



Global zombie companies: measurements, determinants, and outcomes

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Abstract

Academics and practitioners are increasingly concerned about global zombieism, a term used to describe insolvent firms that survive with the support of financial institutions, investors, or governments, particularly during unusual market conditions. Using dual-filters of interest coverage ratio and an empirically validated default prediction model, we propose a new measure to gauge the extent of zombieism in the world's 20 largest economies. The average zombie share of listed firms has increased significantly since 1990, to about 7% in 2020. Zombie firms are typically found among small and medium-sized enterprises. Economic growth, industry compositions, and lenient monetary policies have strong explanatory power for global zombieism. We show that the presence of zombie firms generates significant market congestion, limiting the growth of healthy firms. We also find that the development of global corporate bond markets contributes to zombie firm growth. Leveraging staggered bankruptcy reforms as an exogenous variation, we find that these reforms lower zombie ratio by 1.4% points. The reduction is more substantial if the bankruptcy law becomes more creditor-friendly. Having failed to recover, zombie firms can survive for an average of 5 years before declaring bankruptcy, being delisted, or being acquired. Bankruptcy reforms accelerate the dissolution of zombie status.

Keywords Zombie firms · Financial distress · Interest coverage · Z-score · COVID-19 · High-yield debt · Bankruptcy law · Creditor rights

Introduction

The global economic challenges exacerbated by the COVID-19 pandemic have increased concerns about the zombie firm phenomenon among government policymakers, regulators, quasi-governmental organizations, scholarly discussions, and the media. These “walking-dead” companies, generally insolvent and economically nonviable over a reasonably long period, are presumed to persist due to support from financial institutions or governmental entities.

Zombie firms are known to distort credit allocation and impede real economic growth. A growing body of literature has developed methods to quantify zombie firms and examine the causes of zombification in many advanced economies, focusing on the emergence of zombies in a single country or through specific channels, such as banks' easy credit. Very few studies have measured the extent of such entities across a broad spectrum of countries over a long period of time. Previous studies also suggest using operation or valuation metrics to identify zombie firms, yet most fail to distinguish between likelihood of default and subpar

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performance. Our study bridges this gap by quantifying the extent of zombieism in developed and emerging economies through devising a new measure that considers both the probability of default and the degree of insolvency. Specifically, our study examines: (1) the quantification of zombie firms in a global setting and (2) the economic and legal factors influencing the prevalence and resolution of zombieism.

We compiled data on all publicly traded nonfinancial firms (1990–2021) from the World Bank's top 20 GDP economies as of 2020. Our sample consists of 489,270 firm-year observations. We adopt a two-step filtering process to identify zombie firms in these countries over time. We first calculate the interest coverage ratio (i.e., EBITDA to interest payment) for each firm in a year. A low-interest coverage ratio alone may capture transient shocks to earnings and interest payments, making it an "aggressive" test for spotting zombie firms. Thus, we employ a second filter based on Altman (1968)'s *Z*-score model and a modified version, the *Z''*-score model, developed for international firms (Altman et al., 1995). Both scores account for firms' financial health and the probability of default, and have undergone extensive validation using historical data of defaulted firms. To smooth out short-run fluctuations, a firm is treated as a zombie if its 3-year moving average interest coverage ratio is less than 1 and the 3-year moving average *Z*-score (or *Z''*-score) is below 0.

We find that the average proportion of zombie firms among listed companies rose markedly from 1.5% in 1990 to over 7.0% in 2020 and then declined slightly to 6.5% in 2021 in the world's 20 largest economies. Interestingly, the zombie ratio barely changed from the year before the COVID-19 pandemic started (2019) to 1 year later. This finding lends itself to the presence of two opposing forces during the pandemic period. On the one hand, numerous large businesses declared bankruptcy in 2020 (Altman, 2021). On the other hand, the unprecedented intervention of central banks in financial markets, coupled with governmental incentives and support for banks to provide subsidies to small and medium-sized businesses (Acharya et al., 2020), has played a critical role in sustaining these businesses. We indeed find that smaller enterprises have a much greater likelihood of being zombie firms.

To further validate our zombie metric, we conduct regression analyses to assess the explanatory power of critical economic and political factors on global zombieism, as identified in previous research. In addition, we investigate zombie firms' potential market congestion effects based on our metrics. Our results indicate that countries with higher GDP growth, increased stock returns, and investment-grade sovereign credit ratings have fewer zombie firms. On the contrary, nations with a higher fraction of small and young firms, limited manufacturing activities, and a significant presence in the utility sector exhibit elevated zombie ratios.

Furthermore, the zombie ratio escalates in environments with accommodating interest rates, as evidenced by lower central bank discount rates. Importantly, our results indicate that in industries with a higher proportion of zombie firms, non-zombie firms exhibit reduced investment, diminished sales and employment growth, and fewer new entrants, underscoring notable congestion effects.

Since 1990, global corporate debt markets have expanded significantly due to unconventional monetary strategies, institutional investors' pursuit of yields, the emergence of investors specializing in distressed firms, and global bankruptcy restructuring reforms. Unlike relationship bank lenders, corporate bond investors, likely holding diversified portfolios, are not motivated to subsidize zombie firms. However, they are willing to finance distressed firms, zombie or non-zombie firms, at an attractive yield. As a result, the tremendous growth of high-yield debt (and leveraged loan) markets and yield-seeking institutions helps finance high-default-risk firms and promotes market mechanisms for resolving financial distress by creating a market for distressed debt securities. These mechanisms contribute to a friendly environment for the survival of zombie firms.

To investigate the relationship between corporate debt market growth and zombieism, we devised numerous country-year metrics for debt financing within a multivariate framework. We obtained outstanding loans and debt securities issued by nonfinancial firms domiciled in a country from the International Monetary Fund (IMF) and bond issuance details from nonfinancial and nongovernmental entities from the SDC database and Refinitiv's LPC Dealscan. Our analysis reveals a significant positive correlation between a country's debt issuance and zombieism, with high-yield bond market growth being particularly influential. In particular, a one-standard-deviation rise in high-yield bond issuance corresponds to a 0.5% point increase in the zombie ratio.

Next, we investigate the influence of bankruptcy law on zombieism. To disentangle the impact of bankruptcy law on resolving zombie issues from other confounding legal and economic factors, we referenced previous research to identify significant bankruptcy code reforms in our sample countries. Leveraging bankruptcy reforms from 2000 to 2009 in eight countries – Brazil, China, France, India, Japan, Italy, Spain, and the United Kingdom – we employed difference-in-differences tests to assess post-reform shifts in the proportion of zombie firms. On average, countries that made substantial reforms to their bankruptcy laws experienced a 1.4% point (25–30%) reduction in the fraction of zombie firms. Upon analyzing the time-series dynamics of zombie ratios relative to bankruptcy reforms, no significant disparities existed between reformed and nonreformed countries before the reforms. The results validate the parallel trend assumption, alleviating the concern that bankruptcy reforms in these countries are endogenous responses to



zombie issues. Notably, adopting creditor-friendly bankruptcy laws resulted in an additional 1.6% point decrease in zombie ratios compared to debtor-friendly laws.

Our concluding analysis examines the repercussions of zombie firms utilizing databases including Bankruptcydata.com, Compustat, Worldscope, SDC, and S&P Transaction. We track each firm from its initial classification as a zombie until it either vanishes from our dataset or recovers. Zombie firms are categorized into outcomes: bankruptcy (US firms only), delisted, M&A, recovered, and unknown. Over half of these firms face bankruptcy or delisting, with a minor portion recovering from zombie status. On average, it takes 5 years from being labeled a zombie to bankruptcy or delisting. Utilizing staggered bankruptcy law reforms as exogenous shocks, we discern that these reforms reduce a firm's duration in zombie status by 25% and considerably elevate the likelihood of liquidation or restructuring, indicating that bankruptcy reforms accelerate the removal of zombie firms.

Our work provides multiple contributions to the existing body of literature. There is growing literature on measuring zombie firms and determining the causes and implications of zombie firms. Studies in this domain, whether concentrated on individual countries (such as the United States or Japan) or encompassing multiple nations (e.g., OECD countries), typically follow one of two paths. The first develops methodologies to identify zombie firms and investigate the causes of zombie problems. The other assesses the impacts of zombification on resource distribution and economic growth.¹ Our study is closely related to the first strand of the literature.

Several recent studies by academics and practitioners propose various performance-based approaches for identifying a broad set of zombie firms created beyond bank lending channels, such as government subsidies and weak insolvency regimes.² We propose a method that benefits from employing universally accessible corporate performance metrics to define zombie firms, facilitating more effective cross-country comparisons. Despite many studies using singular or multiple performance metrics to categorize zombie firms, their criteria often lack rigorous empirical validation and are typically “liberal”. In contrast to those studies, we propose a more holistic filtering process with well-trained

default-risk prediction models for identifying zombie firms globally, especially those in emerging economies that prior studies have not included in their samples. In short, the novelty of our approach lies in its validated cutoff and global applicability.

Our paper also adds to the literature on the effects of bankruptcy laws and creditor rights on zombieism, aligning with Adalet McGowan et al. (2017), Becker and Ivashina (2022), and Jordà et al. (2022). Similar to our work, these studies demonstrate that variations in insolvency regimes across countries affect the persistence of zombie firms, suggesting that efficient insolvency resolution procedures can reduce zombie lending during European economic downturns by promoting bankruptcies. Unlike these studies, we take advantage of bankruptcy reforms in eight significant economies to exploit within-country variations to identify the effects of the modernization of bankruptcy law and the strengthening of creditor rights on addressing zombie problems.

Moreover, this paper furthers our understanding of how financial markets affect real economic activities in a global setting. Specifically, our study examines the effect of corporate debt market development on global zombieism. Although credit availability to high-default-risk firms provides an accommodating environment for zombie firms to survive, it allows low-rated and young firms to innovate and grow. Notably, the growth of the high-yield debt market enhances the risk tolerance of financial intermediaries, thereby increasing credit availability to high-risk borrowers. This development promotes market-based solutions for the financially distressed firm by establishing a market for yield-seeking investors. Our findings are pertinent for policymakers seeking to mitigate the domestic zombie issue while ensuring a favorable legal environment and market development for enterprises.

Measuring zombie firms around the world

Conceptually, a zombie firm is a company that is unable to meet its interest payments and even becomes insolvent but continues to survive due to unusual market conditions and the support of financial institutions, equity investors, and/or governments. Although there are no commonly accepted methods for defining zombie firms, a number of studies have primarily relied on firms' interest coverage ratios to define zombie firms (e.g., Adalet McGowan et al., 2017, 2018; Banerjee and Hofmann, 2018, 2022). In those settings, the term “zombie firms” pertains to companies that possess a *less-than-one* interest coverage ratio, sometimes also meeting other criteria, such as age and Tobin's Q. The definition is intuitive: a firm that is unable to create sufficient cash

¹ Since the seminal work of Caballero et al. (2008), who document the congestion effects of zombie firms in Japan, a number of subsequent studies have examined the firm-level impact and macroeconomic implications of zombie firms in various countries (e.g., Acharya et al., 2019, 2020, 2022; Adalet McGowan et al., 2018; Banerjee & Hofmann, 2022; Lam et al., 2017; Schivardi et al., 2021). Those studies show that the presence of zombie firms generates credit misallocation and congestion problems and impedes real economic growth.

