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## Article

# Unveiling living dead: characteristics and consequences of zombie firms

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## ACCOUNTING, CORPORATE GOVERNANCE & BUSINESS ETHICS | RESEARCH ARTICLE

# Unveiling living dead: characteristics and consequences of zombie firms

Sadia Rashid<sup>1</sup>, Kanwal Iqbal Khan<sup>1</sup>, Adeel Nasir<sup>2\*</sup> and Tayyiba Rashid<sup>3</sup>

**Abstract:** The increasing number of zombies is becoming a threat for industrial growth due to their inefficiency and lack of performance. Previous studies show that zombies inhibit the growth of non-zombies and prevent the emergence of new ones. However, there is still a lack of research on the consequences of zombies on industrial growth. Therefore, this study aims to investigate the potential characteristics of the likelihood of zombie firms and analyze their impact on industrial growth. Data were extracted from publicly traded companies on the Pakistan Stock Exchange from 2009–2019. Results confirm the presence of zombie firms in the Pakistani context with low liquidity, low solvency, non-profitability, inefficiency, and relatively younger. Moreover, the findings demonstrated a negative link between zombie firms and industrial growth. It states zombie enterprises negatively impact industrial growth as high industrial indebtedness decreases the chances of industrial growth. These findings may be helpful to policymakers when developing insolvency rules to ensure a stable environment for industrial growth.

**Subjects:** Economic Forecasting; Corporate Finance; Investment & Securities; Accounting; Risk Management; Business Ethics

**Keywords:** zombie firms; interest coverage ratio; profitability; firm-level characteristics; non-viable firms; industrial growth

**JEL Classifications:** G3; L1; L2

### 1. Introduction

Sustainable economic development has become a key challenge for many countries, which seems difficult to achieve without stable industrial growth (Blažková & Dvouletý, 2022). There are two types of firms which could impact industrial growth. The first is healthy firms having high productivity. The second is the existence of non-viable and inefficient firms operating in a country whose presence can greatly hinder stable industrial growth and negatively affect the rest of the economy (Yu et al., 2021). These unproductive firms were first termed zombie firms during the decade-long Japanese economy stagnation of the 1990s, where living-dead firms lived persistently in the market because of the evergreening of loans by banks and other financial institutes (Hoshi, 2006).

Zombie firms represent companies that cannot repay the loan as their operating cash flows are persistently less than their interest payments (Banerjee & Hofmann, 2018). These firms do not cover their cost of debts with their profit and are kept alive due to the cheap financing from their banks or other institutes (K. I. Khan, Qadeer, Mata, Chavaglia Neto et al., 2021). Their continual existence causes negative consequences for the rest of the corporate sector because they hinder

the entrance of young firms and hamper the productivity growth of other, more productive firms (Isayas, 2021). The prevalence of zombie companies has risen significantly since the global financial crisis (GFC) that swept across developed economies (McGowan et al., 2018). In developing countries, the increasing number of zombie firms has emerged as a remarkable phenomenon (Binh et al., 2020). Therefore, identifying zombie firms has become an interesting topic for scholars and policymakers to explore its harmful consequences on industrial and economic growth.

Previous studies stated that different characteristics trigger the likelihood of zombie firms (Hoshi, 2006). Researchers stated that zombie firms are generally new, young, small, single product-producing firms and these findings are also consistent with Schumpeter's theory (Hallak et al., 2018). They also consider strong management, sustainable growth, and consistent output necessary for a company's survival. However, empirical evidence shows that zombie businesses have low operational efficiency, suffer long-term losses, and rely on external resources to keep afloat in the market (Jiang et al., 2017). It raises serious concerns regarding the existence of zombie enterprises in an economic environment.

The current focus of the economies is on stabilizing industrial growth and continuously improving entry efficiency. It is suggested that zombie firms may weaken economic performance and negatively affect the economy (Banerjee & Hofmann, 2018). The efficient allocation of credit plays a vital role in development by increasing industrial productivity and nurturing innovation (Ali & Khan, 2022). However, reallocating capital favouring low-productivity firms hinders industrial development at the expense of high-productivity firms (Geng et al., 2021). The continual survival of zombie firms can drag the broader economy as they hamper the growth and resources for innovative firms while failing to produce meaningful growth themselves.

Industrial growth is crucial in creating new engines for the development of the economy (K. I. Khan, Qadeer, Mata, Dantas et al., 2021). If zombie congestion rises, it limits growth opportunities for potentially more productive firms (Caballero et al., 2008). It eventually directs to a decrease in the industrial growth of a country. The leading cause behind the rise of zombie firms includes a steady rise in subsidized loans by evergreening, low-interest rates and government subsidies to these companies, which are believed to provide livelihoods for these troubled companies (K. I. Khan, Qadeer, Mata, Chavaglia Neto et al., 2021). When a country is home to zombie firms, it can suffocate the entire economy.

The existence of zombie companies and their consequences pose a real challenge to Pakistan's industrial growth. Therefore, this study aims to examine the existence of zombie firms listed in different industrial sectors in Pakistan. It also identifies the potential firm-level characteristics of zombie firms' likelihood and analyses its consequences on industrial growth. Through this, it intends to contribute to the emerging literature on capital structure in various manners. First, it identifies that zombie firms are generally small, new, inefficient, has low liquidity, solvency, profitability ratios, and poor growth. Second, it finds out that zombie firms negatively affect industrial growth as high industrial indebtedness, government debt to GDP, real interest rate, inflation rate and high corporate taxes have decreased the chances of industrial growth.

Third, it provides a general understanding of the logic behind the emergence of zombie companies from the standpoint of industrial growth, which assists in curbing corporate debt growth and reforming and restructuring the economy. Fourth, it is necessary to recognize that the zombie problem lies in the industry and can pose severe economic threats. In this way, zombie firms should be watched since they defy the typical business model. Their existence and detrimental consequences on the economy's competitive environment have been overlooked.

This paper is organized as follows: Section 2 gives an overview of the literature review regarding zombie firms' identification, characteristics, and consequences. Research design and methodology

are discussed in Section 3. Results are provided in Section 4. And Section 5 discusses the conclusion, implications and limitations of the study.

## 2. Literature review

### 2.1. Identifying zombie firms

The term “zombie firm” first appeared in the 1980s, when the US Federal Deposit Insurance Corporation set an unrealistic low credit creation (Jiang et al., 2017). It became popular in the early 1990s as literature states it was the leading cause behind Japan’s decade-long asset price collapse (Caballero et al., 2008). The literature on Japanese economic development claims that the proportion of zombie companies rose between 1995 and 2002, considered a primary cause of its long-term financial crisis (Fukuda & Nakamura, 2011).

The first research on the factor triggering stagnation in Japan was conducted by Caballero et al. (2008). The reason behind Japan’s decade-long asset price collapse in the early 1990s was the increase in zombie firms. The observation states that the inspection regulators were lenient (Kwon et al., 2015). Hence, the bank took advantage of this by restructuring loans to borrowers who otherwise were insolvent to comply with capital standards. The research highlights that the creation of zombies led to a reduction in profit of the other firms to restrain their entry and investment.

