Sette 2019, p. 6). Since the EIS does not include depreciation amount for each year, profit before interest and tax is used. However, with the added investment ratio criterion, companies that invest more and have higher depreciation amounts are not classified as zombies, and therefore healthy companies are prevented from being classified as zombies by mistake.

Consequently, a company is defined as a zombie, if three conditions are met: i) its interest coverage ratio is less than one for three consecutive years, ii) it is more than three years old, and iii) its investment ratio is less than 10%[1]. Zombie companies are examined for the period 2008-2021, since the first year of the database is 2006 and the latest data is released in 2021. In other words, if a company's interest coverage ratio is less than one in 2006, 2007 and 2008 and meets the other two criteria, it is identified as a zombie in 2008.

3.3. The effects of zombie companies on the economy

To explore the effects of zombie companies on the performance of healthy companies, the following econometric model developed by McGowan, Andrews, and Millot (2017) - inspired by Caballero, Hoshi, and Kashyap (2008) is estimated:

$$Y_{ist} = \beta_1 NonZ_{ist} + \beta_2 NonZ_{ist} * Z_{st} + \beta_3 Firmcontrols_{ist-1} + \delta_{st} + \varepsilon_{ist} \quad (1)$$

In Equation (1) Y refers to a measure of performance (the investment rate, the employment growth and the level of multi-factor productivity) in company *i*, in two-digit industry *s*, at year *t*. Three different panel data regression analysis are performed in which the independent variables remain the same and only the performance measure represented by the dependent variable is changed. All variables are defined in Table 1.

The model includes one-year lag effects for the control variables (McGowan, Andrews, and Millot 2017, p. 20). Including these lag effects in the model mitigates reverse causalities, as the dependent variable could impact the control variables of the same year. The model also includes interacted industry and year fixed effects to control for unobserved time-varying industry specific shocks that may adversely affect the performance of healthy companies (δ_{st}), and robust standard errors are clustered at the industry-year level (ε_{ist}) (Gouveia and Osterhold 2018, p. 17).

The expectations for the signs of the coefficients in the predicted model based on the empirical and theoretical literature, are as follows: it is not possible to make a clear estimation of whether the sign of the coefficient β_1 will be negative or positive for the investment rate and employment growth regressions. This coefficient can be positive, as healthy companies are expected to perform better than zombie companies (Hoshi and Kim 2012, p. 11). But if zombie companies receive more subsidies than healthy companies, they can invest more or add more employees, so the coefficient could be negative (McGowan, Andrews, and Millot 2017, p. 20). However, since the theory clearly predicts that healthy companies have higher average productivity than zombies, the sign of the coefficient is expected to be positive for the multi-factor productivity regression (Caballero, Hoshi, and Kashyap 2008, p. 1967).

The model's main purpose is to test the harmful effects of the rising zombie congestion on the performances of healthy companies operating in the same industry. Correspondingly, the following research hypothesis has been developed to be tested: an increase in the share of capital sunk in zombies in an industry reduces investment rate and employment growth of healthy companies in that industry and increases the multi-factor productivity gap between zombie and healthy companies. Therefore, it is necessary to focus on β_2, the coefficient of the interaction term of the non-zombie dummy and the industry zombie shares. This coefficient indicates the change in the non-zombies' performance of indicator Y relative to zombies as the share of capital sunk in zombies in an industry (Albuquerque and Iyer, 2023, p. 26). It will be negative for the investment rate and employment growth regressions, as the congesting of resources (labour and capital) by zombie companies makes it difficult to allocate them to companies that will use them more efficiently (Logarusic and Kristic 2022, p. 164; Gouveia and Osterhold 2018, p. 17). On the other hand, the coefficient will be positive for the MFP regression since the MFP gap between zombie and healthy companies will widen due to the higher productivity threshold that new entrants and existing healthy companies must overcome to cope with the barriers created by zombie companies (McGowan, Andrews, and Millot 2017, p. 20).