² Those studies include (but are not limited to): Adalet McGowan et al. (2017, 2018), Banerjee and Hofmann (2018, 2022), Schivardi et al. (2021), Acharya et al. (2022), Carreira et al. (2022), Favara et al. (2022), and Bonfim et al. (2023). See our Online Appendix for a detailed discussion of related studies.



flows to meet its interest payments but can survive for a few years should be classified as a zombie.

However, there are limitations to using the interest coverage ratio to measure the presence of zombie firms. On one hand, the criteria can be “aggressive” and thus potentially result in a substantial overestimation of the zombie problem. A special report by Standard & Poor’s (2011) demonstrates this point. Among a set of companies rated CCC by the agency, the median EBITDA interest coverage ratio was 1.1. As a result, about half of CCC-rated firms, and even many B-rated companies, would be classified as zombies. On the other hand, the interest coverage ratio measure can be distorted for zombie firms. A key feature of zombie lending is that lenders provide “cheap” credit to zombie borrowers to keep them alive. At times, such credit can be so cheap that even firms with very low cash flows can maintain above-one interest coverage ratio. As a result, the interest coverage ratio alone may be systemically biased for de facto zombie firms.

For the above reasons, we adopt a second filter based on one of the most popular default/bankruptcy prediction models in the literature, the *Z*-score model and the *Z'*-score model.³ These models help accurately identify financially distressed firms that are close to default (Das et al., 2009; McKinsey, 2020).

We use the following formulas to determine these scores:

$$Z\text{-score} = 1.2 \times \frac{\text{Current assets} - \text{Current liabilities}}{\text{Total assets}} + 1.4 \times \frac{\text{Retained earnings}}{\text{Total assets}} + 3.3 \times \frac{\text{EBIT}}{\text{Total assets}} + 0.6 \times \frac{\text{Market value of equity}}{\text{Total liabilities}} + 1.0 \times \frac{\text{Sales}}{\text{Total assets}} \quad (1)$$

$$Z'\text{-score} = 3.25 + 6.56 \times \frac{\text{Current assets} - \text{Current liabilities}}{\text{Total assets}} + 3.26 \times \frac{\text{Retained earnings}}{\text{Total assets}} + 6.72 \times \frac{\text{EBIT}}{\text{Total assets}} + 1.05 \times \frac{\text{Book value of equity}}{\text{Total liabilities}} \quad (2)$$

To assess the validity of the two models for zombie designation, we build bond rating equivalent (BRE) values using the two measures among US firms. In the Online Appendix, we show that the BRE *Z*-score or *Z'*-score value of defaulted bonds of firms that have gone bankrupt, missed interest or principal payments, or been restructured out-of-court in the US is close to 0. We also find similar patterns for public firms listed in the remaining 19 countries in our sample. For example, the median *Z*-score BRE for CCC– and CC bonds are 0.51 and – 0.03, respectively, while this figure for D bonds is – 0.47. Based on these observations, we designate

any firm with a 3-year moving average of interest coverage (IC) less than 1, and a 3-year moving average *Z*-score (*Z*) or *Z'*-score (*Z'*) below 0, as a zombie firm to avoid measurement error resulting from temporary fluctuations of firm performance. We use EBITDA instead of EBIT to define IC in our international setting because the EBIT measure can penalize firms in countries where the fiscal norms favor depreciation and amortization (e.g., Italy and Germany) and thus distort cross-country comparability.⁴

Data sample and variable construction

Public firm sample

Our study sample starts with all publicly traded firms from the top 20 economies by GDP as defined by the World Bank at the beginning of 2020. We collect annual financial statements on US firms from Compustat and non-US firms from Worldscope from 1990 to 2021. We remove firms for which we cannot find corresponding primary share information in CRSP and Datastream. We also remove financial institutions (SIC between 6000 and 6799) and public administrations (SIC between 9100 and 9999). These entities have distinct capital structures and funding sources, making them difficult

to compare to other businesses, particularly those in different countries. We analyze only firms that have no missing interest coverage and data items required to calculate Altman *Z*- and *Z'*-scores. We remove observations in a given year for a country if our sources contain fewer than 50 firms in the year to ensure that we have enough observations and statistical

³ The *Z'*-score model, as proposed by Altman et al. (1995), demonstrates broad international applicability across various non-financial business sectors, notably including smaller and manufacturing firms, as evidenced in Altman et al. (2017, 2019).

⁴ Although the *Z*-score has been proved to be a valued predictor of default, it is not perfect in predicting whether a firm will go bankrupt within 1 year or 2 years. Indeed, Altman (2018) highlights that, based on 50 years of US data, type 1 errors range from 10% to 20%, while type 2 errors are marginally higher. Importantly, using 3-year averages of *Z*-score and *Z'*-scores instead of a single year value helps us not to falsely include distressed non-zombie firms in our sample. Online Appendix shows that the fraction of distressed non-zombie firms exhibits a pro-cyclical rather than an increasing pattern – higher fraction during economic downturns such as those in 2001–2002, 2008–2009, and 2020.



power to draw reasonable country-level inferences.⁵ We further exclude firms with S&P ratings of D (default) or SD (select default) from our analysis, with the exception of validation cases, as these firms are already undergoing restructuring. Our final sample has 489,270 unique firm-year observations from 1990 to 2021 in the 20 largest world economies.

Country-year measures

We construct several country-year measures that are identified by prior studies as major drivers for zombie problems in various countries. We then perform baseline regressions in the “Zombie measure validation: determinants and congestion effects” section by linking these economic, political, and legal institution factors to the fraction of zombie firms in the top 20 economies as a validation of the zombie measure.

We first construct three measures to capture economic activities and government fiscal strengths: annual GDP growth rate (*GDP growth*), value-weighted returns of all stocks primarily listed in a country (*Stock index return*), and an indicator for whether a country’s sovereign credit rating is investment grade or not (*Sovereign rating (investment grade)*). The data sources for GDP growth, stock returns, and sovereign credit ratings are the IMF, Datastream, CRSP, and the S&P Global Credit Ratings database (RatingsXpress), respectively. The rationale for these facts is that zombies are more likely to be created during economic downturns with unconventional monetary policy, regulatory forbearance, and government direct support (Acharya et al., 2019; Caballero et al., 2008; El Ghouli et al., 2021; Peek & Rosengren, 2005; Schivardi et al., 2021).

Because small enterprises are more likely than large firms to get subsidies from governments and their cooperating financial institutions for social, cultural, and economic reasons (Acharya et al., 2020; Bruche & Llobet, 2013), we construct a country-year measure of the fraction of small firms to adjust for cross-country variations in the size distribution of publicly traded firms. We define small firms as firms with \$50 million or less in revenue using the Basel standard (Banerjee & Hofmann, 2022).⁶ *Fraction of small firms* is defined as the number of small publicly traded

firms scaled by the total number of listed firms. Similarly, we measure the fraction of young firms in all listed firms in a country (*fraction of young firms*) because young firms are riskier due to lower capitalization and less accumulation of retained earnings than mature firms. Young firms are defined as those that have an age of less than 10 years. Firm age is defined as the duration since the initial public offering (IPO), as indicated by publicly accessible financial statements and stock trading records. This ratio is especially pertinent in our study because of the common occurrence of low profitability and retained earnings among firms with recent IPOs. Specifically, lower values of those metrics will result in low Z-scores, increasing the likelihood of young firms being (mis)classified as zombies.⁷

Previous studies suggest that the zombie problem is expected to be less prevalent in the manufacturing sector and more pronounced in sectors with government regulations and subsidies (Hoshi, 2006). Hence, we construct two measures to measure an individual country’s industry composition. *Fraction of manufacturing revenue* is defined as the annual total sales of all manufacturing firms (SIC between 2000 and 3999) in a country as a percentage of total sales of all listed firms. *Fraction of utilities revenue* is defined as the annual total sales of all regulated utility firms (SIC between 4900 and 4999) in a country as a percentage of total sales of all listed firms.

Next, we build a country-year measure on whether a country’s central bank has an accommodating monetary policy (Acharya et al., 2019; Banerjee & Hofmann, 2018; Jafarov & Minnella, 2023). We obtain monthly observations of central banks’ discount rates and Treasury bill rates from Global Financial Data and Datastream. We use the discount rate for a country if its history goes back to the beginning of our sample period; otherwise, we use the Treasury bill rate. Because rates across countries have large variations and are highly skewed, we define an indicator variable, *Low interest rate*, that takes the value of 1 if a country’s central bank rate in a given year is below the sample median.

We also construct an indicator variable on whether the prime rate in a country is below the sample median, *Low*

⁵ Broadening the sample to roughly 200 World Bank-tracked economies and maintaining observations from nations with at least 30 years of data and 50 yearly observations yields 37 economies. Untabulated statistics show that these 37 economies’ zombie fraction trend closely matches our sample’s top 20 economies.

⁶ We do not refer to small firms by their market capitalization because the size of small-cap firms, as conventionally defined by popular indices such as the Russell 2000 Small-Cap Index, can be quite substantial in a global context. For example, the average (median) market capitalization of constituents in Russell 2000 is approximately \$2 billion (\$600 million).

⁷ Adalet McGowan et al. (2017, 2018) require a firm to be at least 10 years old to be qualified as a zombie because young firms are likely to be misclassified as zombies based on interest coverage ratio. We also collected firm founding years from Compustat for U.S. firms and Worldscope for international ones. When this information was unavailable, we used Capital IQ, FactSet, and SDC’s new issuance data. Using this method, we obtained founding years for 94.4% of our sample firms. Based on their founding year, the median firm age is 30 years, with 86% having been around for over a decade. In untabulated results, the coefficients for the *Fraction of young firms* variable becomes statistically insignificant, showing that ‘young firms’ – those under 10 years old since incorporation – do not significantly affect the proportion of ‘zombie firms’ in our baseline regression models.