It is argued that due to the restrictions imposed by the Japanese government on the banks, the all-out reforms and the restructuring of the bank have been delayed. Although reforms got delayed, the banks still have to follow international standards like the Basel capital standards. The rule required banks to identify the loans that would not get the money back and write off the capital of their non-performing loans (M. S. M. S. Khan et al., 2019). Fearing being unable to get capital standards, many banks continued to offer loans to inefficient and unsustainable companies, now called zombie companies.

Growing political scrutiny outside of Japan has shown that it is generally accepted that a significant cause of Japan’s economic unrest after the banking crisis of the 1990s was zombie companies and a potential threat to other economies struggling to recover from the 2008 crisis. The decisive factor in the economic downturn was the fall of land and stock prices. Stock prices have fallen 60% since 1989, and commercial real estate prices have fallen about 50% from 1992 to 2002. The decade was marked by economic failure (Chen et al., 2017).

Imai (2016) predicted the occurrence of zombie companies among Japanese SMEs engaged in lending and investment activities from 1999 to 2008. 413% of SMEs were zombie companies during the same period. The borrowing function indicates that the zombie SMEs did not change their loans in response to changes in land prices. The return on investment did not have a gradual return on investment by zombie companies calculated at the marginal Carreira et al. (2022) stated zombie companies cannot repay their debts and need restructuring by exiting the market. They considered loans from all lenders, not just banks and their results showed that most companies are likely to have no change in status, placing them in a stagnant situation with high barriers to recovery and exit.

Among other researchers, McGowan et al. (2018) stated that Japan’s experience could help explain present productivity changes in the OECD (The Organisation for Economic Co-operation and Development) area. The OECD conducted several studies between 2003 and 2013 examining zombie companies. Their suggested definition is that the firm must be ten years old or older, and its interest coverage ratio must be less than one for three years. Credit analysts widely use the interest coverage ratio (ICR) to estimate loan repayment capacity (Seyf, 2021).

Despite the widespread influence of Caballero et al. (2008) research on the concept of zombie firms, several academics have questioned whether these problematic businesses were constructed using

discounted interest rates. In particular, Fukuda and Nakamura (2011) (hereinafter referred to as “FN”) show that interest rates below the base rate are insufficient to represent zombie companies since Japan implemented quantitative easing monetary policy in the 2000s and permitted many companies, including sound companies, to participate. This policy is claimed to be mainly because this policy intensifies competition among banks and lowers lending rates, so borrowing at meagre rates. To more accurately assess the existence of zombie companies, FN has proposed adding two conceptual criteria to the CHK rate criterion: profitability and continuous lending. Based on this revised definition, FN calculated that the proportion of zombie firms in the Tokyo Stock Exchange sample peaked at less than 15% in 2001, roughly half of the CHK estimate, and that proportion has since declined. In the 2000s, before the global financial crisis, it was less than 5% of companies. Since FN proposed a modified concept, it has quickly gained popularity among economists studying zombie companies in Japan and elsewhere (Imai, 2016; Kwon et al., 2015).

Hoshi (2006) used a sample of 63 Japanese listed companies from 1997 to 2001 to investigate the identification of zombie companies. As a result, zombie companies (1) have low profits, high debt-to-total assets ratios, and high bank reliance. (2) When the company’s size is small in terms of capital and labour, the company is more likely to become while there are fewer chances for large firms to become zombies. In addition, it is argued that the possibility of becoming a zombie is lowered due to the size of assets or employment. He also found that the number of zombies outside the metropolitan area increases because of the pressure to secure enterprises outside the metropolitan area.

#### 2.1.1. *Characteristics of zombie firms*

McGowan et al. (2018) studied zombie enterprises and their characteristics in different OECD countries. As a result, it was found that the relationship between the likelihood of a zombie company and its age tends to increase. Moreover, larger companies are more prone to become zombies regarding employees. It is especially veracious for companies that are more than 40 years old. The patterns of zombies and their relation between age and size also rise monotonically (Hallak et al., 2018). As a result, it was confirmed that zombie companies grow as they get older. In terms of size and age, old and large companies are described as opaque. They seem to build up their reputation due to their ability to cope with the temporary false illusion of profitless years. It is justified from the banking point of view in terms of refinancing. Moreover, the longing for higher capital to cover loan costs is high for the larger firms, while the young firms are far away from such considerations.

Hoshi (2006) also addresses the rising questions focusing on the characteristics of zombie firms. He described zombies’ behavioural characteristics and used probit assessments to evaluate logistical reasons to determine the characteristics of a company to be a zombie. His result stated that zombie firms are more likely to increase when it has low profitability and creditworthiness when the firm size is small. They are working outside the metropolitan areas that are non-manufacturing industries.

Goto and Wilbur (2019) depicted Japan’s manufacturing and non-manufacturing industries. The study showed that the proportion of zombie firms in manufacturing is higher than in non-manufacturing. Also, data on small, primarily unproductive businesses are not included, so there is a high potential for bias. Therefore, it can be pointed out that there are many zombie companies in manufacturing, but it should be noted that this ratio is higher than that of non-manufacturing industries.

Using Imai’s concept, Tan et al. (2016) investigated the association between several business qualities and zombie proportions. The zombie ratio was calculated based on market capitalization and firm size. Small and medium firms with equity capital of less than 100 million yen, small and medium enterprises with registered capital of 100 to 1 billion yen, and large enterprises with registered capital of 1 billion yen or more are classified as small and medium enterprises. The data

revealed that the zombie ratios for small businesses in both categories are always greater than for large businesses. This conclusion confirms Imai (2016) contention that tiny enterprises, which were not included in CHK's initial analysis of zombie firms, which only included large firms, are more likely to be zombie firms (Goto & Wilbur, 2019).

Zombie firms have low operational efficiency and production and thus are prone to insolvency and long-term losses (Chen et al., 2017). Their survival is based on society and government funding and resources, and they continue to exist even though they should have exited the market. Geng et al. (2021) compared resource acquisition, efficiency and innovation taken as the potential characteristics of zombie firms with normal firms. The results state that zombie companies have far more financial resources and government subsidy debt associated with subsidizing the profits they consume than regular companies. In addition, as a result of analyzing the characteristics of zombie companies at the corporate level from 2000 to 2007, the current rate of zombie companies was the highest at 17.7% in 2000. Zombie companies generally decline, suggesting that China's zombie company problem improved between 2000 and 2007.

### 2.1.2. *Consequences of zombie firms*

The literature on zombie firms also focused on the consequences of zombie firms and their distortionary effects on healthy firms. McGowan et al. (2018) found that increasing zombie enterprises spurred growth opportunities for many productive firms, reducing potential output growth for non-zombie firms. Caballero et al. (2008) also target zombie firms that reduce job creation and productivity in industries. Research shows that the accumulation of zombies in industries profoundly affects employment growth for small businesses, and productivity growth in young businesses compensates for poor profitability. It prevents young, innovative and productive companies from potentially entering the market.

