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Financial Profile of Zombie Firms: Evidence from the Emerging Turkish Market

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Zombi Firmaların Finansal Profili: Gelişmekte Olan Türkiye Pazarından Kanıtlar

Abstract

This study examines the financial profile of zombie companies that damage other firms, sectors, and the economy in Türkiye, an emerging market. To investigate the factors affecting the likelihood of becoming a zombie company, panel probit models are estimated using 241 non-financial listed firms on Borsa Istanbul from 2013 to 2019. Among these firms, 64 are classified as zombies. The results indicate that the probability of becoming a zombie is higher in companies that are more indebted, less efficient in asset usage, and younger. That is, less experienced companies that invest heavily in inefficient assets have the potential to become zombies and harm the economy in the long run.

Keywords : Zombie Company, Characteristics of Zombies, Borsa İstanbul Non-Financial Firms.

JEL Classification Codes : G30, G32, D22.

Öz

Bu çalışma, Türkiye gibi gelişmekte olan bir ülkede, diğer firmalara, sektörlere ve ekonomiye zarar veren zombi şirketlerin finansal profilini incelemektedir. Zombi olma olasılığını etkileyen faktörleri araştırmak amacıyla, 2013-2019 yılları arasında Borsa İstanbul'da işlem gören 241 finansal olmayan halka açık şirket üzerinde panel probit modelleri tahmin edilmiştir ve 64 firma zombi şirket olarak belirlenmiştir. Sonuçlar, daha borçlu, varlık kullanımında daha verimsiz ve daha genç olan şirketlerin zombi olma olasılığının daha yüksek olduğunu göstermektedir. Yani, daha az deneyime sahip olan ve yüksek borçlarını verimsiz varlıklara yatıran şirketlerin, uzun vadede zombi olma ve ekonomiye zarar verme potansiyeli bulunmaktadır.

Anahtar Sözcükler : Zombi Şirket, Zombi Firma Özellikleri, Borsa İstanbul Finansal Olmayan Firmalar.

1. Introduction

In some developed countries, financial crises through the banking system have created a dead part in the economy, encouraging the establishment of a routine that provides continuous government or financial institution support to firms that have gone bankrupt. This situation has created a network of zombie banks and zombie companies. Thus, a zombie economy emerged (Papava, 2010: 47). The increased number of banks lending zombie credits has led to the misallocation of loans to borrowers protected from bankruptcy, thereby damaging economies (Bruche & Llobet, 2013: 923). The theory examining the negative effects of concessional loans, which banks misdirect to zombie companies that cannot survive without credit support, on healthy companies and the economy is expressed as the "zombie firm theory", "zombie firm hypothesis", or "zombie economy", and is based primarily on the example of Japan (Urionabarrenetxea et al., 2017: 408-419).

Financial distress can lead to substantial and costly business losses (Opler & Titman, 1994: 1037), and the economic consequences of company failure are significant (Šarlija & Jeger, 2011: 133). While the emergence of zombie firms misallocates resources and harms the economy in the long run, preventing these troubled firms from failing is sometimes seen as a temporary measure to mitigate the immediate impacts of financial crises and postpone the bad-loan costs faced by banks. Consequently, particularly after the 2008 global financial crisis and the subsequent COVID-19 pandemic, zombie firms- technically insolvent but not legally bankrupt- have become a growing research subject due to their increasing presence in the global economy.

One of the key reasons for supporting zombie firms lies in the potential externalities they generate. These firms may provide sectoral or economic benefits, such as improving infrastructure, promoting development, or ensuring national priorities, including food security, particularly in industries like agriculture and manufacturing. Additionally, firms considered "too big to fail"- including major banks or state-owned enterprises - pose significant risks, as their collapse could lead to widespread unemployment or financial instability. This risk often prompts government intervention to maintain economic stability. However, financial support, incentives, or subsidies should be carefully regulated to prioritise non-zombie firms, ensuring efficient resource allocation and fostering long-term economic growth.

The role of zombie firms in prolonging the Japanese macroeconomic recession that started in the early 1990s has been examined in the literature, with Hoshi (2000) as a pioneer (Caballero et al., 2008: 1943). After the global financial crisis, the problem of economic zombification has entered the agenda of other countries as a common global issue (Papava, 2010: 35; Wang & Zhu, 2020: 2). Aiming to correct the misallocation of financial capital, encourage the transfer of capital to emerging industries, increase overall productivity and innovation capacity, and thus promote economic growth (Wang & Zhu, 2020: 2), research on determining the characteristics of zombie companies-alongside their damage to the economy-has gained importance.

The allocation of financial capital, which should ideally flow to healthy and productive companies, instead of financially distressed and unproductive zombie firms, significantly damages sectors and the overall economy. To mitigate the adverse effects of this misallocation, it is essential to understand the characteristics of zombie companies and control the flow of funds directed toward them. Although misdirected loans to financially distressed companies are not a new phenomenon, this study aims to highlight the misallocation of resources in Türkiye by examining this issue through the concepts of zombie companies and zombie loans. The objective is to demonstrate that financial weaknesses result in company bankruptcies and cause long-term and broader economic harm as part of the phenomenon of zombie firms.

This study aims to contribute to channelling financial resources to productive areas by determining the characteristics of zombie firms. The attributes of zombie companies are important risk factors not only for zombie businesses but also for healthy companies, sectors, and the economy as a whole. Another goal of this study is to investigate the relationship between several prominent financial weaknesses in developing countries that have not been sufficiently examined in the zombie literature. To achieve these goals, the financial profile of zombies in Türkiye, an emerging country, is investigated by identifying the financial and non-financial factors that increase the probability of becoming a zombie firm. This study is conducted on a sample of non-financial firms listed on Borsa İstanbul (BIST) between 2013 and 2019.

The first contribution of this study is to specify the firm-level characteristics of zombies by focusing on the efficiency of asset usage and liquidity, which are more prominent issues in emerging markets. Previous studies agree that high debt levels and low profitability increase the likelihood of zombies. Liquidity and asset usage efficiency ratios have been overlooked in the literature, except for Urionabarrenetxea et al. (2017), who consider short-term debts as an indicator of urgency regarding the risk of zombification, and Javaheriafif (2017), who examines the asset turnover ratio in the U.K. context. However, the economic, financial, and institutional structure of developing countries, such as Türkiye, exposes companies to liquidity and asset efficiency problems (Akgüç, 2010; SPL [Capital Markets Licensing Registry and Training Agency], 2021; Sevil & Başar, 2015). Thus, this study examines the risks associated with asset efficiency and liquidity in becoming a zombie company and their economic impact.

Secondly, this paper contributes to the literature on firm-specific determinants of zombie firms by expanding the scope to an emerging economy. According to the literature review (summarised in Table 1), firm-level characteristics that distinguish zombies from healthy firms have been identified in three developed countries (Japan, the U.K., and Spain) and two emerging economies (China and the Czech Republic).

Studies using Turkish data have investigated the existence of zombie companies among publicly traded manufacturing firms (Kaplanoğlu & Yükçü, 2019; 2020), as well as their effects on productivity and employment in the manufacturing sector (Dinçer et al.,

2019; Kaplan & Aksoy, 2024). Şahin (2024) examines the post-COVID-19 pandemic and its impact on non-zombie firms. The financial characteristics of zombie companies have been analysed by Horasan (2023), who compares them with BIST 30 firms, and by Sumerli Sarıgül & Avcı (2025) through a case study. However, there appears to be no comprehensive research investigating the determinants of zombie firms using Turkish data.