Table 1 Summary statistics of country-year observations

	Obs.	Mean	Std.	P25	P50	P75
(1) Zombie (IC)	548	16.34%	10.38%	8.73%	14.84%	20.87%
(2) Zombie (IC & Z)	548	5.05%	5.22%	1.19%	3.61%	6.89%
(3) Zombie (IC & Z')	548	5.09%	5.57%	1.15%	3.70%	7.04%
(4) GDP growth	548	2.605	3.528	1.150	2.500	4.350
(5) Stock index returns	548	0.140	0.424	- 0.035	0.116	0.243
(6) Sovereign rating (investment grade)	548	0.852	0.355	1	1	1
(7) Fraction of small firms	548	27.406	19.207	12.234	22.883	37.693
(8) Fraction of young firms	548	51.586	21.748	34.531	47.795	61.917
(9) Fraction of manufacturing revenue	548	46.711	16.874	34.096	48.300	56.128
(10) Fraction of utility revenue	548	92.606	7.685	88.742	95.185	97.421
(11) Low interest rate	548	0.515	0.500	0	1	1
(12) Low lending rate	548	0.522	0.500	0	1	1
(13) Common law	548	0.381	0.486	0	0	1
(14) French law	548	0.516	0.500	0	1	1
(15) German law	548	0.102	0.303	0	0	0
(16) IMF Debt Balance/GDP	508	75.145	34.439	54.098	71.891	97.408
(17) Bond issuance/GDP	545	9.702	13.372	1.999	5.042	12.202
(18) HY bond issuance/GDP	545	0.428	0.710	0.007	0.140	0.503
(19) Loan issuance/GDP	494	5.318	4.868	1.438	3.874	7.856
(20) Leverage loan issuance/GDP	494	0.846	1.500	0.000	0.048	1.233
(21) Creditors' rights (LLSV)	493	1.915	1.259	1	2	3
(22) Creditors' rights (DMS)	548	1.953	1.069	1	2	3
(23) Contract enforcement time (DLLS)	548	5.439	0.825	5.056	5.521	5.886
(24) Contract enforcement time (DHMS)	526	0.986	0.452	0.652	0.916	1.311

This table reports mean, median, standard deviation, and 25th and 75th percentile values of country-year observations. Our sample includes all publicly traded firms with nonmissing 3-year moving average of EBITDA interest coverage, Z-score, and Z'-score from 1990 to 2021 in 20 countries that have the largest nominal GDP at the end of 2019

lending rate. This variable serves as a proxy for the general corporate lending rate in a country. Pinning down prime rates in countries outside the United States and Canada is not straightforward. Among different sources, the World Bank's lending rates offer the closest approximations to prime rates for many countries. The caveats are that these rates supplied by different nations may have cross-sectional inconsistencies due to the creditworthiness of borrowers and consolidating approaches. Furthermore, the rates are not available for a number of countries. For those missing values, we use the conceptually closest interest rate items from IMF and OECD. Finally, we follow Djankov et al. (2008) to identify the legal origins (i.e., Common Law, French, or German) of our sample countries to control for disparities in the litigation environments between nations. The summary statistics of the country-level measures are presented in Table 1. For brevity, detailed definitions of the variables are presented in Online Appendix Table 1.

An overview of zombie companies around the world

In this section, we investigate the temporal evolution in the proportion of zombie firms among public companies across 20 economies. We then analyze the impact of the COVID-19 pandemic on zombie firm prevalence and assess the role of firm size in shaping cross-country differences in zombie firm ratios.

Figure 1 presents the average annual percentage of zombie firms in the population of public firms of the 20 largest economies. The figure shows that the fraction of zombie firms around the world was under 2% in the early and mid-1990s, before surging to a transitory high of 6.8% in 2003. The fraction was then halved between 2003 and 2007, just before the 2008–2009 financial crisis. Following the crisis, a rising trend of global zombieism emerged, with the zombie firm ratio reaching 7% in 2017 and slightly surpassing this level in 2020. The global zombie ratio decreased by about 1% point from 2020 to 2021. In comparison, Banerjee and Hofmann (2022) define zombie firms using different



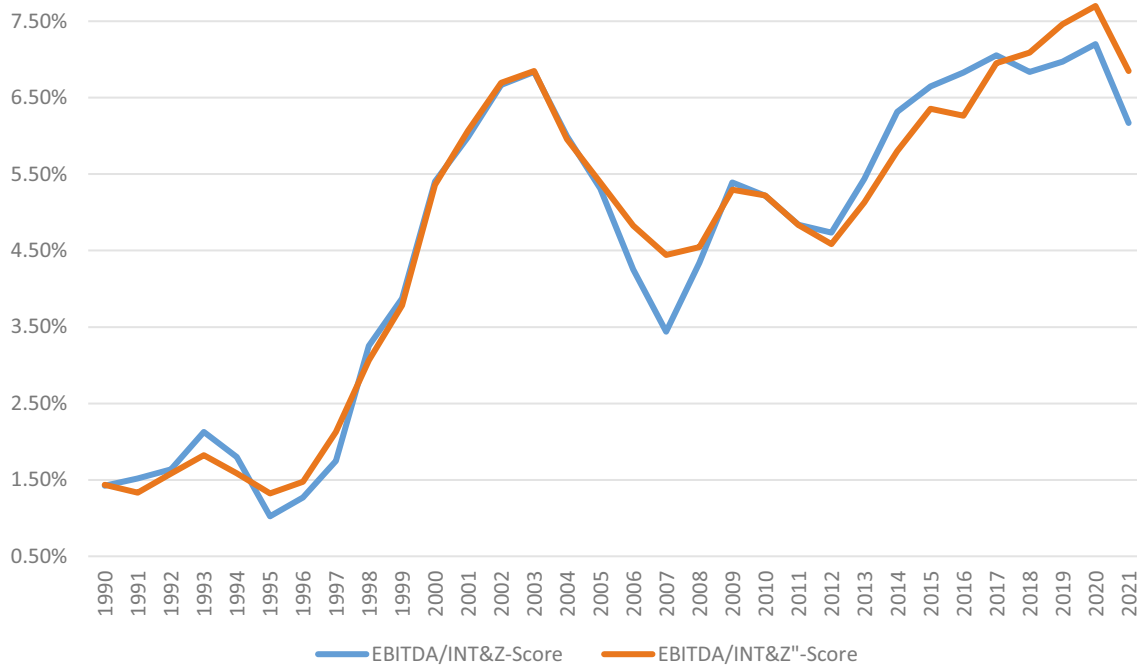


Fig. 1 Fraction of listed zombie firms of the 20 largest economies. The figure shows the average fraction of zombie firms of the 20 largest GDP countries in the world from 1990 to 2021. A zombie firm is

defined as a firm with a 3-year moving average interest coverage ratio that is less than 1 and has either a 3-year average Z-score or Z''-score that is less than 0

methods and observe a similar trend across 14 OECD countries. However, their average zombie share at the end of their 2017 sample is 15%, more than double our finding of 6.5%.

The recent COVID-19 pandemic and its impact on global economies present an interesting setting to assess the effect of economic downturns on zombie creation (Caballero et al., 2008; Hoshi et al., 2023). However, various intriguing phenomena in 2020 also make assessing the pandemic's impact on zombieism challenging. On the one hand, firms experienced significant profit and cash flow declines during 2020, resulting in reduced interest coverage ratios for many firms. On the other hand, due to the central banks' accommodating monetary policies and fiscal stimuli in many countries, the financial markets performed well, directly improving the Z-scores of firms in several countries. Moreover, government support for small and medium-sized firms, such as moratoriums on interest payments, likely improved their interest coverage ratios. For these reasons, marginal firms that may have failed under normal conditions continued to survive, resulting in an increase in zombie populations during the pandemic. Interestingly, Fig. 1 shows that the zombie ratios of our sample of large countries did not change significantly from 2019 to 2020.

Figure 2 compares zombie ratios of the top 20 global economies when zombies are determined using a single filter: 3-year moving average of the interest coverage ratio less than 1, Z-score less than 0, or Z''-score less than 0, and our

dual filters. When using the interest coverage ratio as the only filter, the average zombie firm fraction is about 20%, nearly triple the figure of our dual-filter approach. Although relying solely on Z-scores or Z''-scores tracked zombie firm fractions closely to the double-filter results of the 1990s, a 2% divergence has emerged post-2000. As of 2020, the global fraction of zombie firms determined through the Z-score and interest coverage ratio combination stands at 7.2%, whereas using the Z-score alone results in a figure of 9.4%. Figure 2 underscores the differences and effectiveness of employing both filters for a more accurate assessment of zombie firms.⁸

Smaller firms are more likely than large firms to get subsidies from governments and their cooperating financial institutions for social, cultural, and economic reasons. Banks may have a "too small to fail" strategy, resulting in fewer bank write-offs (Peek & Rosengren, 2005). There may also be government incentives for banks to subsidize small firms through lower-than-market interest rates, among other conditions (Acharya et al., 2019). This was undoubtedly the situation during the COVID-19 pandemic in many countries.

⁸ The online appendix shows the global zombie ratio without newly listed firms. Figure 1 reveals that new IPOs do not affect the average zombie ratio over time, except in the early 2000s. After excluding firms under 5 or 10 years old, most results are qualitatively similar to the primary analyses of this study. The online Appendix also shows zombie firm fractions in individual economies.

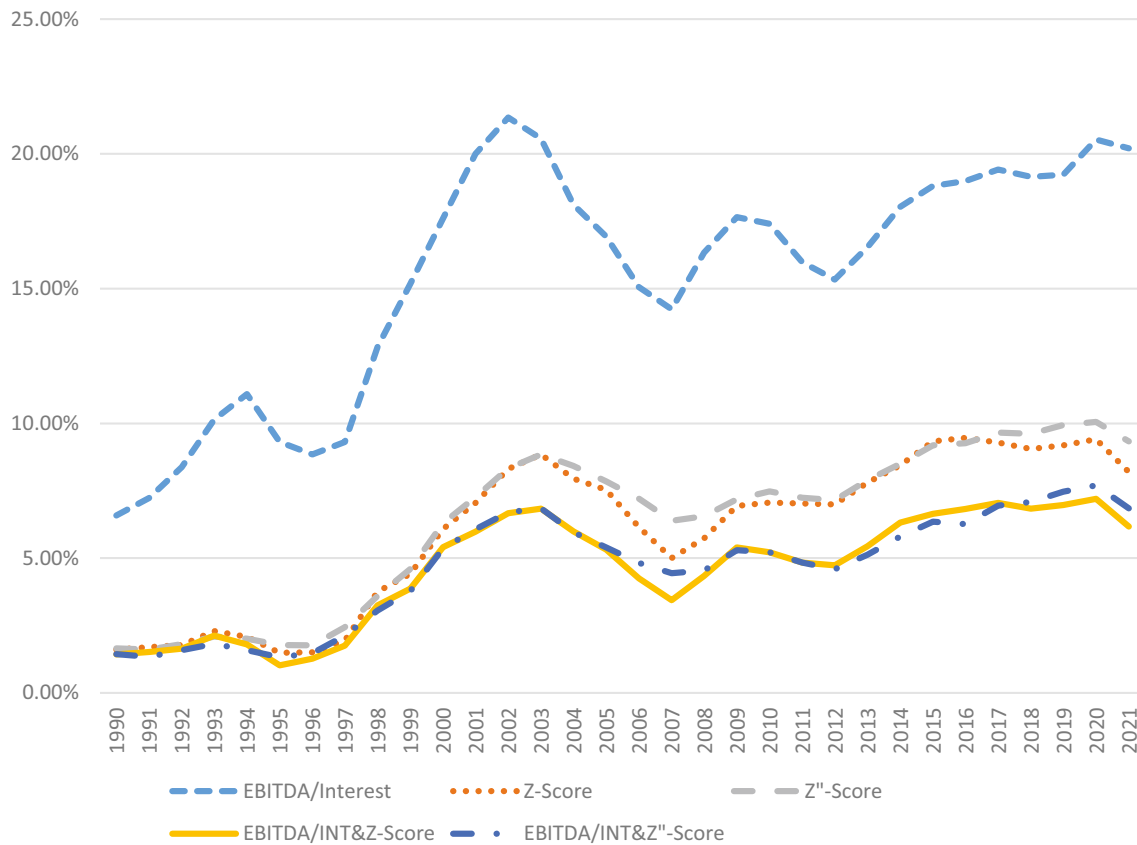


Fig. 2 Fraction of listed zombie firms based on five different measures. Using five indicators, the chart illustrates the average fraction of publicly traded zombie firms in the 20 largest GDP countries from 1990 to 2021. The solid yellow line shows the fraction of zombie firms with a 3-year moving average interest coverage ratio of less than 1 and a Z-score less than 0. The blue dash-dot line shows the fraction of zombie firms having a 3-year moving average interest cov-

erage ratio of less than 1 and a Z'' -score less than 0. The *blue dashed line* shows the fraction of zombie firms having a 3-year moving average interest coverage ratio below 1. The *orange dotted line* shows the fraction of zombie firms with a 3-year moving average Z-score below 0. The *gray dashed line* shows the fraction of zombie firms with a 3-year moving average Z'' score below 0

Therefore, it is important to examine the zombieism phenomenon in our sample of countries by firm size to shed light on the cross-country variations.