Zombies negatively affect the rest of the economy. Companies with high debt levels represent the most severe zombie types (Urionabarrenetxea et al., 2018). This study focused on firms with negative equity capital in the European Union economy. The consequences start with these companies accounting for around 10% of Europe's GDP. Many zombie firms negatively impact competitiveness and ethics in terms of low productivity in industries that limit access to more efficient companies. They concluded that extreme zombie companies across Europe highlighted growing research potential (Grieder & Ortega, 2020).

As a result of the financial crisis of 2008, Caballero et al. (2008) claim that the prevalence of zombie enterprises is to blame for Japan's stagnation and the lack of economic recovery in European Union countries such as France, Italy, and Spain. Given the danger of zombie corporations, it is critical to comprehend why they persist. The main reason for creating a zombie firm in industrialized countries is zombie loans, which banks expand to cover poor debts (Ahmad et al., 2021). On the other hand, government intervention is a crucial cause of zombie enterprises in Chinese literature (Dassatti et al., 2020).

Later, the Chinese local government offered financial support and subsidies to stimulate economic growth and industrial development, resulting in the emergence of many zombie enterprises (Dai et al., 2021). Developed countries have identified two critical drivers for industrial upgrading: innovation and resource allocation (Zhu et al., 2019). A company's long-term existence is not thought to contribute to the industry's complexity. The free flow of resources in businesses and industries is under pressure from many developed countries. The study argued that low-productivity, inefficient zombie companies may not help modernize the industry (Kwon et al., 2015). Furthermore, zombie companies' blood-sucking features allow limited resources to move from more efficient to less productive and less innovative companies through external intervention (Geng et al., 2021).

In 11 European countries, Crosignani et al. (2022) evaluated the relationship between zombie enterprises, bank health, and overall productivity. They discovered that zombies are more likely to

occur in vulnerable banks and are usually caused by banks' relative tolerance. The presence of zombies continued to overwhelm the market and increasingly suppressed normal businesses. Schivardi et al. (2020) used data containing data on the interactions of almost all Italian banks and companies between 2004 and 2013. They found that low-capital banks were less likely to stop zombie lending. Lending has increased the default rate of incumbents and lowered the zombie default rate.

Zombie companies are more likely to be associated with weak banks, suggesting that zombie swarms stem partly from bank tolerance, i.e. the tendency of weak banks to bet on the resurgence of bankrupt companies (Lam et al., 2017). While this highlights the importance of a more aggressive NPL (non-performing loan) policy, it can only be truly effective when accompanied by complementary reforms to the insolvency regime. Bank distortion also underscores the importance of market-based financing for productivity growth. Corporate taxes are characterized by inherent debt bias and a lack of venture capital financing, which are significant barriers to technology diffusion (Isayas, 2021).

### 3. Methodology

#### 3.1. Population and sample

The study uses unbalanced panel data and examines all publicly traded companies listed on the Pakistan Stock Exchange from 2009 to 2019. There are two types of firms listed on the Pakistan Stock Exchange: financial and non-financial, but we emphasized only non-financial companies. The study aims to identify firms whose interest coverage ratio is below 1 for three consecutive years.

Table 1 indicates the study's total population, including all non-financial enterprises listed on the Pakistan Stock Exchange from 2009 to 2019 in all industrial sectors. The table states the decade-long existence of all non-financial firms in 14 different industrial sectors. The total number of firms listed on the Pakistan Stock Exchange from 2009 to 2019 is 4270. It shows the yearly and industry-level information of companies listed on the Pakistan Stock Exchange. The number of companies differs year to year because of the wind-up of some companies, merger of companies, or suspension from trading. Due to these limitations, the overall number of companies differs from the initial number of companies, resulting in an unbalanced panel data set.

Other sample selection rules yield 961 non-financial public limited businesses with 4270 company-year observations. Companies with missing or zero total debts and total assets; Book, market, and financial leverage outside the unit interval (K. I. Khan, Qadeer, Mata, Chavaglia Neto et al., 2021). Organizations with zero cash holding; and Outliers in the data are identified using the stem and leave approach.

For the sample, zombie firms in all publicly traded non-financial companies listed in PSX for all the industrial sectors have been considered, making 434 total. It is essential to describe the criteria for identifying zombie firms used in this research to serve the purpose. Moreover, extreme values are eliminated to reduce the influence of outliers. Finally, there are 3994 company-year observations available, resulting in 434 non-financial publicly traded firms.

Identification of Zombie Firms: Zombie firms whose operating cash flow is persistently below their interest expenses (Banerjee & Hofmann, 2018). These firms could not pay back their debts and rolled over their loans for a prolonged period. There are different views on how to define a zombie firm. Researchers have used several descriptions of zombie companies, usually quantified by the company's profitability and the size of its credit subsidies. Broadly it is defined as a firm whose interest coverage ratio is less than one for three consecutive years. Narrowly defined zombie firms additionally require expectations of a low future.

This study used the OECD (Organization for Economic Co-operation and Development) preferred explanation of zombie firms suggested by Seyf (2021), which describes a zombie firm as having an



**Table 1. Data of non-financial firms listed in PSX (2009–2019)**

Sr. #	Industry	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
1	Textile	164	164	155	155	153	152	147	144	136	133	129
	i) Spinning, weaving, finishing of textile	145	145	137	138	136	136	131	128	121	119	115
	ii) Made-up textile articles	6	6	6	6	6	5	5	4	4	4	4
	iii) Other textile	13	13	12	11	11	11	11	12	11	10	10
2	Sugar	36	36	36	32	31	31	31	31	30	29	29
3	Food products	18	18	18	18	17	16	15	15	16	16	19
4	Chemical & Pharmaceutical Products	43	43	43	43	44	45	45	43	43	43	43
5	Manufacturing	33	33	30	31	32	32	32	32	31	32	32
6	Mineral products	8	8	8	8	8	8	8	9	9	9	9
7	Cement	21	21	20	20	20	20	19	18	17	17	17
8	Motor Vehicles, Trailers and Autoparts	22	22	22	22	22	20	18	18	18	18	19
9	Fuel & Energy	18	18	18	19	19	22	22	22	22	22	21
10	Information, Comm. and Transport Services	13	13	13	13	13	13	11	11	11	11	11
11	Coke & Refined Petroleum Products	9	9	9	9	9	10	10	10	10	10	10
12	Paper, Paperboard and Products	9	9	9	9	9	9	8	8	9	9	9
13	Electrical Machinery and Apparatus	8	8	8	8	8	7	7	7	7	7	6
14	Other Services Activities	9	9	10	10	11	11	11	10	10	10	9
		411	411	399	397	396	396	384	378	369	366	363

interest coverage ratio below one for three years in a row. Credit analysts widely use the interest coverage ratio (operating earnings to interest expenses) as the standard measure for estimating loan repayment capacity. Thus, in this study, firms were classified as zombies in 2009 if they had an interest coverage ratio below one in 2007, 2008 and 2009.