The remainder of this paper is structured as follows: Section 2 provides a literature review on zombie theory and the interrelationships between zombie lending and economies, industries, and banks. Section 3 presents the methodology of the empirical analysis, detailing the processes of sample construction, zombie specification, and the selection of relevant variables. Section 4 presents and discusses the key results, outlines limitations, and offers suggestions for future research. Finally, Section 5 draws concluding remarks.

2. Theoretical Grounding and Hypotheses

2.1. Literature Review on Zombie Lending

Empirical studies on which this paper is based can be categorised into four groups, as presented in Table 1. The first group (Group A in Table 1) focuses on how zombie lending adversely affects healthy firms, sectors, and economies regarding productivity, employment, investment, profitability, credit allocation, and access to finance. The following two categories examine the causes of zombie lending from either the bank perspective (Group B) or the company perspective (Group C). Articles in the D category, labelled "Other Factors (Aspects)," connect the zombie theory to various dimensions, including the COVID-19 pandemic, social responsibility, corporate governance, and monetary policy. This paper is more closely aligned with the C strand of this literature.

Sekine et al. (2003), Ahearne and Shinada (2005), and Caballero et al. (2008), using industry- and firm-level data, along with Imai (2016), who focuses on small business data in Japan, confirm the adverse effects of zombie lending on healthy firms and its contribution to the Japanese macroeconomic recession. Among the studies in Group A conducted in other developed countries (Arrowsmith et al., 2013; Banerjee & Hofmann, 2018; McGowan et al., 2017) and in China (Chen, 2021; Huang et al., 2021; Tan et al., 2016; Wang & Zhu, 2020) as an emerging economy, the crowding-out and harmful effects of zombie firms are consistently acknowledged. Nurmi et al. (2020) suggest that subsidies help zombie firms survive in Finland. Acharya et al. (2020) demonstrate that zombie lending reduces defaults and diminishes productivity and prices, leading to European disinflation. Kaplan and Aksoy (2024) conclude that the increasing prevalence of zombie companies in Turkish manufacturing sub-sectors significantly reduces sectoral productivity.

Table: 1
Summary of Key Studies on Zombie Lending

	Papers	Data Coverage	Period	Analysed Factor
A	**Zombie Lending→ Healthy Firms, Sector and Economy**			**Economic Factors**
1	Sekine et al. (2003)	Japan, 580 listed firms + sectors	1986-1999	Profitability, credit allocation
2	Ahearne & Shinada (2005)	Japan, 604 listed firms + 33 sectors	1970-2001	Productivity
3	Caballero et al. (2008)	Japan, 1,844-2,506 firms + sectors	1981-2002	Investment, employment, productivity
4	Imai (2016)	Japan, 2,357 SMEs	1999-2008	Investment, borrowing
5	Arrowsmith et al. (2013)	UK, pre-survey assessment	2013	SME productivity
6	McGowan et al. (2017)	13 OECD countries + firms	2003-2013	Investment, employment, productivity
7	Banerjee & Hofmann (2018)	14 dev. economies, listed firms	1984-2016	Financing
8	Tan et al. (2016)	China, average 248,174 firms	2005-2007	Output, employment, productivity
9	Wang & Zhu (2020)	China, listed firms, 19,551 obs.	2006-2016	Investment, financing
10	Nurmi et al. (2020)	Finland, firms	1999-2017	Misallocation, subsidies
11	Acharya et al. (2020)	12 European Countries	2012-2017	Productivity, disinflation
12	Chen (2021)	China	Non-empirical	Misallocation
13	Huang et al. (2021)	China, man. firms	1998-2007	Misallocation, productivity
14	Geng et al. (2021)	China	1998-2007	Industrial upgrading, misallocation
15	Wang et al. (2022)	China, man. firms	2003-2013	Investment, competitiveness
16	Kaplan & Aksoy (2024)	Türkiye, man. firms	2009-2022	Sectoral productivity
B	**Bank Specific Factors → Zombie Lending**			**Bank Specific Factors**
17	Peek & Rosengren (2005)	Japan, bank-firm obs.	1993-1999	Capital ratio
18	Fukuda et al. (2006)	Japan, bank-firm obs.	1997-2002	Non-performing loans
19	Okamura (2011)	Japan, bank-113 listed firms	1997-2003	Capital ratio
20	Storz et al. (2017)	7 European Economies, bank-SMEs	2010-2014	Weak financial health
21	Albertazzi & Marchetti (2010)	Italy, bank-firm obs.	2008-2009	Size, capital ratio
22	Broz & Ridzak (2017)	Croatia, bank-firm obs.	2008-2012	Capital ratio of one bank
23	Chari et al. (2021)	India, bank-firm-level	2006-2016	Non-performing loans
24	Bittner et al. (2021)	Germany, bank-firm-level	2009-2013	Weak financial health, trade credit
C	**Firm Specific Factors → Zombie Lending**			**Factor Group**
25	Hoshi (2006)	Japan, four sectors, 5,502-7,429 firms	1981-2002	Financial, sectoral, locational
26	Urionabarrenetxea et al. (2017)	Spain, 1,271 firms	2010-2014	Financial, sectoral, locational
27	Javaheriafif (2017)	UK, 42 firm-year obs.	2008-2012	Financial, sectoral, locational
28	Dai et al. (2019)	China, mining sector,10,477 firms	1998-2013	Financial, sectoral, locational
29	Blažková & Dvouletý (2020)	Czech, food industry, 1,730 firms	2003-2015	Financial, sectoral, locational
30	Horasan (2023)	Türkiye, ISO 1000, BIST 30	-	Financial
31	Sumerli Sarıgül & Avcı (2025)	Türkiye, case study	2023	Financial
D	**Other Factors (Aspects) → Zombie Lending (or Recovery)**			**Factors**
32	Papava (2010)	General & Post-communist States	Non-empirical	Non empirical
33	Fukuda & Nakamura (2011)	Japan, 1,306 listed firms	1995-2004	Recovery, restructuring
34	Bruche & Llobet (2013)	General	Non-empirical	Non empirical
35	San-Jose et al. (2022)	Spain, 2141 firms	2013-2017	Corporate governance
36	Hong et al. (2022)	Japan, loan-level and firm-level	2004-2015	Monetary Policy
37	Abidi & Belkhir (2022)	MENAP, 11 counties, 667 firms	2002-2020	COVID-19 pandemic
38	Hoshi et al. (2022)	Japan, survey 4,093 firms	2020	COVID-19 pandemic, support program
39	Şahin (2024)	Türkiye, average 979,000 firms	2009-2022	COVID-19 pandemic
40	Mashwani et al. (2024)	49 Countries, 40,311 obs.	2002-2019	Environmental and social responsibility
41	Zhaxi & Yasuda (2024)	43 Countries, 185,601 obs.	2015-2021	Culture and bankruptcy law
42	Amundsen et al. (2025)	Canada, average 16 million obs.	2002-2022	COVID-19 pandemic

Notes: Table 1 summarises zombie lending research included in this study, categorised into four groups (A, B, C, and D). The "Data Coverage" column indicates whether the analysis is conducted at the country, sector, or firm level. The period and main factors or factor groups examined in the papers are presented in the last columns. Man.: Manufacturing; Obs.: Observations; Dev.: Developed.