Table 2 presents the fraction of zombie firms by firm size in 2019. We use 2019 instead of 2020, since the latter year may, or may not, be an aberration due to the pandemic. We focus on zombie firms based on the 3-year moving average of an interest coverage ratio less than 1 and a Z'' -score less than 0 because it is a better predictor of default by small firms than the Z-score (Altman et al., 2019). Some remarkable patterns emerge. The two countries with the highest fraction of zombie firms in their economies, Canada (31.9%) and Australia (25.2%), have the largest proportions of small firms in listed enterprises (76% for Canada and 73% for Australia, respectively).⁹ Banerjee and Hofmann (2022) also document that Canada and Australia have the highest

zombie ratios, partially attributed to the prevalence of the commodity sector in those economies. In the United States, small firms constitute a small proportion of listed firms, at only 16%. However, within this subset, there is a notably high zombie rate of 42.5%. Not surprisingly, zombies in many European countries, such as Germany, the United Kingdom, and France, concentrate in small firms. Interestingly, India, which has a relatively high proportion of small enterprises (53%), has an overall proportion of zombies (7.0–7.8%) close to the sample average. This can be related, at least in part, to the elevated incidence of failure among smaller firms in India, which contributes to a decrease in the prevalence of zombies. Furthermore, when a country has a high default/failure rate with high nonperforming loans and bonds, like India does, financially troubled firms are more likely to become delisted, resulting in fewer zombies among listed firms. China, on the other hand, has both a small percentage of listed small firms and a low zombie rate (1.8%),

⁹ After dropping smaller firms, their 2019 zombie ratios drop from 28.7% and 20.78% to roughly 4%.



Table 2 Fraction of zombie firms in individual countries by firm size in 2019

Nation	2019 GDP rank	Small–medium firms (SMEs)			Large firms			Fraction of SMEs (%)
		No. of firms	IC (%)	IC & Z'' (%)	No. of firms	IC (%)	IC & Z'' (%)	
United States	1	315	60.00	42.54	1641	9.81	3.53	16.10
China	2	369	34.42	10.84	3448	8.79	0.87	9.67
Japan	3	352	17.33	2.27	2356	1.95	0.13	13.00
Germany	4	136	39.71	13.24	315	7.30	1.27	30.16
India	5	1279	23.46	9.38	1117	9.76	4.30	53.38
United Kingdom	6	367	55.59	24.80	536	7.84	0.93	40.64
France	7	192	64.06	28.13	305	5.25	0.66	38.63
Italy	8	83	22.89	8.43	190	6.84	1.05	30.40
Brazil	9	17	64.71	52.94	128	14.84	3.13	11.72
Canada	10	1257	60.46	40.89	404	17.33	3.96	75.68
Russian Federation	11	19	42.11	10.53	126	7.14	3.17	13.10
Korea, Rep.	12	632	48.58	10.28	1422	10.48	0.70	30.77
Australia	13	969	56.86	32.92	350	13.43	4.00	73.46
Spain	14	35	31.43	11.43	89	10.11	0.00	28.23
Mexico	15	0	0.00	0.00	83	1.20	0.00	0.00
Indonesia	16	166	22.89	4.22	304	9.54	2.63	35.32
Netherlands	17	18	50.00	22.22	69	10.14	4.35	20.69
Saudi Arabia	18	25	24.00	0.00	104	7.69	0.00	19.38
Turkey	19	117	35.04	8.55	149	11.41	3.36	43.98
Switzerland	20	23	73.91	39.13	145	8.28	0.69	13.69

This table reports the fraction of zombie firms by firm size using interest coverage (IC) ratio and Z''-score model. Small firms are those with sales less than or equal to \$50 million, and large firms are those with sales more than \$50 million. Our sample includes all publicly traded firms with nonmissing 3-year moving average of EBITDA interest coverage, Z-score, and Z''-score in 2020 in 20 countries that have the largest nominal GDP at the end of 2019

partially attributed to its strict listing standards regardless of firm size.¹⁰

Zombie measure validation: Determinants and congestion effects

In this section, we present regressions on the determinants of zombie fractions using key variables identified in the previous literature as important covariates for zombieism and perform congestion regressions to further validate our zombie measures.

Determinants of Zombie fractions

To empirically examine whether the zombie problem can be explained by cross-country variations of financial market developments, we perform the following ordinary least

squares (OLS) regression specification on country-year observations:

$$\text{ZombieFraction}_{i,t} = \beta X_{i,t-1} + \text{Year FE} + \text{Law Origin FE} + \epsilon_{i,t} \quad (3)$$

$$\text{ZombieFraction}_{i,t} = \beta X_{i,t-1} + \text{Country FE} + \epsilon_{i,t} \quad (4)$$

$$\text{ZombieFraction}_{i,t} = \beta X_{i,t-1} + \text{Year FE} + \text{Country FE} + \epsilon_{i,t} \quad (5)$$

The dependent variable $\text{ZombieFraction}_{i,t}$ measures the percentage of listed firms classified as zombies in the country i at time t . $X_{i,t-1}$ represents a vector of explanatory variables discussed in the “Country-year measures” section. The three regression models differ by whether legal origin indicators, country fixed effects, and year fixed effects are included. Utilizing a diverse set of fixed effects to present the results allows us to assess whether within-country time series variations, cross-country variations, or a combination of both, predominantly influences the findings.

Table 3 presents the results. We find that the coefficients for GDP growth are negative and statistically significant at the 5% level or lower in all columns, suggesting that high

¹⁰ The online appendix shows that, whereas small firms have a considerably greater zombie share than large firms, their secular trends are similar globally. The evidence indicates that the temporal pattern in Fig. 1 is not primarily caused by the small firm sample.



economic growth leads to a lower number of listed zombie firms. Similarly, stock index returns in a country also have a strong effect on zombieism. In addition, sovereign ratings have a large effect on zombie ratios. Countries that are rated investment grade have zombie ratios that are 2–4% points lower than those rated non-investment grade, based on the estimates in both panels. These results are consistent with those of several previous studies (e.g., El Ghoul et al., 2021; Schivardi et al., 2021).

The positive and significant coefficients for the *Fraction of small firms* indicate that countries with greater numbers of small firms listed tend to have higher zombie ratios. The results are consistent with our earlier findings that small firms are more likely to be classified as zombies than large firms. Furthermore, we find that the coefficient estimates

for *Fraction of young firms* are positive but not statistically significant in all columns. The evidence suggests that young firms exhibit a heightened likelihood of being categorized as zombies compared with their mature counterparts. Table 3 also shows that the coefficient estimates for *Fraction of manufacturing revenue* are negative and statistically significant at the 1% level across all columns, although their economic effects are small. The coefficient estimates indicate a positive relationship between the fraction of zombie firms and the revenue share of utility firms in an economy. This is in line with previous research, suggesting a higher prevalence of zombie issues in sectors with governmental regulation and subsidies, but to a lesser extent in manufacturing (Hoshi, 2006).

Table 3 Determinants of the fraction of zombie firms

	IC & Z				IC & Z''			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
GDP growth	– 0.215 [0.002]	– 0.169 [0.024]	– 0.229 [0.023]	– 0.223 [0.028]	– 0.215 [0.000]	– 0.123 [0.003]	– 0.120 [0.141]	– 0.114 [0.161]
Stock index returns	– 0.824 [0.013]	– 0.654 [0.015]	– 0.556 [0.064]	– 0.514 [0.075]	– 0.557 [0.027]	– 0.357 [0.123]	– 0.290 [0.267]	– 0.261 [0.303]
Sovereign rating (investment grade)	– 3.488 [0.000]	– 3.679 [0.000]	– 3.945 [0.000]	– 4.013 [0.000]	– 2.331 [0.000]	– 3.020 [0.000]	– 3.500 [0.000]	– 3.555 [0.000]
Fraction of small firms	0.156 [0.000]	0.173 [0.000]	0.131 [0.000]	0.134 [0.000]	0.178 [0.000]	0.213 [0.000]	0.169 [0.000]	0.172 [0.000]
Fraction of young firms	0.018 [0.027]	0.006 [0.334]	0.046 [0.000]	0.045 [0.000]	0.017 [0.040]	0.006 [0.393]	0.048 [0.000]	0.047 [0.000]
Fraction of manufacturing revenue	– 0.078 [0.000]	– 0.086 [0.000]	– 0.074 [0.000]	– 0.076 [0.000]	– 0.095 [0.000]	– 0.086 [0.000]	– 0.068 [0.000]	– 0.070 [0.000]
Fraction of utility revenue	0.026 [0.115]	0.075 [0.020]	0.096 [0.008]	0.100 [0.007]	0.042 [0.016]	0.037 [0.205]	0.052 [0.140]	0.057 [0.110]
Low interest rate	0.628 [0.034]	1.778 [0.000]	0.681 [0.246]		1.204 [0.002]	1.637 [0.000]	0.500 [0.348]	
Low lending rate				0.947 [0.008]				0.888 [0.012]
French law	– 1.849 [0.000]				– 2.364 [0.000]			
German law	– 1.278 [0.001]				– 1.051 [0.016]			
Constant	5.483 [0.001]	– 0.176 [0.950]	– 2.692 [0.404]	– 3.093 [0.342]	3.186 [0.056]	1.631 [0.520]	– 0.607 [0.844]	– 1.129 [0.717]
Year FE	Yes	No	Yes	Yes	Yes	No	Yes	Yes
Country FE	No	Yes	Yes	Yes	No	Yes	Yes	Yes
N. obs.	548	548	548	548	548	548	548	548
Adj. R ²	0.629	0.685	0.705	0.706	0.680	0.760	0.775	0.776

This table reports estimates from regression models (3), (4), and (5) in the paper. The dependent variable is annual fraction of zombie firms in a country based on 3-year moving average EBITDA interest coverage less than 1 and Z-score (Z''-score) less than 0, scaled by the number of publicly traded firms. GDP growth, Stock market return, Sovereign rating (investment grade), Fraction of small firms, Fraction of young firms, Fraction of manufacturing revenue, Fraction of utility revenue, Low interest rate dummy, Low lending dummy, Year fixed effects, Country fixed effects, and Legal origin (French legal origin, and German legal origin) are included as controls



We also find that cross-country differences in the leniency of the monetary policy have an important effect on the zombie ratio. Using estimates across columns (1)–(2) and (5)–(6), we find that the low-interest environment results in zombie ratios that are 0.5–1.8% points higher. However, when controlling for year- and country-fixed effects in columns (3) and (7), the variable's statistical significance diminishes, indicating that its variations are subsumed by two fixed effects jointly. In columns (4) and (8), we replace *Low interest rate* with *Low lending rate* and get similar results. Overall, the evidence shows that a country's fraction of zombie firms is higher when its central bank adopts an accommodating monetary policy. In addition, in columns (1) and (5), the coefficients for indicators of legal origins suggest that common-law nations have a greater tolerance for zombies on average. Comparably, Banerjee and Hofmann (2022) find that the zombie ratio is higher in Anglo-Saxon countries.