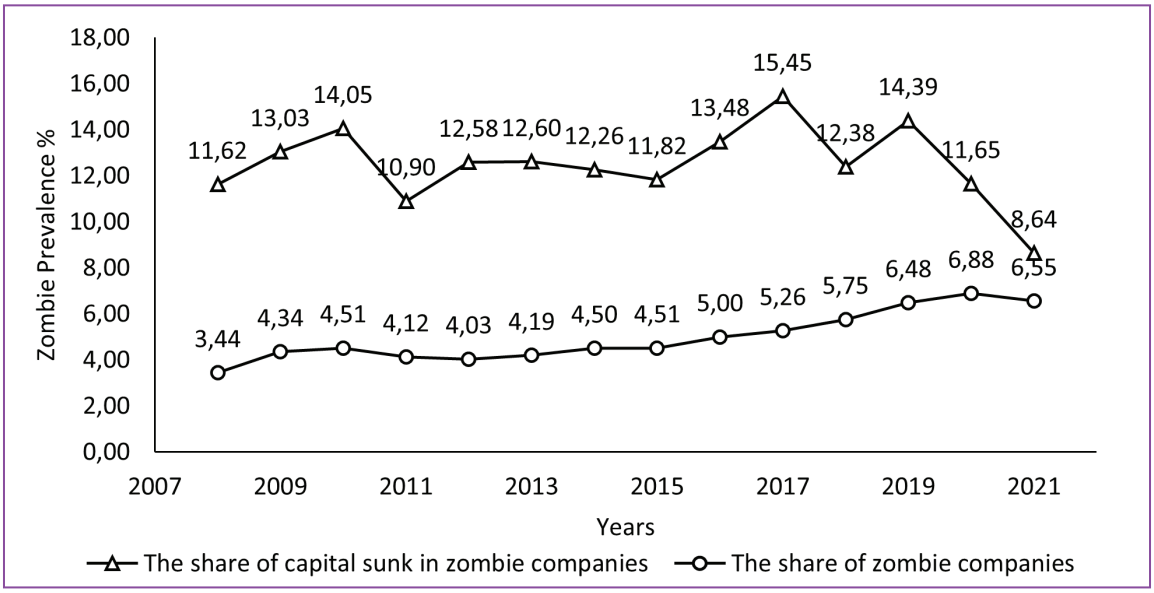
3.4. Results

The prevalence of zombies in terms of both the number of zombie companies and the share of capital sunk in zombie companies are shown in Figure 1. The share of zombie companies is calculated as the ratio of the number of zombie companies to the total number of companies, and the share of the capital stock sunk in zombie companies is calculated as the ratio of the total amount of assets held by zombie companies to the total amount of assets in Türkiye (Hallak, Harasztosi, and Schich 2018, p. 8).

Figure 1 shows that the share of capital sunk in zombie companies is higher than the share of zombies in terms of the number of companies throughout all years. This result means that zombie companies are generally larger companies in terms of assets. This finding also confirms the general theory that the larger the company, the higher the probability of zombies. Large companies tend to be kept alive because of the negative impact that their failure can have on employment and the economy as a whole (Gouveia and Osterhold 2018, p. 8; Urionabarrenetxea, Garcia-Merino, and San-Jose 2018, p. 418).

It should be noted that the share of zombies in terms of the number of companies tends to increase throughout the analysis period. The increase in the share of zombie companies, which was 3.44% in 2008, the first year of the analysis period, was limited in the post-global financial crisis period and after rising 4.51% in 2010, it recovered and started to decline. For this reason, it is seen that the estimates for the economies of most developed countries, which were affected by the global financial and sovereign debt crises that the zombie companies increased diverge from the results obtained in Türkiye. However, after it

Figure 1. Zombie Prevalence in Türkiye



Source: Calculated based on EIS.

managed to decrease to 4.03% in 2012, the share of zombie companies rose again and reached 6.88%, the highest level of the sampling period, in 2020. In 2021, the trend moved downwards and stood at 6.55%. Considering that 2020 and 2021 were the years when the pandemic was experienced, it can be thought that the low level of subsidies given during the quarantine period in Türkiye and the relatively high borrowing interest rates made it difficult for zombie companies to survive. Adoption of a strict quarantine policy to combat the pandemic in many countries as well as in Türkiye forced companies in nonessential sectors to shut down their activities completely, and after the loss of sales and revenues caused by these restrictions, many companies had to go bankrupt due to liquidity shortages (Schivardi, Sette, and Tabellini 2020, p. 569).

Although the share of capital sunk in zombie companies shows a similar trend, it is seen that the ups and downs are sharper. After 2019, there was a sharp decline and the prevalence of zombies according to both definitions converged. For the reason of this finding can be cited as the possibility that large zombie companies have lost their zombie company status through bankruptcy or restructuring.