Studies by Fukuda et al. (2006), Peek and Rosengren (2005), and Okamura (2011) focus on the internal financial problems of Japanese banks that led to the misallocation of loans to financially impaired firms during Japan's economic recession. Research conducted on economies outside Japan (Albertazzi & Marchetti, 2010; Bittner et al., 2021; Broz & Ridzak, 2017; Chari et al., 2021; Storz et al., 2017) typically analyses firm-level data in conjunction with information from the firms' parent banks. In addition to the risk transfer from weak banks to zombie firms, Bittner et al. (2021) also emphasise another systemic contagion risk caused by the increased use of trade credit by zombie firms.

Studies focused on the characteristics that distinguish zombie firms from healthy firms, or factors that increase the likelihood of becoming a zombie, are presented in Section C of Table 1 and are most relevant to the scope of this study. Hoshi (2006) examines the likelihood of becoming a zombie using variables such as profitability, financial structure, size, location, and sector, based on a sample of large Japanese enterprises across the manufacturing, construction, real estate, retail, wholesale trade, and service sectors. Hoshi (2006) also examines the impact of zombie firms on exit probability, job creation, and job destruction.

Urionabarrenetxea et al. (2017) rank 1,271 zombie companies in Spain- defined as firms with negative equity for five consecutive years and more than 10 employees- according to an index developed within the framework of four dimensions of the negative equity problem. Javaheriafif (2017), focusing on a sample of non-financial firms from the FTSE 250 index in the UK, concludes that the probability of becoming a zombie correlates positively with debt burden but negatively with profitability and cash flow. Dai et al. (2019) examine the prevalence and distribution of zombie firms among China's coal mining companies, exploring internal and external determinants of becoming and recovering from zombie status. Blažková and Dvouletý (2020) investigate the characteristics of Czech food and beverage companies before and after they became zombies. Their research is based on 382 zombie firms identified by negative equity, out of 1,730 companies, for which continuous data is available for 43 zombie firms. Horasan (2023) compares zombie companies among the ISO-1000 and BIST-30, highlighting profitability differences in the descriptive statistics. Sumerli, Sarıgül, and Avcı's (2025) case study of a single firm in Türkiye reveals that zombie firms typically exhibit high debt levels, negative profitability, elevated debt-to-equity ratios, and increased financial risks, posing significant threats to their financial sustainability.

Among D category articles, Papava (2010) examines the threat of zombification in post-communist countries. Bruche and Llobet (2013) propose a regulatory framework to address the information rent problem faced by banks that conceal bad loans through zombie lending. Fukuda and Nakamura (2011) analyse corporate restructuring factors from the perspective of zombie recovery.

More recent studies in the D group, as listed in Table 1, approach zombie lending within more contemporary frameworks. Although categorised under group B in Table 1, Wang et al. (2022) demonstrate the harmful effects of zombie firms on the sustainable development of China's regional economy. They are the first to link zombie firms with the green economy. Mashwani et al. (2024) demonstrate that zombie firms underperform in environmental and social responsibilities. Hong et al. (2022) observe that zombies respond to low-interest-rate monetary policies by increasing refinancing rather than investing in Japan. San-Jose et al. (2022) argue that corporate governance in Spain is a critical internal factor that should be considered in analysing zombie firms. Zhaxi and Yasuda (2024) report that countries with more effective insolvency rules and higher levels of individualist culture tend to have fewer zombie firms.

Abidi and Belkhir (2022) argue that zombies that retain their status after the COVID-19 pandemic should be efficiently liquidated to protect competitive and sustainable firms in MENAP countries. Hoshi et al. (2022) demonstrate that government support programs in Japan during the 2020 pandemic primarily benefited poorly performing firms with low credit scores; however, these firms were not necessarily zombies. Şahin (2024) finds that while the share of zombie firms in Türkiye has declined since its peak in 2020 during the COVID-19 pandemic, continued lending by creditor banks to financially distressed firms has contributed to zombification, negatively impacting other firms. Amundsen et al. (2025) note that despite extensive COVID-19 support, the share of zombie firms in Canada decreased as potential zombies exited the market, while support programs helped non-zombie firms survive, and enabled some zombies to recover, boosting overall productivity.

2.2. Research Hypotheses

A zombie company (also referred to as living-dead, half-dead, or half-alive) (Javaheriafif, 2017; Hoshi, 2006) refers to a firm that, under normal market conditions, would be expected to go bankrupt due to its inability to meet debt obligations but continues to operate with support from the government and/or financial institutions. In this study, adhering to this definition, all hypotheses aimed at identifying the factors influencing the likelihood of a company becoming a zombie are formulated within the financial risk framework, specifically the risk associated with meeting financial obligations. The following paragraphs present two main hypotheses and their corresponding sub-hypotheses.

> **H1.** Weaknesses in financial health related to profitability, leverage, liquidity, and asset utilisation efficiency are characteristic of zombie companies.

Profitability: Low or negative profitability metrics indicate various financial health issues (Blažková & Dvouletý, 2020: 17) and can signal financial distress (Campbell et al., 2011: 6; Ni et al., 2014; Uğurlu &Aksoy, 2006; Plat & Plat, 2008: 9; Yuharningsih, 2014). Low profitability is consistently identified as a common trait of zombies, which are often significant loss-makers (Blažková & Dvouletý, 2020; Dai et al., 2019; Hoshi, 2006; Javaheriafif, 2017). Unprofitability, as a component of cash flow and internal financing, can directly and indirectly increase financial risk and the likelihood of becoming a zombie. Therefore, we propose the following hypothesis:

> **H1.1.** Less profitable firms are more likely to become zombies.

Leverage: Financial risk is directly influenced by a firm's leverage decisions (Senbet & Wang, 2012; Bilir, 2015), with distressed firms typically exhibiting higher levels of leverage (Campbell et al., 2011; Uğurlu & Aksoy, 2006). Zombie firms are often characterised by high leverage (Blažková & Dvouletý, 2020; Dai et al., 2019; Hoshi, 2006; Javaheriafif, 2017). Excessive debt levels can hinder their chances of recovery (Fukuda & Nakamura, 2011; Yang et al., 2021). A firm's ability to meet its long-term obligations depends on its profitability and borrowing capacity. Firms with unstable or declining profits and high debt ratios are particularly vulnerable to bankruptcy during economic downturns

or operational slowdowns (Akgüç, 2010; SPL, 2021; Sevil & Başar, 2015). Therefore, a high leverage ratio increases the likelihood of defaulting on debt payments and thus becoming a zombie. This leads us to formulate the following hypothesis:

H1.2. More leveraged firms are more likely to become zombies.