In general, Table 3 shows that the economic, political, and legal characteristics identified in the prior literature are important determinants of the fraction of zombie firms in our sample. The coefficients and p values for key estimates in models with country and year fixed-effects align with expectations, except for the low interest rate. Our results also find similar adjusted R^2 when either year-fixed effects or country-fixed effects are included. Importantly, R^2 is higher when both sets of fixed effects are included. The findings indicate that the models using the aforementioned covariates have comparable impacts in explaining differences in zombie ratios accounting for country, year, and combined fixed effects. Additionally, since models with combined fixed effects demonstrate slightly better fit and stricter controls over cross-sectional and time-series variations, we will adhere to such models in subsequent analyses.

Congestion effects

Using various zombie measures, several previous studies (e.g., Acharya et al., 2019; Adalet Mc-Gowan et al., 2018; Caballero et al., 2008; Schivardi et al., 2021, 2022) show that the presence of zombie firms generates market congestion, creating a barrier to entry and limiting the expansion possibilities of healthy firms. Capital sunk in zombie firms is associated with lower investment and slower growth of non-zombie firms. Such capital misallocation impedes real economic growth. A natural question for our setting is: *Do firms designated as zombies by our metric contribute to congestion effects?*

Examining this question using our study sample is important on at least two fronts. First, if our zombie firm definition generates evidence of congestion and misallocation, the evidence will be useful to further validate our measure. Second,

the existing empirical evidence on the congestion effects of zombie firms is mixed. Our zombie metrics on congestion will add to the discussion about how well firm performance and distress risk metrics can connect zombie problems to misallocation on a global scale.

To examine whether the presence of zombie firms has spillover effects on healthy companies in their industry and country, we use the model specification proposed in prior studies:

$$Y_{i,j,s,t} = \beta_1 \text{NonZombie}_{i,j,s,t} + \beta_2 \text{NonZombie}_{i,j,s,t} \times \text{ZombieShare}_{i,j,t} + \text{Control}_{i,j,s,t-1} + \eta_i + \theta_t + \varepsilon_{i,j,s,t} \quad (6)$$

where $Y_{i,j,s,t}$ represents investment, employment growth, and sales growth of a firm s of industry j in country i and year t , or an indicator on the fraction of young firms in an industry-country-year. The firm-level measures are adopted from the studies referenced above on zombie congestion. Specifically, investment is measured by the ratio of capital expenditure at the end of a fiscal year to gross property, plant, and equipment at the beginning of the year; employment (sales) growth is measured by the differences between employment (sales) in the current year and previous year, scaled by employment (sales) in the previous year; we measure young firm formation using an indicator variable that equals 1 if a firm is less than 8 years old since incorporation, and 0 otherwise, following Banerjee and Hofmann (2022).

$\text{NonZombie}_{i,j,s,t}$ is an indicator variable equal to 1 if a firm s of industry j in country i is not classified as a zombie firm in year t , and 0 otherwise. $\text{ZombieShare}_{i,j,t}$ is the asset-weighted share of zombie firms as a fraction of all firms in industry j of country i in year t and $\text{Control}_{i,j,s,t-1}$ represents a set of firm-level control variables, including the log of total assets, returns on the assets, and firm leverage (debt/assets) at the beginning of the year (Acharya et al., 2022). We also include firm fixed effects (η) and year fixed effects (θ) to control for firm- and time-specific unobservables that may affect investments and firm growth. Our coefficient of interest is β_2 , which shows whether non-zombie firms in an industry with a higher fraction of zombie firms invest less and have lower sales growth or employment growth than non-zombie firms in industries with fewer zombie firms.

Table 4 presents the results, with Panel A measuring zombie firms using interest coverage ratio and the Z-score and Panel B measuring zombie firms using interest coverage and the Z''-score. We first find that the coefficient for $\text{NonZombie}_{i,j,s,t}$ is positive in all columns, showing that non-zombie firms have higher investments, employment growth, sales growth, and more young firm formation than zombie firms. The evidence suggests that our definition of zombie firms indeed helps identify firms of weak performance and slower growth. More importantly, the coefficient of interest, β_2 , is negative in all columns and statistically significant at



Table 4 Zombie congestion effects on non-zombie firms

	(1)	(2)	(3)	(4)
	Capital expenditures/ fixed assets	Employment growth	Sales growth	Young firm growth
<i>Panel A: Zombie firms based on interest coverage and Z-score</i>				
Non-zombie	8.700 [0.000]	5.274 [0.000]	10.228 [0.001]	0.054 [0.000]
Non-zombie × share zombies	− 0.218 [0.000]	− 0.126 [0.000]	− 0.137 [0.028]	− 0.124 [0.000]
Leverage _{<i>t</i>−1}	− 8.314 [0.000]	− 4.357 [0.008]	− 3.618 [0.035]	− 0.047 [0.000]
ROA _{<i>t</i>−1}	− 3.989 [0.001]	4.968 [0.000]	− 11.411 [0.001]	0.001 [0.894]
Asset _{<i>t</i>−1}	− 7.489 [0.000]	− 7.635 [0.000]	− 16.490 [0.000]	− 0.028 [0.000]
Firm FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
<i>N. obs.</i>	299,060	248,457	297,205	299,060
Adj. <i>R</i> ²	0.284	0.130	0.103	0.574
<i>Panel B: Zombie firms based on interest coverage and Z''-score</i>				
Non-zombie	6.569 [0.000]	4.962 [0.000]	4.651 [0.069]	0.047 [0.000]
Non-zombie × share zombies	− 0.164 [0.002]	− 0.080 [0.052]	− 0.147 [0.145]	− 0.065 [0.059]
Leverage _{<i>t</i>−1}	− 8.926 [0.000]	− 4.464 [0.007]	− 4.995 [0.009]	− 0.050 [0.000]
ROA _{<i>t</i>−1}	− 3.826 [0.002]	4.859 [0.000]	− 10.831 [0.002]	0.001 [0.869]
Asset _{<i>t</i>−1}	− 7.505 [0.000]	− 7.681 [0.000]	− 16.369 [0.000]	− 0.028 [0.000]
Firm FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
<i>N. obs.</i>	299,060	248,457	297,205	299,060
Adj. <i>R</i> ²	0.283	0.130	0.102	0.574

This table presents the congestion effects of zombie firms on non-zombie firms using regression model (6) in the paper. All specifications include firm-year fixed effects. Standard errors are clustered at the year levels

the 5% level or better in five of the eight regressions. The results show that based on our measure, zombie firms give rise to significant congestion effects. In terms of economic magnitude, as illustrated in column (1) of Panel A, a 1% point increase in the proportion of zombie firms within an industry of a country results in a 1.5% decline in the investment activities of non-zombie firms relative to the mean investment. In a parallel manner, columns (2) and (3) of Panel A show that a 1% point increase in the zombie share of an industry in a country leads non-zombie firms to a

reduction of employment growth by 2.5% and a reduction of sales growth by 1.0% compared to their respective means.¹¹

The evidence in Table 4 indicates that zombie firms, as defined by our dual-filter measure, are not only less productive, but also contribute to congestion and misallocation in the top 20 global economies.

¹¹ The unconditional means of investment ratio, employment growth, and sales growth are 14.56, 5.06, and 15.35%, respectively.



The effects of corporate debt market development

The corporate debt market, including the high-yield bond market, has experienced tremendous growth around the world since 1990. The fast growth can be attributed to a few factors. First, unconventional monetary policies present a low-cost environment for companies to raise financing in the public bond market, which significantly increased the supply of corporate debt.¹² Second, the low-interest-rate environment encourages institutional investors, such as pension funds and insurance companies, to take on high-yield investments to meet future obligations. Corporate debt instruments, especially high-yield bonds, increasingly appeal to asset managers as a means to enhance expected returns, resulting in heightened institutional demand. Finally, a wave of bankruptcy restructuring reforms culminated in an accelerated proliferation of European high-yield bond markets following the global financial crisis of 2008 (Becker & Josephson, 2016).

Although investors in the bond market are arm's-length creditors who are not incentivized to "subsidize" zombie firms in a way that relationship lenders do, they are willing to lend to distressed firms, zombie or non-zombie firms, at an attractive yield. Without development of the high-yield debt markets, risky borrowers have no choice but to seek financing from traditional financial institutions (i.e., the corporate financing model in many countries from the 1970s to the 1990s). It is worth noting that our study uses a broader definition of zombie firms than those simply engaged in zombie lending. This distinction is particularly pertinent to listed firms, many of which are rated and can tap into corporate bond markets. Importantly, as a new breed of specialized investors in distressed companies became active players in the distressed debt financing market and corporate restructuring since the 1990s (Dou et al., 2023; Eckbo et al., 2023; Hotchkiss & Mooradian, 1997; Jiang et al., 2012), distressed firms are able to tap into the debt markets for financing and receive forbearance when needed. In fact, Carreira et al. (2022) point out that forbearance lending does not necessarily come only from banks but also from other types of creditors. Skillful distressed investors often provide help to troubled companies for their restructuring of assets and financial liabilities. We posit that the tremendous growth of the high-yield markets and the yield-seeking institutions contribute to an accommodating environment for the survival of zombie firms.

Before investigating the effects of the development of corporate bond market on the growth of zombie firms globally, we present two stylized facts on zombie firms' financing in the bond market.

Stylized fact 1: Many globally rated firms are zombie firms To provide some direct evidence on zombie companies accessing corporate debt markets, we retrieve historical S&P global issuer credit ratings from S&P RatingsXpress. In our Online Appendix, we tabulate the fraction of zombie firms worldwide by rating categories and find that that 7.3, 27.4, and 29.9% of issuers with ratings of B, CCC, and CC (or lower), respectively, are, in fact, zombie firms by our definition based on interest coverage ratio and Z-score. The statistics are comparable when we restrict the sample to US firms only. In an untabulated analysis, we also retrieve historical Moody's bond issue-specific ratings of US firms from Mergent and find similar evidence for US issuers.