This study uses a sample of 434 companies comprised of 14 sectors listed on the Pakistan Stock exchange, period 2009–2019. The results depicting the presence of zombie firms according to the definition are shown in Table 1 and Table 2, respectively. The data used for the research of this study is shown as follows:

Table 2 states the industry-level data of zombie firms used as a sample in this research. This sample represents all 14 industrial sectors with zombie firms from 2009 to 2019. The number of zombie firms changes in different years and for different sectors. Zombie firms have the highest existence in the Textile sector and the chemical, manufacturing and sugar sectors. In 2015, the zombie firm was highest, representing 142 zombie firms.

**Table 2. Data of zombie firms (2009–2019)**

Sr. #	Industry	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
1	Textile	73	24	15	16	18	22	61	58	63	56	46
	i) Spinning, weaving, finishing	70	22	13	13	15	20	53	51	56	51	41
	ii) Made-up textile articles	1	1	1	1	1	1	2	1	1	1	1
	iii) Other textile	2	1	1	2	2	1	6	6	6	4	4
2	Sugar	6	3	2	3	4	5	11	7	4	5	6
3	Food products	1	0	0	0	0	0	5	5	4	4	4
4	Chemical & Pharmaceutical Products	12	9	4	3	5	8	18	13	9	9	8
5	Manufacturing	8	5	3	3	7	7	11	6	5	5	6
6	Mineral products	2	1	1	2	1	1	3	3	4	4	4
7	Cement	10	10	9	4	2	2	5	3	3	2	1
8	Motor Vehicles, Trailers and Autoparts	7	3	3	3	1	1	3	3	2	2	2
9	Fuel & Energy	2	2	2	2	5	7	7	6	4	6	5
10	Information, Comm. and Transport Services	5	5	3	2	2	3	5	5	4	4	4
11	Coke & Refined Petroleum Products	3	1	0	0	2	2	2	1	1	1	1
12	Paper, Paperboard and Products	2	1	0	0	0	0	3	3	2	2	2
13	Electrical Machinery and Apparatus	1	1	0	0	0	2	3	1	2	2	2
14	Other Services Activities	3	1	1	2	1	2	5	3	4	3	1
	<b>Total</b>	<b>135</b>	<b>66</b>	<b>43</b>	<b>40</b>	<b>48</b>	<b>62</b>	<b>142</b>	<b>117</b>	<b>111</b>	<b>105</b>	<b>92</b>

### 3.2. Data collection

This study employs secondary data sources for data collection since they are freely accessible and meet the research design requirements. From 2009 to 2019, 434 publicly listed firms were selected from 4270 companies listed on the Pakistan Stock Exchange (PSX). This research did not use any financial companies in Pakistan. Only non-financial companies have been considered, comprising 14 different sectors. This study employed panel data from financial statements analysis of non-financial businesses registered on the Pakistan Stock Exchange, formally published by the State Bank of Pakistan's Statistics and DWH Department (SBP).

The study aims to identify zombie firms, their characteristics, and their impact on the industrial growth of Pakistan. Therefore, our research focuses on the available data on all industrial sectors of non-financial companies to shed light on the existence of zombie firms in the Pakistani industry.

### 3.2.1. Measurement

In this study, the variables used to measure different characteristics of zombies are shown in Table 3. It fully describes the factors used in the analysis and the expected relationship orientations based on theoretical and empirical justifications.

Table 3 presents the variables for measuring different characteristics of zombie firms. It summarises all the variables that can be used to see the possibility of becoming a zombie firm. In order to examine which characteristics are associated with becoming a zombie firm, the following equation is constructed:

$$Zombie_t = \alpha + \beta_1 LIQ_t + \beta_2 SOLV_t + \beta_3 PROF_t + \beta_4 EFFI_t + \beta_5 GROW_t + \beta_6 MARK_t + \varepsilon_t \quad (1)$$

Model 1 depicts the research model, covering the following key variables: liquidity, solvency, profitability, efficiency, growth, and market. Here,  $Zombie_t$  is a dependent variable that indicates the proportion of zombie firms. It is a dummy variable with the value “1” if a firm is classed as a zombie firm and “0” if it is not classified as a zombie firm. Table 3, which gives variables for measuring distinct features of a zombie firm, goes into detail for each area.

Zombie firms are not conducive to industrial growth, and to study the impact of zombie firms on industrial growth following equation is constructed:

$$IndG_t = \alpha + \beta_1 Zombie_t + \beta_2 IndLiq_t + \beta_3 IndSol_t + \beta_4 IndProf_t + \beta_5 EF_t + \varepsilon_t \quad (2)$$

Where  $t$  represents the time,  $IndG_t$  indicating industrial growth, used as a dependent variable in the industry.  $Zombie_t$  representing a percentage of businesses that have become zombies,  $IndLiq_t$  denoted as industrial liquidity,  $IndSol_t$  is industrial solvency,  $IndProf_t$  represents industrial profitability and  $\beta_1 EF_t$  denoted as an economic factor and  $\varepsilon_t$  is the error term.

## 4. Data analysis and results

### 4.1. Summary statistics

Summary statistics provide descriptive statistics for all the variables presenting characteristics of zombie firms after outliers have been addressed. Table 4 displays summary data for zombie firm variables from 2009 to 2019. It shows the mean, standard deviation, 10th, 25th, 50th, 75th, and 90th percentiles, and the number of observations classified as zombie firms. Skewness and kurtosis are also calculated to ensure that the data is normal (Khan et al., 2016).

The descriptive statistics for all the variables used to measure zombie enterprises are listed in Table 4. According to the findings, enterprises in the study have an average current ratio of  $-0.03$ , an operating cash flow ratio of  $-0.70$ , and cash holdings of  $-1.50$ . The solvency factor shows that the debt-to-equity ratio is  $0.15$ , financial leverage is  $2.62$  and interest coverage ratio is  $1.11$ . The results state that most solvency ratios maintain the acceptance criteria except for financial leverage, which is way more than the acceptance value that justifies their inclusion in this study and examines their impact on industrial growth.

The profitability factor shows that the return on assets is  $0.74\%$ , the return on equity is  $1.12\%$ , the return on sales is  $-0.89\%$ , and the net profit ratio is  $0.88\%$ . The efficiency of the companies states that the asset turnover ratio is  $-0.37$ , sales to an asset is  $-0.09$ , Days Inventory Outstanding is  $2.14$  times, Days payable outstanding is  $0.06$  times, days receivable outstanding is  $4.77$  times, and cash conversion cycle is  $2.36$  times.