Regression analysis was performed to analyse the effects of zombie companies on the performance of healthy companies. According to the results of the Hausman test, panel model with fixed effects was applied. The fixed effects model was also the model used in previous research on the subject. Following McGowan, Andrews, and Millot (2017), interacted industry and year fixed effects were added to the model in this framework. As Gouveia and Osterhold (2018) explained, it is necessary to use fixed effects to control for industry-specific shocks (as they affect both companies' performance and resources sunk).

It is necessary to test the basic assumptions of the linear model with fixed effects to be used and thus improve the model in case of deviations from the assumptions (Tatoğlu 2021, p. 79). In economic theory, the assumption of homoscedastic errors is rarely justified, that is, it is assumed that the errors of the relation are heteroscedastic until proven otherwise (Logarusic and Kristic 2022, p. 175). Heteroscedasticity was tested by the Breusch-Pagan / Cook-Weisberg test. According to the test result, the null hypothesis, which claims no heteroscedasticity, was rejected ($p<0.05$) and the heteroscedasticity was determined. By testing the autocorrelation with the Wooldridge test, the null hypothesis claiming no autocorrelation was rejected ($p<0.05$) and the autocorrelation was determined. Thus, heteroscedasticity and autocorrelation were corrected by clustering the standard errors at the interacted industry-year level. On the other hand, the fact that information is obtained from the units and the number of observations is high in panel data models shows that the multicollinearity, which expresses the existence of linear relations between the independent variables, is not a significant problem (Tatoğlu 2021, p. 274). However, the multicollinearity was tested with the Variance Inflation Factor (VIF) and it was determined that the VIF values of all independent variables were less than 5 and there was no multicollinearity.

The baseline estimates of equation (1) where the effects of zombie companies are analysed in terms of the investment rate, the employment growth and the level of multi-factor productivity of healthy companies are presented in Table 2.

Columns (1) and (2) of Table 2 show that β_2, the coefficient for the interaction term (NonZ*Z), is negative, as predicted in previous researches. According to this result, an increase in the zombie share in an industry reduces both the investment rate and employment growth of healthy companies in that industry. Column (3) shows that the coefficient of the interaction term is positive, as predicted in the theory. This shows that as the percentage of zombies in an industry rises, the multi-factor productivity gap between zombie and healthy companies widens. These findings align with the model's main predictions in Caballero, Hoshi, and Kashyap (2008) and McGowan, Andrews, and Millot (2017). However, in these two studies, the negative effects of zombie companies on the employment growth of healthy companies were found to be smaller than those on investment, while in this study on the example of Türkiye, the negative effects on investment were found to be smaller. This result can be interpreted as the crowding out effects of zombie companies in Türkiye are stronger in the labour market.

Evidence that zombie companies have negative effects on the performance of healthy companies; are consistent with those in Hoshi and Kim (2012), Imai (2016), Hallak, Harasztosi, and Schich (2018), Banerjee and Hofmann (2018), Albuquerque and Iyer (2023). However, these findings contradict the conclusions of Logarusic and Kristic (2022), Silva and Gonçalves (2022) that no adverse effects could be detected. It can be thought that the reason for this difference is that the economies of the countries where these two studies are conducted have not reached full capacity yet, and therefore, the increase in the resource demand of the zombie companies does not have a crowding-out effect on the healthy companies.

Table 2 also shows that the coefficient of the non-zombie dummy is positive for all regression analysis. According to this result, it can be concluded that healthy companies have higher investment rates, employment growth and are more productive relative to zombie companies. Similarly, the same conclusions were made in the studies of Caballero, Hoshi, and Kashyap (2008), Hoshi and Kim (2012), McGowan, Andrews, and Millot (2017), Banerjee and Hofmann (2018).

Table 3 shows that the estimates for the analysis of the effects of zombie companies on the performance of healthy companies are consistent with theoretical expectations.