Stylized fact 2: Zombie firms access corporate bond markets for financing We obtain debt structure records from Capital IQ to measure the extent to which a firm raises financing in the bond market. We also compile annual global bond issuance using the SDC database to measure bond market activity. Because the data source consists of S&P and Moody's ratings at issuance, we are able to differentiate between high-yield bonds and investment-grade (including nonrated) bonds. We first present the fraction of zombie firms with nonzero bonds on their balance sheets in the subsample of firms that have Capital IQ coverage (in lines) against annual bond issuance (in bars) in Panel A of Fig. 3. The figure shows that as bond issuance increased significantly after the 2008–2009 financial crisis, the fraction of zombie firms that used bond financing doubled during the same time period.¹³ Panel B of Fig. 3 focuses on the zombie subsample. The two solid lines show the number of zombie firms that ever switched to the bond market to obtain financing as a percentage of total number of zombie firms increases over time. We find that the bond market is a crucial venue for zombie firms to secure the necessary funding for their survival. By the end of our sample, approximately 40% of zombie firms accessed the bond market in our sample period.

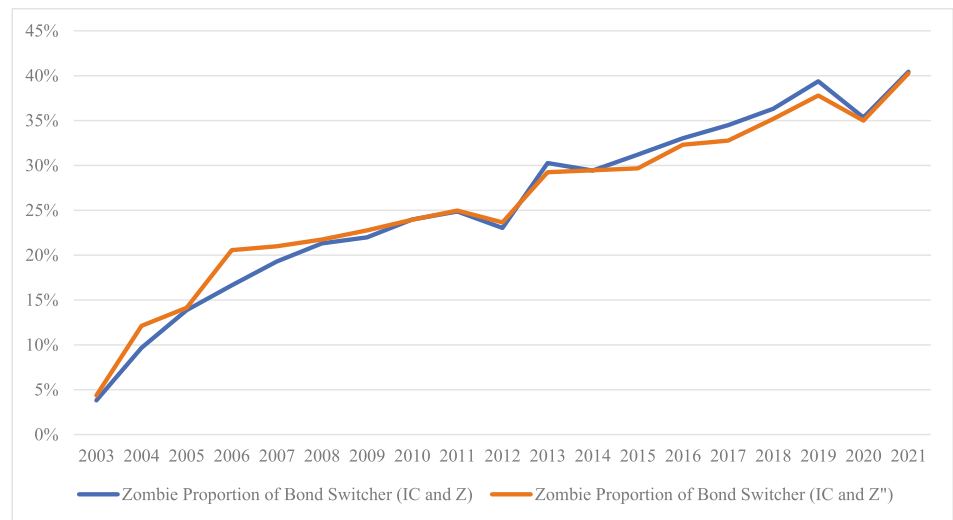
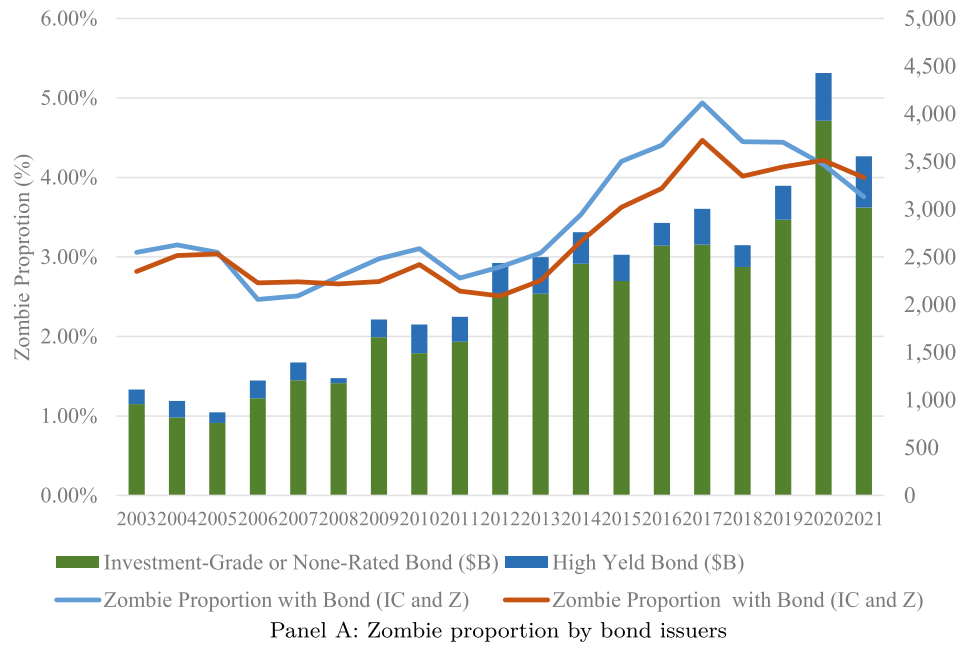
To empirically examine whether the zombie fraction can be explained by both cross-country variations and within-country temporal variations of financial market developments, we perform the following ordinary least squares (OLS) regression specification on country-year observations:

¹² The 2008 financial crisis and prolonged economic recovery compelled central banks worldwide to keep interest rates low. In the US, high-yield corporate bond issuance rose from \$55 billion in 2008 to \$435 billion in 2020, while in Europe, it rose from \$4 billion in 2008 to almost \$120 billion in 2020, reports Bank of America.

¹³ The correlation coefficient between annual bond issuance and zombie ratio is 74% if zombie firms are defined using the interest coverage ratio and Z-score.



Fig. 3 Zombie firm bond issuers. This figure illustrates the relationship between bond market access and fractions of listed zombie firms. **A** The proportion of zombie firms that rely on bond financing (i.e., those firms with a value of Total Senior Bonds and Notes greater than 0) and the total amount of investment-grade and high-yield bond issuance over time. **B** The proportion of zombie firms that ever shifted to financing in the bond market



$$\text{ZombieFraction}_{i,t} = \beta X_{i,t-1} + \delta \text{Controls}_{i,t-1} + \text{Year FE} + \text{Country FE} + \epsilon_{i,t} \quad (7)$$

The dependent variable $\text{ZombieFraction}_{i,t}$ measures the fraction of listed firms that are classified as zombies in country i at time t . The variable of interest in the above equation, $X_{i,t-1}$, is the time-varying debt financing activity in individual countries. The coefficient β captures how debt financing activities are associated with zombie problems. $\text{Controls}_{i,t-1}$ in Eq. (7) is a set of additional explanatory variables identical to those used in Table 3. Standard errors are clustered at the year level.

To construct country-year measures on bond issuance activities, we first use the IMF database, which is consolidated from various sources, including central banks, BIS, Dealogic (a data vendor), and local banks, to obtain outstanding loans and debt securities issued by nonfinancial firms domiciled in a country. Next, we obtain individual bond issuance by all nonfinancial and nongovernmental entities of the 20 largest economies in our sample from the SDC database. We focus on corporate bonds to construct the annual issuance amount (in USD) of all bonds and only high-yield bonds. Specifically, we treat an initial bond issue as a high-yield bond if either S&P or Moody's rates it below investment grade. To measure loan issuance activities, we



Table 5 Debt market development and the fraction of zombie firms

	IC & Z					IC & Z''				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
IMF firm debt/GDP	0.023 [0.051]					0.021 [0.024]				
Bond issuance/GDP		0.033 [0.063]					0.032 [0.068]			
HY Bond issuance/GDP			0.700 [0.042]					0.652 [0.032]		
Loan issuance/GDP				0.116 [0.013]					0.067 [0.177]	
Leverage loan issuance/GDP					0.216 [0.121]					0.139 [0.245]
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N. obs.	508	545	545	494	494	508	545	545	494	494
Adj. R ²	0.734	0.707	0.708	0.717	0.715	0.803	0.777	0.777	0.782	0.781

This table reports estimates from regression model (7) in the paper. Panel A(B) reports the results with 3-year moving average EBITDA interest coverage less than 1 and Z-score (Z''-score) less than 0, scaled by the number of publicly traded firms. GDP growth, Stock market return, Sovereign rating (investment grade), Fraction of small firms, Fraction of young firms, Fraction of manufacturing revenue, Fraction of utility revenue, Low interest rate dummy, Low lending dummy, Year fixed effects, and Country fixed effects are included as controls. *p* values calculated with robust standard errors clustered by year are reported in brackets

use Refinitiv's LPC Dealscan database, which contains detailed facility-level information on syndicated loans issued in different countries and currencies.¹⁴ We obtain all loans issued by firms in the top 20 economies after 1994. We also convert each loan facility amount denominated in a local currency to US dollars. Moreover, we categorize a loan as "leveraged" if a facility belongs to the leveraged or highly leveraged segments in Dealscan.¹⁵ Next, we scale the annual bond and loan issuance measures by a country's GDP level and construct five specific measures for our variable of interest, $X_{i,t-1}$: IMF firm debt/GDP, Bond issuance/GDP, HY bond issuance/GDP, Loan issuance/GDP, and Leveraged loan issuance/GDP.

The regression results are in Table 5, with columns (1)–(5) presenting the results for zombie ratios determined by IC and Z-score and columns (6)–(10) showing the results when zombie firms are defined using IC and Z''-score. Our results show that most debt market development measures have strong explanatory power for the zombie ratios across

countries and over time. First, on the relation between total debt securities issued by nonfinancial firms in a country and the zombie ratio, column (1) shows that a one-standard-deviation increase in outstanding corporate debt as a fraction of GDP results in a 0.79% point-higher zombie ratio. Second, columns (2) and (4) show that a one-standard-deviation increase in total corporate bond issuance and total loan issuance as a fraction of GDP results in percentage point increases of 0.44 and 0.56 in the zombie ratio, respectively. Columns (3), (5), (8), and (10) present the results on the effects of high-yield bond and leveraged loan market activities on zombie ratios. Using the estimates in column (3), we find that a one-standard-deviation increase in the high-yield bond issuance as a fraction of GDP results in an almost 0.50% point-higher zombie ratio. In addition, despite concerns of collinearity, our untabulated results suggest that high-yield bond issuance is statistically and consistently more important in explaining zombie fractions after controlling total bond or loan issuances in the models. The leveraged loan market development has a similar but insignificant effect on the growth of zombies.

Overall, the results in this section show that debt market development, particularly the growth of high-yield debt markets, contributes to the growth of zombie firms.

¹⁴ Despite its limitation, DealScan has been used by many prior studies on zombie firms to measure loan issuance activities (Acharya et al., 2020; Becker & Ivashina, 2022). Indeed, the absence of comprehensive alternative loan databases positions DealScan as the primary data source in corporate loan studies.

¹⁵ Leveraged loans refer to those loans that are rated non-investment grade or those that carry spreads of 125–150 basis points over a risk-free reference rate.



Bankruptcy law Reforms

The bankruptcy code of a country lays out a formal legal framework for a distressed company to reorganize or liquidate its assets in an orderly manner under the supervision of a court. Recognizing the importance of a modern and comprehensive bankruptcy law to contracting efficiency and economic growth, many countries in our sample formalized their bankruptcy laws or made significant revisions to existing laws during the sample period. For example, Brazil enacted a new bankruptcy law similar to Chapter 11 in the United States in 2005, and China passed its modern bankruptcy code in 2007. The primary goal of the bankruptcy law reforms in many countries was to make major updates to an outdated bankruptcy code so as to improve the efficiency of the restructuring process and corporate investment and debt capacity (Cumming & Zhang, 2023; Djankov et al., 2007; Gopalan et al., 2017; John et al., 2020; Li & Pontcellini, 2021; Pontcellini & Alencar, 2016; Rodano et al., 2016; Wang, 2022). Moreover, many of these law amendments resulted in strong creditor rights in the bankruptcy process (e.g., Brazil and Spain). Table 6 lists countries that have enacted or amended their bankruptcy codes, specifying the effective years and associated studies on these institutional backgrounds.¹⁶ Additionally, we classify the reforms as having either strong creditor rights or strong debtor rights based on their inherent characteristics.