The selected companies have an average of  $0.30$  revenue growth; sales growth indicates  $-0.73$ , and asset growth is  $-1.05$ . The negative value indicates very few changes in growth, which also aligns with the statement that zombie firms additionally require expectations of a low future and

**Table 3. Measurement of characteristics of zombie firms**

Variables	Expected Relation	Measurements	Relation Found in Prior Studies	
			Positive	Negative
<b>Liquidity</b>	Current Ratio	Current Assets/Short-term liabilities		Khan et al. (2017)
	Operating Cash Flow Ratio	Operating Cashflow/ Current Liabilities		Binh et al. (2020)
	Cash Holding Ratio	Cash&Cash Equivalent/Total Assets x 100		Dai et al. (2021)
<b>Solvency</b>	Debt to Equity Ratio	Total Debt/Total Equity	Blazková and Dvouletý (2022)	
	Financial Leverage	Total Debt/Total Assets	Kwon et al. (2015)	
	Interest Coverage Ratio	Net Profit/Interest Expense	Pham et al. (2021)	
		EBIT/(EBIT—EBT)	Seyf (2021)	
<b>Profitability</b>	Return on Asset	Net Income/Assets	Schivardi et al. (2020)	
		EBIT/Total Asset	K. I. Khan et al. (2016)	
	Return on Equity	Net Profit Before Tax/Average Shareholder Equity	Clausing (2013)	
	Return on Sales	Earnings after tax/Sales	Blazková and Dvouletý (2022)	
	Net Profit Ratio	Profit Before Depreciation & Interest/Net Sale	Pham et al. (2021)	

(Continued)

**Table 3. (Continued)**

Variables	Expected Relation	Measurements	Relation Found in Prior Studies	
			Positive	Negative
<b>Efficiency</b>	Asset Turnover Ratio	Net Revenue/Average Total Assets		Qiao and Fei (2022)
	Sales to Asset Ratio	Net Sales/Total Assets		Yu et al. (2021)
	Days Inventory Outstanding	$365 \times 0.5 \times (\text{INVT } t + \text{INVT } t-1) / \text{COGS } t$	Dai et al. (2021)	
	Days Payable Outstanding	$365 \times 0.5 \times (\text{AP } t + \text{AP } t-1) / \text{COGS } t$	Dai et al. (2021)	
	Days Receivable Outstanding	$365 \times 0.5 \times (\text{RECT } t + \text{RECT } t-1) / \text{REVT } t$	Dai et al. (2021)	
	Cash Conversion Cycle	Days Inventory Outstanding + Days Receivable Outstanding—Days Payable Outstanding	Dai et al. (2021)	
<b>Growth</b>	Revenue Growth	$(\text{Revenue } t - \text{Revenue}(t-1)) / \text{Revenue}(t-1)$		K. I. Khan et al. (2021)
	Asset Growth	Ln of total assets in year t subtract Ln of total assets in year t-1		Binh et al. (2020)
	Sales Growth	$(\text{Sales } t - \text{Sales}(t-1)) / \text{Sales } (t-1)$	Grieder and Ortega (2020)	
<b>Market</b>	Size	The logarithm value of total assets.		K. I. Khan et al. (2016)
	Age	The number of years since the firm's establishment	Hoshi (2006); McGowan et al. (2018)	

**Table 4. Summary Statistics for Pakistani Listed Firms**

Variables	Mean	SD	Percentiles					Skewness	Kurtosis
			10th	25th	50th	75th	90th		
<i>i.Liquidity</i>									
CR	-0.03	0.43	-0.58	-0.14	0.03	0.21	0.42	-1.38	6.82
OCFR	-0.70	0.60	-1.51	-1.05	-0.67	-0.33	0.01	0.08	3.91
CHR	-1.50	0.42	-2.11	-1.82	-1.42	-1.33	-0.99	0.36	3.52
<i>ii.Solvency</i>									
DE	0.15	0.54	-0.46	-0.15	0.15	0.42	0.74	0.38	6.23
FL	2.62	0.64	1.79	2.30	2.64	2.94	3.43	-0.06	3.89
ICR	1.11	1.25	-0.07	0.26	0.67	1.83	3.26	0.91	3.17
<i>iii.Profitability</i>									
ROA	0.74	0.57	0.02	0.44	0.81	1.11	1.33	-0.49	6.28
ROE	1.12	0.63	0.35	0.79	1.19	1.48	1.79	-0.39	5.06
ROS	-0.89	0.66	-1.59	-1.29	-0.99	-0.62	-0.08	1.09	5.61
NPR	0.88	0.76	-0.04	0.40	0.85	1.27	1.85	0.53	4.72
<i>iv.Efficiency</i>									
ATR	-0.37	0.51	-0.87	-0.85	-0.31	0.06	0.26	0.00	2.16
SA	-0.09	0.42	-0.58	-0.22	-0.01	0.14	0.30	-1.56	7.49
DIO	2.14	0.90	1.34	1.70	1.95	2.35	3.85	0.73	4.41
DPO	0.06	1.93	-1.92	-1.15	-0.28	0.89	2.43	1.77	6.33
DRO	4.77	6.65	0.63	0.71	2.26	3.23	18.06	1.64	4.28
CCC	2.36	0.97	1.26	1.71	2.46	2.80	3.34	0.62	4.18
<i>v.Growth</i>									
RG	0.30	0.65	-0.58	-0.07	0.35	0.85	0.85	-0.25	3.98
SG	-0.73	0.57	-1.42	-1.04	-0.75	-0.43	-0.04	0.52	5.19
AG	-1.05	0.46	-1.64	-1.33	-1.04	-0.73	-0.49	-0.08	3.07
<i>vi.Market</i>									
SZ	0.83	0.54	0.22	0.31	0.75	1.18	1.57	0.82	3.79
Age	1.12	0.31	0.78	1.00	1.15	1.28	1.49	-0.52	4.70

hinder the growth of other healthy firms (Caballero et al., 2008) . The results also specify that the average size of the firms is 0.83, and the age is 1.12.

Most of the values in the data are not according to acceptable average values as the data include both profit-making firms and firms which are at a loss. That is why some variable shows negative values. All the standard deviation values are below one except financial leverage, interest coverage ratio, and days payable outstanding, indicating the higher dispersion in the data.

The skewness and kurtosis are calculated to ensure that the data is normal. A normal data distribution is shown by absolute values of skewness and kurtosis (i.e., between |2|), (K. I. Khan, Qadeer, Mata, Dantas et al., 2021). All of the skewness values are less than 2, and only a few variables are unsupportive in the case of kurtosis. However, some scholars argue that skewness is | 2|, whereas the standard for normality is |7| (Hoyle et al., 1995). According to some sources, the absolute values of Skewness and Kurtosis should not exceed 3 and 10, respectively. All study variables meet the normality criteria based on this condition. If the normality assumption is satisfied, the connection between variables is also homoscedastic because homoscedasticity is related to the normality assumption (Baltagi, 2005).

#### **4.2. Models for unbalanced panel data**

Between 2009 and 2019, 434 non-financial enterprises were studied using a panel data technique. The qualities of cross-sectional and time-series data are combined in panel data. It has a variety of cross-sectional components for various historical periods. Individuals can get information from this type of data over time. Using a panel data model has numerous advantages. According to Hoyle et al. (1995), the two main advantages are estimating efficiency and enhanced analytical depth. For the economic study, panel data can be highly beneficial.

Unbalanced panel data and balanced panel data are two different types of panel data. The panel data in this study is imbalanced. Panel data is balanced when there is data for all individuals across time. Also, it may not be possible to collect data for all persons over time, referred to as unbalanced data. One of the many benefits of panel data is heterogeneity (Baltagi & Maasoumi, 2013).