Liquidity: Weak short-term solvency ratios reflect inefficient net working capital management. Liquidity problems and the disproportionate use of short-term debt increase the likelihood of financial distress (Ni et al., 2014; Uğurlu & Aksoy, 2006; Xuezhou et al., 2020). Javaheriafif (2017) identifies a negative relationship between a firm's ability to generate cash (measured by operating cash flows or assets) and the likelihood of becoming a zombie. Similarly, Urionabarrenetxea et al. (2017) highlight short-term debts as a magnifying factor in their index of zombie risk. Although previous research has not fully explored whether liquidity or working capital management effectively distinguishes zombies from non-zombies, weak liquidity is expected to increase the likelihood of becoming a zombie. This relationship may be particularly relevant in emerging markets, where firms often face liquidity challenges driven by economic, financial, and institutional factors (Akgüç, 2010; SPL, 2021; Sevil & Başar, 2015). Accordingly, the following hypothesis is proposed:

H1.3. Less liquid firms are more likely to become zombies.

Efficiency: Inefficient use of assets, reflecting management's ability to compete under challenging market conditions (Altman, 1968: 595), can contribute to financial distress (Ni et al., 2014; Wang & Li, 2007). A defining characteristic of zombie companies is their inability to convert substantial capital investments into adequate output (Wang et al., 2022: 7). A low asset turnover ratio, or inefficiency in asset usage, can signal various structural financial issues. Although the asset turnover ratio, which measures efficiency, profitability, and risk, has not been extensively examined in previous research, we argue that inefficiency in asset usage could hinder a firm's ability to repay debt and increase its risk of becoming a zombie. In Türkiye, asset turnover ratios are generally lower than those in developed countries, influenced by investments in low-value-added assets, low capacity utilisation rates, relatively high inventory levels, and extended accounts receivable terms (Akgüç, 2010; Atradius, 2019; Şahin, 2019). Therefore, we propose the following hypothesis:

H1.4. Less efficient asset usage increases the likelihood of becoming a zombie firm.

H2. Being a zombie relates to size, age, location, and economic conditions as non-financial factors.

Size: Empirical findings on the effect of firm size on the likelihood of becoming a zombie are complex and nuanced. Smaller firms face various disadvantages compared to larger firms in terms of financial health, credibility, access to finance, agency costs, fragility, negotiating power, economies of scale, competitiveness, and market opportunities (Blažková & Dvouletý, 2020: 16; Gultekin & Sayilgan, 2021; Hoshi, 2006; Lopez-Valeiras

et al., 2016; McGowan et al., 2017: 16; Urionabarrenetxea et al., 2017: 413-416). These weaknesses often exclude small firms from capital markets and constrain their access to credit (Mateut & Mizen, 2003). Credit-constrained smaller firms usually struggle to secure short-term financing, which can lead to failure (Campbell et al., 2011). Blažková and Dvouletý (2020) and Hoshi (2006) recognise these negative characteristics of small companies as factors that weaken their financial health and accelerate the process of becoming zombies. On the other hand, the advantages enjoyed by larger companies explain why they receive more financial support and are less likely to become zombies (Urionabarrenetxea et al., 2017; Javaheriafif, 2017; Dai et al., 2019) or are more likely to recover with government assistance (Yang et al., 2021). We argue that the former argument prevails and propose the following hypothesis:

H2.1. Smaller-sized firms are more likely to become zombies.

Age: The related literature (Blažková & Dvouletý, 2020; Dai et al., 2019; Geng et al., 2021; McGowan et al., 2017) investigating the influence of company age on the likelihood of becoming a zombie generally agrees that older, long-established firms are more susceptible. This argument is based on the perception that older firms are viewed as more credible, less risky, and thus have better access to external finance (Nurmi et al., 2020; Blažková & Dvouletý, 2020), even when they encounter repayment difficulties. Younger companies often require more time for their investment projects to yield returns (Banerjee & Hofmann, 2018: 68) and have not yet accumulated significant profits, which increases their likelihood of failure in their early years (Altman, 1968: 595). Relative youth and inexperience typically correlate with lower financial performance (Ghafoorifard et al., 2014; Lo et al., 2016) and higher risk (Altman et al., 2017: 143-144; Blažková & Dvouletý, 2020: 16), thereby tightening their financial constraints (Nurmi et al., 2020: 18). Financially constrained firms are often smaller, younger, and riskier, relying heavily on bank loans. Smaller and younger firms tend to carry higher debt burdens, and any disruption in bank credit flow significantly affects these firms, which are dependent on bank financing (Akgüç, 2010; Mishkin & Eakins, 2018: 185; Bernanke & Gertler, 1995: 35-40; Sevil & Başar, 2015). Within this framework, the hypothesis is formulated as follows:

H2.2. Younger firms are more likely to become zombies.

H2.3. Operating in an economically less developed area reduces the likelihood of becoming a zombie.

Location: Hoshi (2006) suggests that crisis effects are more pronounced in metropolitan areas, whereas political and social pressures to avoid firm failure are higher outside urban areas in Japan. He tests both hypotheses and confirms that being in smaller areas increases the possibility of becoming a zombie. In contrast, Blažková and Dvouletý (2020) specify that zombie firms are concentrated in metropolitan areas within the Czech food industry, while Urionabarrenetxea et al. (2017) associate zombie firms with regions characterised by more extensive business networks in the UK. Geng et al. (2021) attribute

the high prevalence of zombie firms in China's central and western regions to the government's regional balancing strategy.

The economies' dynamics influence the relationship between zombie firms and regions. Regional incentive practices, part of Türkiye's investment incentive system, aim to reduce the economic development gap between cities and enhance their production and export potential. Under this system, all provinces across the country are grouped into six regions based on their socio-economic development levels, with Region 1 being the most developed. Economically less developed areas receive higher investment contribution rates, interest or dividend support, and tax and insurance premium incentives (Republic of Türkiye Ministry of Industry and Technology, 2021). Furthermore, banks under protocols with the Turkish Ministry of Economy (such as Türkiye Finans Katılım Bankası A.Ş., Development and Investment Bank of Türkiye, Aktif Yatırım Bankası A.Ş., Vakıf Katılım Bankası A.Ş.) offer incentive loans with subsidised interest rates or dividend support to priority, underdeveloped regions. These aids from the state and financial institutions can potentially prevent companies from becoming zombies by offering temporary solutions to financial problems. Based on the assumption that zombies are less likely to emerge in underdeveloped areas, the following hypothesis is proposed:

> **H2.3.** Operating in an economically less developed area reduces the likelihood of becoming a zombie.

Economic Condition: Adverse economic and sectoral conditions worsen financial performance (Opler & Titman, 1994: 1037) and may cause financial distress by magnifying the negative consequences of risky financial structures (Uğurlu & Aksoy, 2006). Conversely, distressed firms are less likely to survive during economic downturns (Campbell et al., 2011: 1). Economic recessions generally correlate with increased aggregate insolvency (Javaheriafif, 2017: 58), whereas economic expansions contribute to the recovery of zombie firms (Fukuda & Nakamura, 2011). Countries experiencing higher GDP growth tend to have a lower prevalence of zombie firms (Altman et al., 2021: 5).

Unlike previous crises, the 2008 global financial crisis compelled governments to implement extraordinary support policies, leading financial institutions to adopt a more lenient approach toward troubled loans. These measures facilitated the survival of technically bankrupt yet operational zombie businesses (Javaheriafif, 2017; Dai et al., 2019). The COVID-19 pandemic further accelerated government and financial institution support for heavily indebted corporations in the USA and other countries, resulting in a global increase in zombie firms (Altman et al., 2021). Based on these arguments, we propose the following relationship:

> **H2.4**. Economic growth affects the likelihood of becoming a zombie.