In this section, we exploit the eight bankruptcy reforms listed in Table 6 to examine whether the modernization of bankruptcy code leads to the exit of zombie firms and thus a reduction in zombie ratios, and particularly whether zombie ratios change differently after a country adopts a more creditor-friendly law versus a more debtor-friendly law. Because the bankruptcy reforms in our sample are enacted in different years, we follow prior studies to take advantage of these cross-country and temporal variations to examine the causal effect of the modernization of bankrupt law on zombieism.¹⁷ Specifically, we adopt the following difference-in-differences specification:

$$\text{ZombieFraction}_{i,t} = \gamma \text{PostReform}_{i,t} + \beta \text{Control}_{i,t-1} + \text{Year FE} + \text{Country FE} + \epsilon_{i,t} \quad (8)$$

¹⁶ We do not consider the enactment of the Bankruptcy Abuse Prevention and Consumer Protection Act (BAPCPA) in the United States in 2005 as the modernization of the bankruptcy code like in other countries.

¹⁷ A few studies exploit bankruptcy reforms and the strengthening of creditor rights in some of our sample countries to study their causal effects on firm investment, innovation, and growth (e.g., Acharya and Subramanian, 2009; Acharya et al., 2011; Favara et al., 2017). More broadly, the bankruptcy law and strengthening of creditor rights have implications for corporate investments and debt contracting (Cumming & Zhang, 2023; Cumming et al., 2020; El Ghouli et al., 2020).

where $\text{PostReform}_{i,t}$ takes on the value of 1 for all annual observations after country i reformed its bankruptcy code in year $t - 1$. We include country fixed effects to account for unobserved country-specific heterogeneity while allowing for the exploitation of within-country temporal variations. If the existence or growth of zombies is a result of an inefficient bankruptcy process, enactment of a modernized bankruptcy procedure should encourage zombie firms or their creditors to seek bankruptcy restructuring or liquidate firm assets in an orderly manner. Therefore, we expect a negative γ coefficient.

Table 7 presents the results. In column (1), we find that countries that enact major reforms to their bankruptcy codes see their zombie ratio declining by 1.4% points, regardless of how zombie firms are classified. The decline in zombie ratios has significant economic implications, considering an average zombie ratio of 5% in all countries and years sampled. Our results are consistent with those of Becker and Ivashina (2022), who suggest that the inefficient resolution of insolvency plays an important role in zombie lending in European countries.

A potential concern for our specification is that bankruptcy reforms may be a policy response to a sudden rise in zombie problems in a country and are thus endogenous to zombie ratios. To further address this concern, we investigate the time-series dynamics of zombie ratios around reforms. Specifically, we adopt the following specification:

$$\begin{aligned} \text{ZombieFraction}_{i,t} = & \gamma_1 \text{ReformYear}(-3) + \gamma_2 \text{ReformYear}(-2) + \gamma_3 \text{ReformYear}(0) \\ & + \gamma_4 \text{ReformYear}(1) + \gamma_5 \text{ReformYear}(2) + \gamma_6 \text{ReformYear}(3) \quad (9) \\ & + \gamma_7 \text{ReformYear}(4) + \beta \text{Control}_{i,t} + \text{Year FE} + \text{Country FE} + \epsilon_{i,t} \end{aligned}$$

$\text{ReformYear}(-3)$, $\text{ReformYear}(-2)$, $\text{ReformYear}(0)$, $\text{ReformYear}(1)$, $\text{ReformYear}(2)$, $\text{ReformYear}(3)$, and $\text{ReformYear}(4)$ equal 1 for more than 2 years before, 2 years before, the year of, 1 year after, 2 years after, 3 years after, and more than 3 years after reforms, respectively, and 0 otherwise. The year before the reform is the benchmark year. In this parallel trend analysis, the time-series indicators capture the annual dynamics of changes in zombie ratios around reforms relative to those without reforms.

Columns (3) and (4) of Table 7 present the results. We find a gradual decline in zombie ratios after the reforms. Zombie ratios are more than 2% points lower in reformed countries from the third year after the reform, according to estimates in column (3). The slightly delayed response in zombie reduction after the reforms is related to our use of a 3-year moving average of the measures to define zombies. More importantly, our results show that the zombie ratios in countries before the reforms are indistinguishable from those in other countries. The results of the parallel trend analysis indicate that bankruptcy reforms are unlikely to be a response of increasing zombie ratios in reformed countries.



Table 6 Country and event list of formalized/reformed bankruptcy laws since 2000

Country	Year	Bankruptcy law reforms	Friendly	References
Brazil	2005	The country formalized a new bankruptcy law similar to US Chapter 11 and Chapter 7 (Amends Federal Law 11.101). The new law changed the order in which claims are paid when a firm is liquidated, giving higher priority to secured creditors (giving secured creditors' claims priority over tax claims)	Creditor	Pontcelli and Alencar (2016) and John et al. (2020)
China	2007	The modern bankruptcy law, Enterprise Bankruptcy Law, was enacted in 2007, replacing the 1986 Bankruptcy Law and all other insolvency provisions. The new law introduced a detailed reorganization procedure that resembles Chapter 11 of the US Bankruptcy Code. and adopted several internationally recognized practices such as automatic stay on assets	Debtor	Li and Pontcelli (2021) and Hotchkiss et al. (2022)
France	2006	La Loi de Sauvegarde des Entreprises (The Business Safeguard Act) was enacted in 2006 – formalizing the bankruptcy law (facilitating debt renegotiations). To receive safeguard protection, a firm needs to prove that although it has not yet suspended debt service payments, its financial condition is such that it will be unable to make future payments. The safeguard procedure includes an automatic stay that prevents secured lenders from seizing the collateral. The debtor continues to manage the company throughout the process, similar to US Chapter 11	Debtor	Gilson et al. (2010) and Altman et al. (2019)
India	2002	The Securitization and Reconstruction of Financial Assets and Enforcement of Security Interests Act (SARFAESI) was enacted in 2002. It is a major reform to increasing creditor rights that allows them to bypass the lengthy and judicial process to seize and liquidate the assets of the defaulting firm	Creditor	Vig (2013), Gopalan et al. (2017), Gormley et al. (2018) and Altman et al. (2019)
Italy	2005	The 2005 reform introduced reorganization procedures, facilitating loan renegotiation; the 2006 reform led to substantial strengthening of creditor rights	Creditor	Rodano et al. (2016)
Japan	2009	Japan's insolvency code historically provided creditor-oriented procedures, often dominated by large <i>keiretsu</i> banks. A quasi debtor-in-possession system was introduced in 2009 under which the debtor's director or counsel is appointed as trustee. The revision aims at strengthening the provisions for firms restructured as going concerns	Debtor	Altman et al. (2019)
Spain	2004	The modern Insolvency Law (Ley Concursal) came into effect on September 1, 2004; the reform led to the strengthening of creditor rights (the DMS creditor rights index increases by 1)	Creditor	Djankov et al. (2007)
UK	2002	The Enterprise Act of 2002 was adopted based on the Insolvency Act and Insolvency Rules of 1986 and the Companies Act of 1985. It abolished administrative receivership for loans made after September 15, 2003, and substituted it with Administration, the closest to US Chapter 11. It emphasizes the survival of the debtor as a going concern	Debtor	Davydenko and Franks (2008), Gilson et al. (2010) and Altman et al. (2019)

Next, we follow previous studies to assess how reforms affect zombie firms concerning their inclination toward creditor-friendly or debtor-friendly stances, as outlined in Table 9. Creditor rights empower creditors with legal and institutional mechanisms to obtain collateral, and accelerate bankruptcy liquidation. Therefore, we expect the reduction in zombie fractions in a country that adopts a creditor-friendly law environment to be larger than that for those with a debtor-friendly procedure.

We replace $PostReform_{i,t}$ in the model (8) with two interaction terms: $PostReform_{i,t} \times Strong\ debtor\ rights$

and $PostReform_{i,t} \times Strong\ creditor\ rights$. The regression results in columns (5) and (6) of Table 7 show that the coefficients for both interaction terms are negative. However, the F -test strongly rejects the null that reformed countries experience the same changes in zombie ratios after the reforms. Countries that adopt more creditor-friendly laws see a 1.6% point-larger reduction in zombie ratios than countries that adopt debtor-friendly laws. Our results are consistent with the notion that zombie firms are possibly to be pushed into bankruptcy for restructuring/liquidation in countries with solid creditor rights. Hence,



Table 7 Bankruptcy law reforms and the fraction of zombie firms

	IC &Z (1)	IC &Z'' (2)	IC &Z (3)	IC &Z'' (4)	IC &Z (5)	IC &Z'' (6)
PostReform	- 1.459 [0.022]	- 1.437 [0.015]				
ReformYear(- 3 and before)			- 0.362 [0.740]	0.121 [0.892]		
ReformYear(- 2)			- 0.603 [0.647]	0.217 [0.838]		
ReformYear(0)			0.297 [0.877]	0.663 [0.633]		
ReformYear(+ 1)			- 0.907 [0.661]	- 0.016 [0.991]		
ReformYear(+ 2)			- 1.463 [0.331]	- 0.337 [0.796]		
ReformYear(+ 3)			- 1.726 [0.092]	- 1.216 [0.147]		
ReformYear(+ 4 and after)			- 2.270 [0.026]	- 1.917 [0.035]		
PostReform × Strong debtor rights					- 0.756 [0.158]	- 0.794 [0.101]
PostReform×Strong creditor rights					- 2.410 [0.011]	- 2.309 [0.008]
<i>p</i> value of <i>F</i> -test					0.017	0.014
Controls	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
Country FE	Y	Y	Y	Y	Y	Y
<i>N.</i> obs.	548	548	548	548	548	548
Adj. <i>R</i> ²	0.707	0.779	0.708	0.781	0.709	0.780

This table reports estimates from regression models 8 and (9) in the paper. The dependent variable is measured as the number of zombie firms, those with 3-year moving average EBITDA interest coverage less than 1 and Z-score less than 0 in columns (1), (3), and (5) or 3-year moving average EBITDA interest coverage less than 1 and Z''-score less than 0 in columns (2), (4), and (6), scaled by the number of publicly traded firms. Strong debtor (creditor) rights is an indicator variable equal to 1 if a reform is more debtor (creditor) friendly, and 0 otherwise. See Table 6 for a list of these events. GDP growth, Stock market return, Sovereign rating (investment grade), Fraction of small firms, Fraction of manufacturing revenue, Fraction of utility revenue, Low interest rate dummy, Year fixed effects, and Country fixed effects are included as controls. *p* values calculated with robust standard errors clustered by year are reported in brackets

over the post-reform period, financially troubled firms are more likely to dissolve than to persist as zombies in a creditor-friendly legal environment.