#### **4.3. Models for dichotomous dependent variable**

Model 1 of this study has a dichotomous (dummy variable) dependent variable that scored as “1” if zombie and “0” if non-zombie. The Probit or logit model can be used for linear regression with a dependent variable of “0” or “1”. Probit and logit models are useful in the analysis because they transcend the limitations of linear regression. Over the years, Logit and Probit models have been utilized in various fields, and many studies have recognized their similarities (K. I. Khan et al., 2017). At the same time, many authors were working on how to distinguish between Logit and Probit models. The distribution of Logit and Probit models differs significantly. Probit utilizes a typical normal distribution, while Logit uses a logistic distribution (Frühwirth-Schnatter & Frühwirth, 2010). These models are frequently utilized in applied economics, sociology, and political science.

For binary dependent variables, the OLS (ordinary least square model) is frequently employed in economic and financial studies (Hsiao, 2007), especially when the modelling is extremely close to “0” or “1”. Scholars used it for its easiness in interpreting the data, but the problem with OLS is: (1) in general, it has a possibility of biasness and inconsistency, (2) nonsensical predicted values and (3) heteroscedasticity (Horrace & Oaxaca, 2006).

The Probit and Logit functions are pretty similar in terms of predictions. In corporate finance research, the Logit and Probit models are frequently used to analyze the presence and causes of zombie enterprises (Qiao & Fei, 2022). However, while both models frequently provide identical results, some researchers prefer the Probit regression model due to its major property of normal distribution (Hsiao, 2007). Logit or Probit both show similar results as it is typically a personal preference to use Logit or Probit. This study uses the Probit regression model for data estimation of a model (1).

Hence, this study utilizes the Probit regression model for the dependent variable zombie firm (ZF), which assumes the value “1” or “0”. The results of the probit regression model are provided in Table 5, which states the outcomes of the probit regression model to determine the characteristics of zombie enterprises.

Table 5 gives an overview of the model used to investigate the characteristics of the firms classified as zombie firms. The significant characteristics depicted in Table 5 are liquidity, solvency, profitability, efficiency, growth and market. Empirically, to identify the characteristics associated with the possibility of becoming a zombie firm, this paper estimated panel probit regression with the dependent variable of the zombie as a dummy variable that takes the value “1” if it is zombie “0” otherwise. All the ratios associated with these characteristics are mentioned above. The results indicate that debt to equity ratio (DE) has a significant positive relationship with zombie firms while operating cashflow ratio (OCFR), return on equity (ROE), return on sales (ROS), asset turnover ratio (ATR), revenue growth (RG), sales growth (SG), asset growth (AG) and age have a significant

**Table 5. Probit regression model**

Variables	B	S.E
CR	0.06	0.071
OCFR	-0.367*	0.06
CHR	0.069	0.088
DE	0.730*	0.101
FL	-0.041	0.042
ICR	0.027	0.034
ROA	0.128	0.13
ROE	-0.390*	0.115
ROS	-0.179*	0.069
NPR	0.02	0.06
ATR	-0.720*	0.1
SA	-0.382*	0.11
DIO	-0.052	0.041
DPO	-0.015	0.026
DRO	0.043	0.043
CCC	0.045	0.04
RG	-0.377*	0.108
SG	-0.107***	0.056
AG	-0.187*	0.069
SZ	0.01	0.062
Age	-0.291**	0.118
Constant	-2.157*	0.324
Observations	3994	
LR-Chi-Square	622.43	
Pseudo R <sup>2</sup>	0.255	

\*p < 0.01 \*\*p < 0.05 \*\*\*p < 0.1

negative relation with zombie firm (ZF). These variables are significant at 1%, 5 % and 10% levels of significance, while the rest of the variables are insignificant to zombie firms.

The results from Model 1 support the assumption that zombie firms have a negative relationship with liquidity, as the operating cashflow ratio is negatively significant with zombie firms. It indicates that companies with sufficient liquidity are less likely to become zombies, in line with Binh et al. (2020). The debt-to-equity ratio (DE) has a positive correlation with zombie companies. It indicates that an increase in DE ratio also increases the chances of the firm's becoming a zombie. It means firms with low solvency have a high chance of becoming zombies. It is also in line with the finding in the literature (Blažková & Dvouletý, 2022).

It is also not surprising that firms becoming a zombie experience have worse financial results regarding ROS and ROE. Hence, the result of both the profitability factors shows a negative correlation with zombie firms, which means firms with high profitability are less likely to become zombies. Asset turnover ratio (ATR) and sales to asset ratio (SA), which represent the company's efficiency, are also negatively associated with being a zombie firm. It indicates that highly efficient companies are less likely to become a zombie. As far as the growth is concerned, asset growth ratio (AG) and revenue growth (RG) negatively correlate with zombie firms, which states firms with a high growth rate have fewer chances of becoming zombie firms.



Moreover, sales growth (SG) has a negative relationship with a zombie at a significance level of 10%, which indicates that the 1% increase in sales growth decreases the probability of a zombie firm by approximately 10%. Lastly, the age of a company is negatively connected with the likelihood of it becoming a zombie company, implying that young companies are more prone to become zombies as they are smaller in size, low in profitability and high in indebtedness (Isayas, 2021). It supports the empirical findings of Goto and Wilbur (2019), who state that zombies are more common in young firms.

#### 4.4. Characteristics of zombie firms

An additional comparison analysis is carried out in this study to see how the proposed characteristics affect zombie and non-zombie enterprises. Variable ZF is further segregated into zombie and non-zombie, representing “1” for the zombie firms and “0” for non-zombie firms. Table 6 shows the correlation, mean, and standard deviation for each variable in the zombie and non-zombie groups. To examine the effect of grouping variables, the t-test and Wilcoxon tests are used. The results are shown below:

T-tests and Wilcoxon tests are also used in Table 6 to see how these variables affect different categories. The t-test compared the two groups’ means and is a statistical test determining how different the two groups are from one another based on the population effect. The Wilcoxon test is preferred when two or more groups or pairings are significantly different from one another. The results reveal the differences in CR and OFCR of liquidity, DE of solvency, ROA, ROE, ROS, NPR of profitability, ATR, SA, CC of efficiency and RG, SG and AG of growth, while the remaining variables