3. Methodology

The methodology section presents the econometric framework of the analysis.

3.1. Sample Construction

The analysis data were gathered from the Public Disclosure Platform (PDP, 2020). When data collection began on September 2, 2020, the PDP (2020) database included 272 non-financial companies, excluding 127 financial institutions, out of 399 firms traded on Borsa İstanbul. Starting from 2013, when changes were made to the financial statement format, the analysis period was set from 2013 to 2019. Since the pre-merger data of five companies that merged into a single company in 2020 were included, the sample selection process began with 276 companies (272 - 1 + 5).

Among these 276 firms, 35 were excluded from the analysis because their trading either started or was suspended during the analysis period. Of these, 34 companies were listed in 2014 or later, and one firm (MEMSA) was delisted during the period. After excluding these 35 firms, the final sample consisted of 241 companies (276 - 35 = 241). Consequently, the 7-year financial statement data of 241 firms for the 2013-2019 period were combined, resulting in 1,687 observations (241 firms × 7 years) for each variable.

Financial distress encompasses all difficulties, from meeting obligations to bankruptcy (Plat & Plat, 2008: 5; Bilir, 2015). It refers to the inability to meet short- and long-term commitments, including continuous obligations such as interest payments and other financial expenses (Xuezhou et al., 2020: 649). Financially distressed firms are generally defined as those that do not have sufficient earnings to meet their obligations (Aktümsek & Göker, 2018: 402). Zombies are considered half-dead (or half-alive) companies because they are neither entirely insolvent nor have a healthy financial structure to make debt payments (Javaheriafif, 2017: 72).

Zombies are incapable of paying their financial obligations but remain operational due to support from governments or financial institutions. This support, often privileged, prevents them from going bankrupt, despite the risk they pose. For a firm to be considered a zombie, it must meet at least two conditions beyond merely defaulting on creditors' claims. Suppose a company, unable to generate adequate earnings to make payments, continues to receive additional debt infusion from financial institutions or government support for at least one year. In that case, it can be considered supported and protected from bankruptcy. In summary, while a zombie is a financially distressed firm, not every financially distressed firm qualifies as a zombie.

This analysis identified zombie firms based on the conditions of low profitability and additional borrowing, as described in the Fukuda and Nakamura (2011: 1126-1127) model, and the persistence of these conditions for a period of two years. In the zombie firm identification process, low profitability was assessed first. Firms with current period EBIT lower than their financing expenses were selected. The next step was to identify companies whose financial debts increased despite not generating sufficient profit, or despite EBIT being less than the interest expense. In other words, companies supported by financial institutions, even though they did not have enough profit to make interest payments, were

identified. This second criterion, in the form of new credit usage, can be expressed as the financial support criterion.

In the final stage, among the companies that met the first two criteria, those that maintained these conditions for at least two consecutive years were identified. This condition was referred to as the "permanence condition", implying that the zombie situation was not temporary. As a result, 64 firms that experienced an increase in their financial borrowings in the t+1 period despite their EBIT being less than financing expenses in the t period, and whose conditions persisted for at least two consecutive years during the seven-year analysis period, were identified as zombie firms.

3.2. Explanatory Variables

We determined the analysis variables based on the relevant literature and the characteristics of the data to be analysed. Proxies for profitability, financial structure, liquidity, and financial efficiency constitute the financial variables. Non-financial variables include size, age, location, and GDP growth rate.

3.2.1. Financial Variables

Profitability: Various profitability measures, such as return on sales (Blažková & Dvouletý, 2020; Hoshi, 2006), return on assets (Dai et al., 2019), operating income or EBIT (Hoshi, 2006; Javaheriafif, 2017), and notable gains and losses relative to total sales (Fukuda & Nakamura, 2011), have been employed in previous studies on zombie firms. Return on assets and, alternatively, the gross profit ratio were selected as proxies for profitability, as they were deemed suitable for the dataset in this study[1].

Leverage: Zombie studies have utilised total debt burden (Blažková & Dvouletý, 2020; Fukuda & Nakamura, 2011; Hoshi, 2006[2]; Javaheriafif, 2017) or financial debt levels (Hoshi, 2006; Blažková & Dvouletý, 2020) as indicators of leverage. Consistent with prior research, we employed two leverage measures: total debt and total financial debt (comprising both short-term and long-term financial liabilities), both expressed as a percentage of total assets.

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[1] *In the dataset, the revenues of four companies (CASA, MIPAZ, TURGG, and ULAS) for periods with zero revenue were recorded as '1' to maintain data consistency. Certain firms, such as ESCOM and SONMEZ, reported unusually high or low levels of other income or losses from operating or non-operating activities, resulting in extreme values for profitability ratios, including operating income and net income. Similarly, instances of negative equity combined with period losses produced misleadingly positive return on equity values. These outliers were retained in the sample to preserve both the sample size and the number of observations for the dependent variable, as some of these firms met the criteria for classification as zombies. For example, 44 of the 60 negative equity observations belonged to 12 companies identified as zombies. Instead of excluding these outliers, more appropriate profitability measures, such as return on assets and, alternatively, gross profitability, were used in this study.*

[2] *Hoshi (2006) uses the share of bank credit extended by a firm's parent bank relative to total bank credit as an indicator of the firm's dependency on its parent bank or the strength of its parent-bank relationship.*

Liquidity: The current and acid-test ratios were included in the regressions to proxy for liquidity.

Efficiency: The asset turnover ratio, a comprehensive indicator of financial efficiency, was used as a proxy for efficiency in this analysis, following the approach of Javaheriafif (2017), who employed the activity ratio (also known as the asset turnover ratio).

3.2.2. Non-Financial Variables

Size: Consistent with studies (Blažková & Dvouletý, 2020; Hoshi, 2006; Javaheriafif, 2017) that explore the relationship between company size and zombie lending, we included a size variable measured by the logarithm of total assets. Additionally, the logarithm of revenue was used as an alternative indicator of size in some regression specifications.

Age: We used two age variables: one based on the establishment year (2019 minus the foundation year) and the other based on the date of BIST entry (2019 minus the listing year). We first referred to the PDP footnotes and general information to obtain the establishment and listing year information. For some missing or conflicting dates, we consulted the company's website, the trade registry gazette, the websites of some investment companies, and internet news sources.

Location: According to the address of the company headquarters in the PDP database, 190 firms (79% of the 241 sampled firms) are located in five cities (İstanbul, İzmir, Ankara, Bursa, Kocaeli), and 115 companies (approximately 48%) are located in İstanbul. These five cities are the most economically developed regional group (ranking 1) in Türkiye's regional incentive practices. The level of economic development of cities is ranked based on the number of firms whose headquarters are located in each city. The location effect was controlled with two dummy variables: one for the first five cities (LKSYN) and one for the largest city, İstanbul (LKSYNI).

Economic Condition: To control for economic conditions (such as economic development, growth, or the economic cycle), a broad measure, GDP growth, was employed. GDP growth was used as a country-level control in Javaheriafif (2017) and for cross-country variations in Altman et al. (2021).

3.3. Descriptive Statistics

Tables 2 and 3 present the descriptive statistics for the entire sample (1,687 observations from 241 companies over 7 years) and for the zombie firms (448 observations from 64 zombie firms over 7 years).