What happened to zombie firms?

In the final section of the paper, we investigate what happened to the global zombie firms. We employ a variety of data sources, including CRSP, Compustat, Datastream, Worldscope, SDC, and S&P Transaction, to classify zombie firm outcomes as the following: *Delisted*, which refers to a firm being delisted from stock exchanges; *Merger & Acquisition*, which refers to a firm

being acquired based on information obtained from the various databases; *Recovered*, which refers to a firm being no longer recognized as a zombie based on our double-filter approach and still publicly listed; and *Unknown*, which refers to a firm being no longer in the sample but for which we cannot identify a reason, likely pertaining to bankruptcies or liquidations given our data sources' extensive coverage of M&A transactions. Furthermore, for US firms, we utilize Bankruptcydata.com and



Table 8 Outcomes of zombie firms

			N (%)	Number of years to outcome						
				Mean	StdDev	P10	P25	Median	P75	P90
<i>Panel A: Zombie firms based on interest coverage and Z-score</i>										
US	Bankruptcy		504 (15.26%)	4.71	4.8	1	1	3	6	11
	Delisted		1397 (42.31%)	3.75	4.06	1	1	2	5	8
	Merger and acquisition		1036 (31.37%)	5.51	5.53	1	1	3	8	14
	Recovered		365 (11.05%)	3.94	3.81	1	1	3	5	9
	All		3302 (100.00%)	4.47	4.72	1	1	3	6	11
Non-US	Delisted		1945 (34.68%)	6.38	4.59	2	3	5	9	13
	Merger and acquisition		647 (11.54%)	3.09	3.7	0	1	1	5	8
	Recovered		1970 (35.13%)	3.79	2.99	1	2	3	5	8
	Unknown		1046 (18.65%)	3.35	3.57	0	1	2	5	8
	All		5608 (100.00%)	4.52	4.03	1	1	3	6	10
<i>Panel B: Zombie firms based on interest coverage and Z''-score</i>										
US	Bankruptcy		546 (14.15%)	5.18	5.2	1	1	3	7	12
	Delisted		1714 (44.43%)	4.12	4.5	1	1	3	5	9
	Merger and acquisition		1230 (31.88%)	5.9	5.88	1	1	4	9	15
	Recovered		368 (9.54%)	4.76	4.25	1	2	3	6	11
	All		3858 (100.00%)	4.9	5.11	1	1	3	7	12
Non-US	Delisted		1938 (35.22%)	6.71	4.72	2	3	6	10	13
	Merger and acquisition		697 (12.67%)	3.22	3.72	0	1	1	5	9
	Recovered		1799 (32.69%)	4.08	3.23	1	2	3	5	8
	Unknown		1069 (19.43%)	3.65	3.99	0	1	2	5	9
	All		5503 (100.00%)	4.81	4.25	1	2	3	7	11

This table displays the outcomes of zombie firms, categorized as bankruptcy (Chapter 11 or Chapter 7 filings in the United States), delisted, merger and acquisition, recovered, and unknown. The table also reports the average years between when a company became a zombie firm and when it reached 1 of the outcomes. For each zombie measure, we present statistics for the US firms and all firms separately. We rely on Bankruptcydata.com, CRSP, Compustat, Worldscope, SDC, and S&P Transaction databases to determine zombie firm outcomes. We consider a company to have recovered from zombie status if it is no longer identified as a zombie by interest coverage and Z-score or Z''-score

S&P Transaction to determine whether a firm filed for either Chapter 11 or Chapter 7 bankruptcy.¹⁸

Among the 8910 zombie firms as determined by interest coverage ratio and Z-score, our sample contains 3302 US and 5608 non-US zombie instances. Table 8 shows that among those US zombie firms, 15.3% filed for bankruptcy and 42.3% were delisted. That is, a total of 58% of US zombie firms eventually “died.” It takes an average (median) of 4.7 (3.7) years from the time a firm is initially recognized as a zombie to the bankruptcy (delisting) date. The distribution is quite skewed, as at the 90th percentile, the number of years it takes a zombie firm to restructure is as high as 11 years. About 31.4% of zombie firms are acquired in the United States. It takes on average 4 years for 11.1% of zombie firms to be out of zombie status (i.e., recovered). For non-US zombie firms, delisting takes longer, an average of 6.4 years. Approximately 53% of zombie firms experience

delisting (35%) or have unknown outcomes (18%), a statistic mirroring the pattern observed in US firms that ceased operations. Only a minority (11.5%) of these firms are subjects of acquisition, with M&A typically transpiring within an average of 3.1 years. Furthermore, non-US firms demonstrate a higher likelihood of recovering from zombie status, with a 35% recovery rate compared to 11% in their US counterparts. Statistics on the outcomes of zombie firms based on the interest coverage ratio and Z''-score are similar to those of zombie firms based on Z-score. Overall, our results suggest that only a quarter of zombie firms are able to recover from their zombie status. A zombie can stay alive on average for 5 years before being restructured, delisted, or acquired.

In the final set of tests, we explore the effect of bankruptcy law reforms on zombie outcomes. Specifically, we exploit the staggered bankruptcy reforms presented in Sect. 7 to examine whether the number of years a firm stays in the zombie stage and the change in outcomes of zombie firms after reforms take place in those countries. Table 9 presents the difference-in-differences analysis using the sample

¹⁸ We do not have access to a database that provides comprehensive coverage of non-US bankruptcies.



of zombie firms. Columns (1) and (2) present the results using a staggered regression that is similar to columns (1) and (2) of Table 6, while columns (3) and (4) present stacked difference-in-differences regressions for the zombie firms in each of the eight reformed countries and matched countries based on country-level economic and geopolitical characteristics. In both models, we control for year, industry, and country fixed effects. The variable of interest is the interaction of *Treat* and *Post*, where *Treat* is an indicator taking the value of 1 if the country of a zombie firm reforms its bankruptcy code and *Post* is an indicator taking the value of 1 for years after the reform, similar to those in Eq. (8).

The dependent variable across four columns in Panel A is the number of years a zombie firm reaches one of the outcomes listed in Table 8. We find that bankruptcy reforms shorten the time that a firm remains in zombie status by approximately a year, representing a 25% reduction based on the unconditional mean of 4.5 years. These findings are consistent with our country-level analysis in Section on Bankruptcy Law Reforms, which shows that bankruptcy law reforms result in a reduction in the zombie ratio in those countries.¹⁹ The dependent variable across four columns in Panel B is an indicator variable *Death* that takes the value of 1 if a firm files for bankruptcy (for US firms only because of data availability), is delisted, or has unknown outcomes, and 0 if it is acquired.²⁰ Panel B shows that bankruptcy reforms increased the probability of zombie firms' death rate by 7–14%, which translates to a 9–19% increase over the unconditional mean of 74%. Our results in Panel B of Table 9, combined with those in Table 7, show that the reduction in zombie ratio after bankruptcy reforms is the result of an increased death rate of zombie firms.

Conclusion

Zombie firms in various countries have received heightened scrutiny and attention from both academics and practitioners. However, there is significant debate on the effective measurement of global zombie firms. Unlike studies employing traditional definitions of zombie firms through zombie lending or operational/pricing metrics, our research introduces a novel measure combining the interest coverage ratio with an empirically validated default

¹⁹ A valid explanation is that the reduction in time in a firm's zombie status is likely due to bankruptcy restructurings or liquidations. The caveats are that due to data limitations on bankruptcy filings outside of the United States, we are not able to provide empirical evidence to directly support the explanation.

²⁰ Acknowledging potential type 1 errors in our classification of global zombie firms (i.e., a non-zombie firm identified as a zombie firm) and other noise presented in our outcome analysis, we exclude the "recovered" subsample from regressions to focus solely on terminating cases.

Table 9 Bankruptcy law reforms on zombie status

	Staggered		Stacked	
	IC & Z	IC & Z''	IC & Z	IC & Z''
	(1)	(2)	(3)	(4)
<i>Panel A: Zombie duration</i>				
Treat × Post	− 0.901 [0.050]	− 0.928 [0.046]	− 1.155 [0.020]	− 1.137 [0.031]
Post			0.507 [0.112]	0.578 [0.154]
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes
N. obs.	8910	9362	8345	8860
Adj. R^2	0.135	0.146	0.132	0.143
<i>Panel B: Death</i>				
Treat × Post	0.068 [0.129]	0.127 [0.008]	0.089 [0.082]	0.143 [0.009]
Post			− 0.068 [0.170]	− 0.068 [0.176]
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes
N. obs.	6573	7194	6276	6925
Adj. R^2	0.081	0.076	0.080	0.075

This table reports regression results from difference-in-differences models that examine the effect of bankruptcy law reform on zombie outcomes as follows:

$$\text{Outcome}_i = \text{Treat}_{i,c} \times \text{Post}_{i,c} + \text{Post}_{i,c} + FE + \epsilon_{i,c},$$

where Outcome_i is Duration_i or Death_i . Duration_i denotes the number of years from when a firm first becomes a zombie to the year in which it is no longer categorized as a zombie in our sample. The status for a zombie firm includes bankruptcy, delisted, M&A, recovered, and unknown. We consider a company to have recovered from zombie status if it is no longer identified as a zombie based on our double-filtering method. *Death* is a dummy variable equal to 1 if a firm is terminated for a reason other than M&A, and 0 otherwise. *Treat* is a binary variable that equals 1 if the country c experienced a bankruptcy reform over our sample period and 0 otherwise; *Post* is a binary variable that equals 1 for the years of and after the bankruptcy reform. Staggered regressions presented in columns (1) and (2) are similar to those in columns (1) and (2) in Table 7. For stacked models, we manually match each of the eight reformed countries with one of the remaining 12 countries based on economic and geopolitical characteristics. *N. obs.* is the number of zombie firms. *Adj. R^2* is the adjusted R^2 . *p* values calculated with robust standard errors clustered by industry-year are reported in brackets. *t*-statistics reported in parentheses are computed based on adjusted standard errors clustered at the industry-year level

*, **, and *** denote significance at the 10, 5, and 1% levels, respectively

predictor. We document that the average proportion of publicly traded zombie firms in the world's 20 largest economies has increased significantly over the past three decades, going from 1.5% in 1990 to above 7% in 2020.



Despite substantial cross-country variations, the proportion remained stable throughout the 2020 COVID-19 pandemic.

Our multivariate analysis shows that the key economic measures suggested by prior studies have robust explanatory power in predicting the fraction of zombie firms globally. Zombie firms by our measure contribute to significant congestion in the top 20 economies. We also find that the growth of corporate bond markets, especially the high-yield bond markets, contributes to global zombieism. Moreover, exploiting bankruptcy reforms in eight countries in our sample after 2000, we find that the zombie ratio fell substantially in countries that reformed their bankruptcy law, especially those that strengthened creditor rights. We also find that bankruptcy reforms shorten the time that a firm remains in zombie status by 25% and elevate the likelihood of zombie firms' termination through bankruptcy or exchange delisting. Overall, our methodology and cross-country findings have significant implications for policymakers, particularly in nations striving to balance national economic growth with the needs of businesses and people in the workforce.

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