**Table 6. Characteristics of zombie firms**

Variables	Correlation	Non-Zombie = 0		Zombie = 1		Test of Differences Non-Zombie = 0 and Zombie = 1	
		Mean	SD	Mean	SD	t-test	Wilcoxon test
CR	-0.089	-0.034	0.435	0.000	0.426	-2.056**	-1.929***
OFCR	0.019	-0.614	0.564	-0.970	0.651	16.210*	17.221*
CHR	0.000	-1.508	0.427	-1.490	0.415	-1.110	-1.93***
DE	-0.102	0.094	0.485	0.331	0.650	-11.988*	-12.614*
FL	-0.109	4.600	6.758	4.530	6.707	0.278	1.051
ICR	0.117	1.057	1.139	1.279	1.558	-4.719*	-0.196
ROA	-0.059	0.710	0.575	0.836	0.548	-5.906*	-5.933*
ROE	-0.109	1.084	0.593	1.255	0.729	-7.258*	-6.753*
ROS	0.128	-0.990	0.559	-0.566	0.828	-17.863*	-14.428*
NPR	0.133	0.723	0.651	1.425	0.847	-26.634*	-22.917*
ATR	-0.584	-0.298	0.501	-0.630	0.443	18.102*	16.332*
SA	-0.109	-0.018	0.355	-0.336	0.527	21.115*	19.159*
DIO	0.177	2.154	0.889	2.112	0.926	1.237	0.619
DPO	-0.039	0.109	2.006	-0.090	1.646	2.742*	0.693
DRO	-0.110	4.782	6.663	4.737	6.603	0.182	0.544
CCC	-0.510	2.322	0.985	2.479	0.924	-4.312*	-6.127*
RG	0.015	0.253	0.667	0.461	0.560	-8.590*	-7.495*
SG	-0.088	-0.751	0.567	-0.670	0.587	-3.747*	-4.144*
AG	0.024	-1.031	0.458	-1.106	0.453	4.387*	5.433*
SZ	0.088	0.823	0.549	0.851	0.521	-1.353	-1.694***
Age	0.236	2.614	0.618	2.649	0.712	-1.452	-1.871***

\*p < 0.01 \*\*p < 0.05 \*\*\*p < 0.1

show no significant difference. Table 6 demonstrates that the values of these variables are statistically significant, indicating that the properties of these grouping variables differ significantly. The significance of all of these factors was assessed at three levels of significance: 1%, 5%, and 10%.

#### 4.5. Categorical analysis of existence of zombie firms

Research Question 1 is to check the firm-level characteristics attributed to zombie firms. For this purpose, a comparative analysis of different characteristics of zombie firms has been conducted, such as leverage, profitability, efficiency, growth, size and age, to examine the presence of zombie prevailing characteristics across organizations.

The categories are low high, profitable non-profitable, efficient, inefficient, and small-large in terms of age and size. In addition to the categories, the total number of observations, mean, and standard deviation are shown. T-tests and Wilcoxon tests are used to define these variables and group them into specific categories.

In Table 7, only zombie firms are categorized into different characteristics to understand which category shows the higher presence of zombie firms. The result provides significant shreds of evidence in favour of all the variables. The N category (existing numbers) states that many of these firms are new, highly leveraged, inefficient and have a low growth rate. Moreover, zombie firms are present in both small and large firms, but mostly in small firms. As far as profitability is concerned, most firms categorized as non-profitable have a high rate of zombies.

To compare the effect of grouping variables on zombie businesses, the t-test and Wilcoxon tests are used. The comparison results reveal the differences in leverage, profitability, efficiency, growth, size and age of the firms characterized as zombie firms. As a result, it shows a significant difference in all of these grouping variables' properties. All of these variables are assessed for significance at a 1% significance threshold.

#### 4.6. Estimation models for linear regression

Panel data regression analysis is a data format that reflects panel data and is widely used in the economy. It is a mix of cross-sectional data and time series in which the same unit cross-section is measured at different points in time. In other words, panel data is information gathered from

**Table 7. Categorical analysis of existence of zombie firms**

Variables	Category	N	Mean	SD	t-test	Wilcoxon test
Leverage	High	506	0.019	0.569	-60.923*	-26.122*
	Low	413	2.822	0.821		
Profitability	Profitable	69	-0.354	0.399	-23.825*	-13.829*
	Non-Profitable	850	0.933	0.434		
Efficiency	Inefficient	916	-0.635	0.437	-5.384*	-3.058*
	Efficient	3	0.725	0.000		
Growth	Low	883	-0.727	0.517	-16.556*	-10.184*
	High	36	0.725	0.475		
Size	Small	467	0.408	0.201	-52.141*	-26.242*
	Large	452	1.309	0.313		
Age	Old	217	0.696	0.227	-34.532*	-22.145*
	Young	660	1.288	0.216		

\*p < 0.01

a group of people over a period of time. There are three methods for estimating a regression model using panel data. Dow and Endersby (2004) defined three types of panel models in Panel data models: (1) Pooled—this model depicts total variations, (2) Fixed—this model depicts individual variations; and (3) Random effects—this model depicts time variations.

Because the panel data are estimated using an Ordinary Least Squares (OLS) approach, which presupposes that the behaviour of the company data is consistent overtime periods, which is not the case here, the pooled least square model is not appropriate for this study. Pooled OLS is employed when selecting distinct samples by year or period of the panel data, according to Hsiao (2007), Fixed or random effects are used when multiple persons, states, or other variables are observed in the same sample.

To check how much data are poolable, this study uses the Breusch-Pagan Lagrange multiplier test, which states that the null hypothesis H0 has zero variance of unobserved fixed effects, and pooled OLS might be the suitable model. The null hypothesis was rejected, and the test concluded that the Random Effect model would be appropriate as  $P < 0.05$ , as shown below. That's why we switched to a fixed effect and random effect model.

The first test, the L-M test, determines whether a pooled or random-effect model is preferable. The Hausman test determines whether the fixed or random effect model is more appropriate for the data. Hausman test rejects the null hypothesis as  $p < 0.05$ , which means the fixed model is appropriate for the data.

As a result, the influence of zombie firms on industrial growth is investigated using a fixed-effect model in this study. The results of the fixed effect model are reported in Table 8.

Table 8 states all the values are significant at a 1% significant level, and the result states that all variables have either a positive or negative significant relationship with industrial growth. Industrial growth is defined in this model as the median value of growth for all firms in each industry during the year under consideration (Denis & McKeon, 2012). Cooper et al. (2004) take asset growth as representative of industrial growth. Broussard et al. (2005) developed a simple and comprehensive measure of total asset growth to identify the sources of the growth effect at the

**Table 8. Fixed effect model**

<b>Ind.G</b>	<b>Coef.</b>	<b>Std. Err.</b>
ZF	-0.039*	0.011
OCFRIA	0.081*	0.014
DEIA	-0.026*	0.010
ROEIA	0.030*	0.008
ATRIA	0.220*	0.030
GDP	0.007*	0.001
CTR	-0.070*	0.011
InfR	-0.029*	0.009
RIR	-0.010*	0.003
GDGDP	-0.009*	0.003
Constant	-1.631*	0.381
Observation	3994	
R-squared	0.396	

\*p < 0.01

firm level. They claim that total asset growth captures a broader picture than investment and finance activity growth.

Industry liquidity, industrial solvency, industrial profitability, and industrial efficiency are the median values of the operating cash flow ratio (OCFRIA), debt to equity ratio (DEIA), return on equity ratio (ROEIA), and asset turnover ratio (ATRIA) for all the firms existed in a specific industry of the year under consideration. ZF is a dummy variable for the zombie that indicates “1” if it is a zombie and “0” otherwise, and control represents a group of control variables that are macro-economic factors such as gross domestic product, corporate tax rate, inflation rate, real interest rate, and Government debt to GDP are all measures used to account for macroeconomic swings throughout time.