The average values of zombie firms, when compared to the entire sample, show that zombie firms generally exhibit lower profitability, liquidity, and asset efficiency, while their total debt and financial debt levels are higher. On average, zombie firms have a -2% return on assets (ROA), a total debt level of 77%, a financial debt level of 43%, and a current ratio

of 1.2. Zombie firms are similar in size to the overall sample but have higher sales volumes. Based on their establishment and listing years, they also tend to be slightly younger.

Table: 2
Descriptive Statistics of the Explanatory Variables in the Analysis Sample

Main Group	Sub Group	Proxy	Type	Abbr.	Mean	Std. Dev.	Min	Max
Financial Independent Variables	Profitability	Return on Assets	%	ROA	3.0	20.9	-153.1	680.5
		Gross Profit	%	GRPR	22.0	24.4	-514.3	100.0
	Leverage	Total Debt	%	DEBT	55.7	38.8	0.7	526.3
		Total Financial Debt	%	DEBTF	26.3	26.2	0.0	282.0
	Liquidity	Current Ratio		CURR	2.8	15.8	0.0	363.1
		Liquidity Ratio		LIQU	2.3	15.8	0.0	363.1
	Efficiency	Asset Turnover Ratio		ATO	0.9	0.7	0.0	4.9
Non-Financial Independent Variables	Size	Size_Asset	Log	SIZEA	8.6	0.8	6.5	11.2
		Size_Revenue	Log	SIZER	8.3	1.2	0.0	11.0
	Age	Age		AGE	39.8	16.1	6.0	109.0
		Age Market		AGEM	19.8	9.4	6.0	35.0
	Location	Location_5 cities	Dummy	LCTN	0.8	0.4	0.0	1.0
		Location_Istanbul	Dummy	LCTNI	0.5	0.5	0.0	1.0
	Economic Cycle	GDP Growth	%	GDPG	4.9	2.5	0.9	8.5

Notes: The analysis sample comprises 1,687 observations from 241 firms over 7 years for each variable. The dependent variable is the binary dummy variable ZOMBIE, which takes 1 if the company is identified as a zombie during the screening process, and zero otherwise. Abbr.: Abbreviation. ROA: Net Profit / Total Assets. GRPR: Gross Profit / Net Sales. DEBT: Total Liabilities / Total Assets. DEBTF: Total Financial Liabilities / Total Assets. CURR: Current Assets / Current Liabilities. LIQU: (Current Assets - Inventories) / Current Liabilities. ATO: Net Sales / Total Assets. SIZEA: Log of Total Assets. SIZER: Log of Net Sales. AGE: 2019 minus establishment year. AGEM: 2019 minus listing year. LCTN: Takes the value of 1 if located in one of the following cities: İstanbul, İzmir, Ankara, Bursa, or Kocaeli. LCTNI: Takes the value of 1 if located in İstanbul. GDPG: Annual percentage change in the gross domestic product of Türkiye.

Table: 3
Descriptive Statistics for Only Zombie Firms

Main Group	Sub Group	Proxy	Type	Abbr.	Mean	Std. Dev.	Min	Max
Financial Independent Variables	Profitability	Return on Assets	%	ROA	-2.1	35.2	-137.5	680.5
		Gross Profit	%	GRPR	18.7	20.4	-128.0	73.1
	Leverage	Total Debt	%	DEBT	77.1	57.7	14.2	526.3
		Total Financial Debt	%	DEBTF	42.7	34.3	0.0	282.0
	Liquidity	Current Ratio		CURR	1.2	0.8	0.0	5.9
		Liquidity Ratio		LIQU	0.8	0.7	0.0	4.9
	Efficiency	Asset Turnover Ratio		ATO	0.8	0.6	0.0	4.4
Non-Financial Independent Variables	Size	Size_Asset	Log	SIZEA	8.6	0.8	6.6	10.7
		Size_Revenue	Log	SIZER	8.4	1.0	5.7	11.0
	Age	Age		AGE	37.5	16.0	9.0	84.0
		Age Market		AGEM	18.4	9.6	6.0	33.0
	Location	Location_5 cities	Dummy	LCTN	0.8	0.4	0.0	1.0
		Location_Istanbul	Dummy	LCTNI	0.5	0.5	0.0	1.0
	Economic Cycle	GDP Growth	%	GDPG	4.9	2.5	0.9	8.5

Notes: The 64 zombie firms over 7 years produce 448 observations. Zombie firms: 64 firms among 241 non-financial BIST firms whose financial debt in year t+1 > financial debt in year t and whose EBIT in year t < financing expense in year t for at least two consecutive years during 2013-2019. Abbr.: Abbreviation. ROA: Net Profit / Total Assets. GRPR: Gross Profit / Net Sales. DEBT: Total Liabilities / Total Assets. DEBTF: Total Financial Liabilities / Total Assets. CURR: Current Assets / Current Liabilities. LIQU: (Current Assets - Inventories) / Current Liabilities. ATO: Net Sales / Total Assets. SIZEA: Log of Total Assets. SIZER: Log of Net Sales. AGE: 2019 minus establishment year. AGEM: 2019 minus listing year. LCTN: Takes one if located in one of the following cities: İstanbul, İzmir, Ankara, Bursa, or Kocaeli. LCTNI: Takes one if located in İstanbul. GDPG: Annual percentage change in gross domestic product of Türkiye.

3.4. Method

Among the 241 firms sampled, 64 were identified as zombie enterprises based on two criteria:

1) A low profitability criterion ($EBIT_t < \text{financing expense}_t$), and

2) A financial support criterion ($\text{financial debt}_{t+1} > \text{financial debt}_t$).

These conditions were met for at least two consecutive years between 2013 and 2019. The dependent variable was 1 for the 64 zombie firms throughout 2013-2019. Panel probit regressions were conducted to identify the financial and non-financial characteristics distinguishing these 64 zombie firms from the 177 non-zombie firms. Limited dependent variable panel data models were employed to estimate the probit model, assuming random effects. Similar studies analysing factors influencing the likelihood of becoming a zombie firm (Blažková & Dvouletý, 2020; Hoshi, 2006; Javaheriafif, 2017; Urionabarrenetxea et al., 2017) and those examining other aspects of zombie theory (Hoshi, 2006; Peek & Rosengren, 2005; Yang et al., 2021) have also applied probit estimations.

The first equation presents the general binary choice model used in the analysis. The second equation, derived from the general model, represents the study's base model.

$Y_{it} = \beta X'_{it} + \varepsilon_{it}$, ($Y_{it} = 1$, $y_{it}^{*} \geq 0$, $Y_{it} = 0$, otherwise), Equation (1)

In the general panel binary choice model represented by Equation (1), X′ denotes a vector of regressors, and ε_{it} represents the random error term. Y is the binary dependent variable, while y_{it}^{*} is an unobserved latent variable. The relationship between the latent variable y_{it}^{*} and the observed binary outcome Y_{it} is defined as "$Y_{it} = 1$, $y_{it}^{*} \geq 0$, $Y_{it} = 0$, otherwise".

$ZOMBIE_{it}=\beta_1 ROA_{it}+\beta_2 DEBT_{it}+\beta_3 CURR_{it}+\beta_4 ATO_{it}+\beta_5 SIZEA_{it}+\beta_6 AGE_{it}+\beta_7 LCTN_{it}+\beta_8 GDPG_{it}+\varepsilon_{it}$, Equation (2)

Equation (2) is formulated by adjusting the first equation according to the base model variables of the analysis. In this equation, the dependent variable $ZOMBIE_{it}$ takes the value of 1 if firm i is classified as a zombie in period t, and zero otherwise.