Table 2. The effects of zombie companies on the performance of healthy companies

	(1)	(2)	(3)
Variables	Investment rate	Employment growth	Multi factor productivity
NonZ	0.338***	0.168***	0.745***
	(0.007)	(0.006)	(0.034)
NonZ*Z	-0.172***	-0.225***	0.439*
	(0.049)	(0.041)	(0.249)
Observations	2,677,211	2,669,903	2,601,941
R2	0.030	0.028	0.223
Control variables	Yes	Yes	Yes
Industry*year fixed effects	Yes	Yes	Yes

***, **, * respectively indicates statistical significance at 1%, 5%, and 10% levels.

Table 3. Expected Sign and Estimated Sign of Coefficients

Variables	Investment rate		Employment growth		Multi factor productivity	
	Expected	Estimated	Expected	Estimated	Expected	Estimated
NonZ	+/-	+	+/-	+	+	+
NonZ*Z	-	-	-	-	+	+

4. CONCLUSIONS

Zombie companies are businesses that cannot cover interest payments from current profits over an extended period, yet kept alive with support. The artificial extension of the life of these companies through interventions prevents the allocation of resources to healthy companies, causing both the performance of healthy companies and the country's economy to stagnate (Silva and Gonçalves 2022, p. 2).

In order to investigate the existence of zombie companies and the potential effects of the presence of such companies on the economy, it is important to determine which companies are identified as zombies correctly. However, it is seen that there is no consensus in the literature on a quantitative definition of these companies. Several definitions have been used with different advantages and disadvantages. In this study, the zombie identification method is adapted from the approaches presented by McGowan, Andrews, and Millot (2017) and Storz et al. (2017).

The analysis for 2006-2021 provides evidence of the prevalence of zombie companies in Türkiye. It has also determined that the share of capital sunk in zombie companies is higher than the share of zombies in terms of the number of companies for all years. This finding shows that large companies with easier access to credit and other support are zombie companies, which is in line with the prediction of Gouveia and Osterhold (2018) and Urionabarrenetxea, Garcia-Merino, and San-Jose (2017). However, this result contradicts the conclusion of Goto and Wilbur (2019) and Altman, Dai, and Wang (2022) that smaller companies are more likely to become zombies.

According to the empirical findings, healthy companies have higher investment rates, employment growth and are more productive compared with zombie companies (Caballero, Hoshi, and Kashyap 2008; Hoshi and Kim 2012; McGowan, Andrews, and Millot 2017; Banerjee and Hofmann 2018). This result states that the increase in the share of zombie companies negatively affects economic growth due to their low performance. At the same time, an increase in the share of capital sunk in zombies in an industry reduces investment rate and employment growth of healthy companies in that industry. This means that zombie companies increase their borrowing costs by absorbing resources from the industry in which they operate, thus crowding-out the investment of healthy companies (McGowan, Andrews, and Millot 2017, p. 6), and excluding healthy companies from the labour market by increasing salaries to retain employees (Hallak, Harasztosi, and Schich 2018, p. 11). Similarly, the multi-factor productivity gap between healthy and zombie companies widens in industries where zombie prevalence increases. This result provides empirical evidence supporting McGowan, Andrews, and Millot's (2017) theoretical conjecture that healthy companies must clear a higher productivity threshold to overcome the entry barriers that zombie companies create (McGowan, Andrews, and Millot 2017, p. 20).

Policymakers need to develop long-term market-oriented policies that will ensure the operability of the creative destruction mechanism to reduce the existence of zombie companies, which are found to underperform compared to healthy companies and have negative effects on their performance. In this context, strengthening the banking sector can be an effective solution in the decreasing the prevalence of the zombie companies. Improving the health of the banking sector by means of the application to the stricter bank supervision and regulations can be effective on the preventing zombie loans. Additionally, companies in financial distress can be prevented from becoming zombies by encouraging them to resorting to methods such as capital increase and mergers. The final step in policy carried out is to facilitate the exit of these companies from the market rather than keeping them alive. Therefore, the preparation and implementation an effective bankruptcy law can ensure the liquidation of the zombie companies as soon as possible. Thus, economic growth can be promoted.

The most important limitation of this study is that financial data is entered into the data set with a delay. Therefore, the year in which the latest analysis carried out is 2021. However, since this limitation is valid for all data sets used in prior studies, it is thought that it doesn't have impact on the importance of the study.

In this study, the existence of zombie companies in Türkiye and their effects on the economy are examined, but no research is conducted on the determinants of these companies, the persistence of the zombie status, and the incidence of zombie companies across different industries. Further studies may contribute to the literature on these subjects.

Endnotes

1. The three-year age criterion was introduced because start-ups are generally considered to be three years old or younger (McGowan, Andrews, and Millot 2017). The investment ratio limitation was accepted as 10%, as it showed a significant increase in capacity.

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