This study used a fixed effect regression model to quantify the influence of zombie firms on industrial growth. The results state that the variable zombie is statistically correlated with industrial growth at a significance level of 1% and is negatively correlated with the dependent variable. It indicates that the presence of zombie firms in an industry overall decreases industrial growth, as a 1% increase in zombie firms leads to a decrease of 3.9% growth in the industry.

The results depict that liquidity, profitability and efficiency factors are positively correlated with industrial growth, which states that an increase in liquidity, profitability and efficiency of the industry also increases the chances of industrial growth. On the other hand, solvency negatively affects industrial growth, which means high indebtedness decreases the chances of industrial growth. According to the macroeconomic considerations, the GDP coefficient is notably positive, which states higher the values of this variable higher the industrial growth. At the same time, corporate tax rate, inflation rate, real interest rate, and government debt to GDP are strongly negative, implying that the larger the ratio, the worse the prospects of industrial growth. This corresponds to the findings of Clausing (2013), who states that a higher corporate tax rate would build up over income tax, reduce long-term productivity growth, and lower growth chances.

## 5. Conclusion

The presence of non-viable and inefficient firms termed zombies still operating in a country hinders stable industrial growth. Previous studies suggested that zombie firms may weaken economic performance and negatively affect the economy. This study empirically examined the existence of zombie firms listed in different industrial sectors in Pakistan, investigated the potential firm-level characteristics of the likelihood of zombie firms and analyzed its impact on industrial growth.

This paper investigated whether the firm-level characteristics such as a firm’s liquidity, solvency, profitability, efficiency, size and age increase or decrease the probability of being a zombie. The results indicated that zombie firms tend to be available in the firms with characteristics of low liquidity, low solvency, non-profitability, and inefficiency. Those firms that are young in age have high chance of being classified as zombie firms. It means the likelihood of a zombie firm is reduced with the high liquidity, solvency, profitability, and high efficiency. Moreover, age is negatively related to zombie firms, meaning new firms have a high chance of becoming zombies.

Moreover, the existence of zombie companies can have positive or negative effects on industrial growth in general and Pakistan’s industry in particular. Therefore, dealing with zombie companies disguised in the industry is an urgent and topical task. We investigated the impact of zombie firms on industrial growth. The findings revealed a negative association between zombie firms and industrial growth, with the presence of zombie firms in an industry lowering the likelihood of industrial growth. Furthermore, high industrial indebtedness, Government debt to GDP, real interest rate, inflation rate and high corporate taxes have decreased the chances of industrial growth. According to the findings, zombie enterprises negatively impact industrial growth.

### **5.1. Implications**

The findings of this study contribute to the literature and support adjusting Pakistan's industrial growth, where the scope and significance of the issue regarding zombie firms are apparent and must be brought to light. Following are some practical implications of the study:

First, this study will urge public officials and decision-makers to realize that the zombie problem exists in Pakistan and that it would be fair to factor these businesses into their strategies. The employment of bankruptcy laws is an effective tool for liquidating a zombie corporation. As a result, businesses would be incentivized to generate positive cash flows, lowering debt and restoring a "healthy" capital structure.

Second, this research will be significant for regulatory authorities as regulators play a crucial role in breaking off the ongoing debt cycle. Previous research states that non-viable zombie firms crowd out investment and opportunity growth for healthier firms, and this study shows its impact on industrial growth. In this way, regulators can generate larger space to protect industrial growth by devising effective regulatory measures to capture zombie firms in the marketplace.

At last, in a developing country, governments should use market policies and creative destruction in the long run to eliminate zombie enterprises. Developing countries can only boost industrial upgrading in this way. Managers should look for risky business partners and pay extra attention to contracting with them to minimize risk transfer to their companies depending on the recognized symptom.

Overall, a basic comprehension of the reasoning underpinning zombie companies' creation and their relevance to industrial growth will help them make better policy decisions to curb corporate debt growth and reform and restructure the economy. Furthermore, it is recommended that the scope of the zombie problem is monitored and that these risky firms be included in economic models because they fall outside of the conventional theory of a firm, and their existence and negative effects on the competitive environment in the economy have been overlooked to date.

### **5.2. Limitations and future directions**

Despite the fact that this study adds to the existing literature on zombie firms in many ways, it has some limitations that must be acknowledged. These restrictions bring up new opportunities for future researchers to investigate the concept of the zombie firm in new circumstances using a unique data set and learn more about the consequences for practitioners and academics.

First, this study urges other researchers to focus on this expanding, visible research subject in the future. Other features of zombie enterprises that have not been the topic of this study restrict the provided conclusions, aside from the potential to examine the real impact of zombie firms on the economy. For example, the involvement of banks and financial institutes in providing the evergreen loans to these mistress firms and credit subsidies received by these firms would also broaden the empirical research on these topics.

Second, given the limits of this study, more evidence is needed to understand better the correlation between profitability, productivity, and the risk of becoming a zombie, particularly from a larger range of industries. Third, it also encourages future researchers to explore the undisputed influence of top management and directors' characteristics on the companies' situation. Also, the productivity factor could be used for a better understanding of the issue of zombie firms.

Fourth, due to data availability and limitations, this study investigates the presence of zombie enterprises among non-financial public limited corporations. Future researchers would find it interesting to explore and extend the study on the presence and prevalence of zombie firms in other types of organizations, such as private companies and small and medium enterprises. This

will widen the study's scope and allow researchers to look at new reasons for the existence of zombie enterprises in the industry.

Fifth, this study is undertaken in a developing country such as Pakistan, providing substantial evidence for the existence of zombie enterprises in the industry. Previously published research by Hallak et al. (2018) was undertaken in industrialized countries. More research from emerging economies must confirm the current study's findings. Future scholars may potentially undertake a comparative study between rich and developing countries to investigate further causes of a zombie apocalypse.

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## APPENDIX A

Table A1. Nomenclature symbol description	
CR	Current Ratio
OCFR	Operating Cashflow Ratio
CHR	Cash Holding Ratio
DE	Debt to Equity Ratio
FL	Financial Leverage
ICR	Interest Coverage Ratio
ROA	Return on Asset
ROE	Return on Equity
ROS	Return on Sales
NPR	Net Profit Ratio
ATR	Asset Turnover ratio
SA	Sales to Asset Ratio
DIO	Days Inventory Outstanding
DPO	Days Payable Outstanding
DRO	Days receivable outstanding
CCC	cash conversion cycle
RG	Revenue Growth
SG	Asset Growth
AG	Sales Growth
SZ	Size
AGIA	Industrial Asset Growth
OCFRIA	Industrial Operating Cashflow Ratio
DEIA	Industrial Debt to Equity Ratio
ROEIA	Industrial Return on Equity Ratio
ATRIA	Industrial Asset Turnover Ratio
GDP	Gross Domestic Product
CTR	Corporate Tax Rate
InfR	Inflation Rate
RIR	Real Interest Rate
GDGDP	Government Debt to GDP
ZF	Zombie
Ind.G	Industrial Growth





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