Table: 4
Pearson's Correlation Coefficients Between Independent Variables

	ROA	GRPR	DEBT	DEBTF	CURR	LIQU	ATO	SIZEA	SIZER	AGE	AGEM	LCTN	LCTNI
ROA	1.00												
GRPR	**0.15**	1.00											
DEBT	-0.09	-0.14	1.00										
DEBTF	-0.07	-0.11	**0.83**	1.00									
CURR	0.02	-0.01	-0.11	-0.10	1.00								
LIQU	0.01	-0.01	-0.10	-0.10	**1.00**	1.00							
ATO	0.09	-0.13	0.28	0.04	-0.08	-0.08	1.00						
SIZEA	0.06	0.03	0.11	0.17	-0.04	-0.04	0.09	1.00					
SIZER	0.06	0.02	0.18	0.18	-0.35	-0.35	0.40	**0.74**	1.00				
AGE	0.09	0.05	-0.06	0.00	-0.10	-0.11	-0.03	0.33	0.31	1.00			
AGEM	0.07	0.07	0.00	0.03	-0.07	-0.07	0.01	0.34	0.32	**0.65**	1.00		
LCTN	-0.02	0.09	-0.03	-0.07	0.03	0.03	0.07	0.16	0.09	-0.02	0.04	1.00	
LCTNI	-0.04	0.03	0.02	-0.04	0.05	0.05	0.09	0.17	0.08	-0.13	-0.09	**0.50**	1.00
GDPG	0.03	-0.02	-0.04	-0.04	-0.01	-0.01	0.01	-0.12	-0.05	0.00	0.00	0.00	0.00

Notes: Table 4 presents pairwise correlation coefficients. ROA: Net Profit / Total Assets. GRPR: Gross Profit / Net Sales. DEBT: Total Liabilities / Total Assets. DEBTF: Total Financial Liabilities / Total Assets. CURR: Current Assets / Current Liabilities. LIQU: (Current Assets - Inventories) / Current Liabilities. ATO: Net Sales / Total Assets. SIZEA: Log of Total Assets. SIZER: Log of Net Sales. AGE: 2019 minus establishment year. AGEM: 2019 minus listing year. LCTN: Takes 1 in case of a location in one of the cities: İstanbul, İzmir, Ankara, Bursa, or Kocaeli. LCTNI: Takes 1 in case of location in İstanbul. GDPG: Annual percentage change in the gross domestic product of Türkiye.

The bolded Pearson's correlation coefficients in Table 4 represent the correlations between the basic variables and their substitutes. Generally, except for the 15% correlation between ROA and gross margin, the correlations between the basic variables and their substitutes range from 50% to 100%. To avoid multicollinearity among the independent variables and to test the robustness of the base model, we re-estimated the model using most of the substitute variables. Time effects were controlled using year dummies.

4. Empirical Results

The findings are reported in Table 5. In Table 5, the base model (Model 1), shown in the second column, includes basic variables for profitability (ROA), leverage (DEBT), liquidity (CURR), financial efficiency (ATO), size (SIZEA), age (AGE), location (LCTN), and the economic cycle (GDPG).

Examining the estimation results in Table 5, starting with the base model, the probability of becoming a zombie is positively associated with the debt ratio, while negatively associated with the asset turnover ratio and age. These parameters suggest that firms with higher financial leverage, lower asset turnover, and less experience (i.e., younger firms) are likelier to become zombie companies. The results of other specifications (Models 2 to 7) confirm the findings of the base model.

The second model, which uses gross profitability instead of ROA, yields similar results for the DEBT and ATO variables, with ATO showing more substantial significance at the 1% level. Additionally, the AGE variable loses its importance in this model. In the third model (Column 4), financial debt usage, which substitutes total liabilities, remains a significant factor, alongside ATO and AGE. The current ratio only becomes statistically significant (at the 10% confidence level) in this model, whereas it remains insignificant in the others.

The fourth model (in Table 5), which replaces the current ratio with the liquidity ratio, and the fifth model, which substitutes asset size with revenue size, produces results similar to the base model. The sixth model, which replaces the establishment date with the listing date, highlights the importance of experience while maintaining similar economic and statistical significance for the other variables. The final model (Model 7) examines whether being located in Istanbul, as opposed to one of the five major cities, impacts becoming a zombie firm and yields results similar to the base model.

Across all specifications, the results suggest that firms with lower debt levels, higher revenue-generating capabilities from assets, and more extended establishment periods are less likely to become zombie firms.

Leverage: Consistent with Hoshi (2006), Javaheriafif (2017), Dai et al. (2019), and Blažková and Dvouletý (2020), the likelihood of becoming a zombie firm is positively correlated with leverage, whether measured by total debt or financial debt usage. Higher debt levels increase the probability that a firm will become a zombie. A defining

characteristic of zombie firms is their high debt usage, which increases risks for the firms themselves and their sectors and the economy by misallocating resources. This finding supports the argument that a sustainable economic recovery requires reducing leverage in banks and firms (Storz et al., 2017).

Given the high and rising levels of corporate borrowing in Türkiye, it is unsurprising that leverage plays a significant role in the formation of zombie firms. As an emerging economy, the underdevelopment of capital markets, institutions, and instruments in Türkiye limits the availability of equity capital, thereby encouraging firms to rely on debt financing. The real sector mainly depends on funding from banks and suppliers. Between 2010 and 2020, banks accounted for 71% of financial sector funding, capital market institutions for 24%, and non-bank financial institutions for 5%. Trade credits from suppliers are primarily short-term.

The volatility and upward trend of inflation and interest rates constrain the availability of long-term loans from banks. Non-bank financial institutions, which offer long-term loans, are not sufficiently developed. In Türkiye, the proportion of current assets in companies' asset structures is relatively high, while profitability is low, and internal financing opportunities are limited. This structure increases the share of short-term debt in total liabilities (Akgüç, 2010; Sevil & Başar, 2015; SPL, 2021; CBRT, 2022; Şahin, 2021).

Short-term debt exposes companies to interest rate risk, foreign exchange risk in FX borrowings, and credit extension risk, which is the risk of not obtaining a loan at the required amount and cost when needed. The real sector's increasing borrowing, coupled with rising interest and exchange rates, has led to high financing costs for the sector (Gitman & Zutter, 2014: 657-660; Şahin, 2019: 175-176; Şahin, 2021). According to the CBRT's company accounts for the Turkish real sector over the past 12 years (2009-2020), current assets accounted for 57% of total assets, the total debt ratio was 68% (compared to 54% for the 2002-2008 period), and the short-term debt ratio was 45% (with 66% of liabilities being short-term). Operating profitability stood at 5.3%, with financing expenses accounting for 3.6% of total costs. Notably, 75% of these expenses were attributed to short-term borrowing, specifically 2.7% (CBRT, 2022).

Efficiency: In Javaheriafif's (2017) analysis, the activity ratio showed a negative sign in univariate regressions but was excluded from multivariate analysis due to its low confidence level (10%). In this study, the probability of becoming a zombie firm negatively correlates with higher asset utilisation efficiency. Zombie firms use their assets less efficiently than healthy firms, meaning companies unable to generate sufficient revenue from their investments are more likely to become zombies.

Firms that cannot effectively utilise their fixed or current assets often face financial challenges, such as low profitability and weak solvency. The Turkish real sector's average asset turnover ratio (ATO) from 2009 to 2020 was 0.9 (CBRT, 2022), compared to 1.0 during 2002-2008. Descriptive statistics in Table 2 confirm that asset utilisation efficiency,

averaging 0.9, remains inadequate even among publicly listed companies in Türkiye. Low-value-added investments and insufficient asset turnover erode the financial health of firms, contributing to the creation of zombie companies that pose systemic risks to the broader economy.

Table: 5
The Parameters of the Base Model and Alternative Regression Specifications

Variable	1	2	3	4	5	6	7
	Base Model	ROA	DEBT	CURR	SIZEA	AGE	LCTN
		GRPR	DEBTF	LIQU	SIZER	AGEM	LCTNI
ROA	-0.00		-0.01	-0.00	-0.00	-0.00	-0.00
	(-0.12)		(-0.37)	(-0.03)	(-0.15)	(-0.12)	(-0.13)
GRPR		-0.00					
		(-0.09)					
DEBT	0.03***	0.03***		0.03***	0.03***	0.03***	0.03***
	(3.89)	(4.52)		(3.85)	(3.61)	(3.60)	(3.93)
DEBTF			0.04***				
			(4.09)				
CURR	-0.25	-0.25	-0.38*		-0.29	-0.25	-0.26
	(-1.19)	(-1.28)	(-1.82)		(-1.18)	(-1.06)	(-1.23)
LIQU				-0.47			
				(-1.61)			
ATO	-0.82**	-0.77***	-0.41***	-0.81**	-0.97**	-0.79**	-0.82**
	(-2.36)	(-2.60)	(-1.35)	(-2.40)	(-2.53)	(-2.09)	(-2.35)
SIZEA	0.10	0.05	-0.02	0.11		0.13	0.10
	(0.41)	(0.24)	(-0.10)	(0.47)		(0.49)	(0.41)
SIZER					0.26		
					(1.26)		
AGE	-0.02*	-0.02	-0.02*	-0.02*	-0.02**		-0.02*
	(-1.69)	(-1.63)	(-1.83)	(-1.75)	(-1.99)		(-1.71)
AGEM						-0.04*	
						(-1.92)	
LCTN	-0.34	-0.34	-0.25	-0.34	-0.32	-0.29	
	(-0.83)	(-0.89)	(-0.60)	(-0.80)	(-0.78)	(-0.68)	
LCTNI							-0.28
							(-0.81)
GDPG	0.09	0.09	0.04	0.09	0.10	0.09	0.09
	(0.31)	(0.31)	(0.15)	(0.29)	(0.32)	(0.26)	(0.30)
N	1687	1687	1687	1687	1687	1687	1687
Wald X2	34***	38***	37***	33***	32***	29***	35***
p (Wald X2)	0.001	0.000	0.000	0.002	0.002	0.007	0.001
LR x2	1289***	1297***	1279***	1282***	1286***	1287***	1288***
p (LR x2)	0.000	0.000	0.000	0.000	0.000	0.000	0.000

*Notes: Table 5 presents the panel estimation statistics of the probit model with random effects. Zombie firms: Among 241 non-financial BIST firms, 64 firms are identified as zombies if their financial debt_t+1 > financial debt_t and EBIT_t < financing expense_t for at least two consecutive years during 2013-2019. For each year from 2013 to 2019, zombie firms are coded as 1, and non-zombie firms are coded as 0 (177 firms in total). The regressions use t-year values for all variables. The base model (first in the second column) includes the core independent variables. Subsequent models (2 to 7) introduce alternative variables (listed in the third row) for one of the core variables (listed in the first row). ROA: Net Profit / Total Assets. GRPR: Gross Profit / Net Sales. DEBT: Total Liabilities / Total Assets. DEBTF: Total Financial Liabilities / Total Assets. CURR: Current Assets / Current Liabilities. LIQU: (Current Assets - Inventories) / Current Liabilities. ATO: Net Sales / Total Assets. SIZEA: Log of Total Assets. SIZER: Log of Net Sales. AGE: 2019 minus establishment year. AGEM: 2019 minus listing year. LCTN: Takes 1 if located in İstanbul, İzmir, Ankara, Bursa, or Kocaeli. LCTNI: Takes one if located in İstanbul. GDPG: Annual percentage change in Türkiye's gross domestic product. Z-values are shown in brackets. *, **, and *** denote significance levels of 10%, 5%, and 1%, respectively.*

Age: In contrast to studies suggesting that zombie firms tend to be middle-aged (Blažková & Dvouletý, 2020) or older (McGowan et al., 2017), this study indicates a negative association between the likelihood of becoming a zombie firm and age. Being relatively younger in terms of establishment or listing years appears to be a characteristic of zombie firms. Due to their shorter operational history and limited experience, young companies face risks such as restricted internal financing, high debt usage, asymmetric information, and dependency on banks, making them more susceptible to becoming

zombies. Instead of relying on debt, financing these firms through instruments like crowdfunding (Şahin, 2021) could better align with their growth opportunities and risk profiles, helping to prevent them from becoming zombies and enhancing their economic contribution.

5. Conclusion

The related literature unanimously acknowledges the detrimental effects of zombie firms on non-zombie firms, industries, and the overall economy. This study examines the presence and characteristics of zombie firms in the Turkish real sector, utilising a panel dataset comprising 241 non-financial listed firms from 2013 to 2019. Among the 241 sampled companies, 64 firms were identified as zombies based on a pattern of increasing financial debt while their earnings before interest and taxes failed to cover financial expenses for two consecutive years. Probit regressions were conducted, with the dependent variable being the likelihood of a firm being classified as a zombie. The analysis aimed to uncover the relationship between a firm's financial and non-financial characteristics and its probability of becoming a zombie.

Examining the findings, it can be concluded that financial characteristics, such as a high level of leverage, low asset efficiency, and a younger firm age, drive the probability of becoming a zombie firm in Türkiye. Relatively inexperienced businesses that channel their high debt into inefficient investments are more likely to become zombies, posing a long-term economic risk.

The experience of the Turkish listed real sector with zombie companies from 2013 to 2019 indicates that the zombie problem exists in Türkiye and has the potential to undermine the competitiveness and sustainability of healthy firms and the overall economy. Therefore, economic and financial policies should not overlook the harmful effects of zombie firms. Policy implications may include setting limits on debt burdens, linking leverage restrictions to a company's age, and restricting entry for companies with low added value due to inefficient asset usage. Financial support, incentives, grants, or subsidies could be regulated to prioritise non-zombie firms.

The findings of this study should be considered in light of certain limitations. The primary restriction affecting the generalizability of the results is the relatively small sample size, which includes only listed non-financial firms in Türkiye. Expanding the sample size could involve incorporating non-listed firms from Türkiye or listed firms from other emerging economies. An important area for further research in Türkiye is examining industrial variations in zombie firm prevalence and incorporating industry-specific variables based on predetermined factors such as business risk, financial risk, capital-labour intensity, or regulatory environment.

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