Global Zombies[*]

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Abstract

We propose a two-step filtering process using interest coverage ratio and default prediction models to measure the extent of "zombieism" globally: a phenomenon that describes the existence of companies that are insolvent but continue to survive due to unusual market conditions and the support of financial institutions and government. We find that the average share of publicly traded zombie firms in the world's 20 largest economies increased significantly in the past 30 years, at above 7% at the end of 2020. We also find that financial market development, creditor rights, and debt enforcement efficiency help explain cross-country variations in zombie ratios. Using staggered bankruptcy reforms in eight countries after 2000 as an exogenous variation to the modernization of bankruptcy law, we find that the zombie ratio declines by 1.3 percentage points after the reforms in those countries. Reforms strengthening creditor rights lead to a larger reduction.

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1 Introduction

The global economic challenges exacerbated by the COVID-19 pandemic have increased concern about the zombie firm phenomenon among government policymakers, bank regulators, quasi-governmental organizations, scholarly discussions, and recently, the media.[1] Even bankruptcy judges expressed similar concerns.[2] These "walking-dead" companies, which have become insolvent by some definitions and would cease operations under normal circumstances, continue to operate owing to factors such as government support or financial institutional aid. In addition, the explosive growth of corporate debt in the United States and other countries, combined with historically low interest rates, has possibly resulted in an increasing number of zombie firms globally.

Prior studies show that the presence of zombie firms distorts credit allocation and impedes real economic growth. Subsidized credit to zombie firms has real effects on corporate investment, employment, productivity, profits, and price deflation.[3] The existing discussion and empirical evidence center on the creation of zombies in a specific country or through a particular economic channel, such as banks' easy credit and government support. None of the prior studies measure the extent and institutional/market determinants of such entities across a broad spectrum of countries over a long period, nor the reasons for cross-country differences. To bridge this gap, our study aims to quantify the extent of zombieism with global implications. Specifically, our study focuses on two critical aspects of the zombie problem: (1) how to properly quantify the amount and significance of zombie firms across

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[1] See "The Corporate Undead: What to Do About Zombie Firms," *The Economist*, September 29, 2020; "America's Zombie Companies Rack up $2 Trillion of Debt," *Bloomberg*, November 17, 2020; "Zombie Firms: The Dangers of the Walking Dead," Group of Thirty, "Reviving and Restructuring the Corporate Sector Post-Covid," December 1, 2020; "Zombies Threaten European Bank Recovery," January 13, 2021, *Wall Street Journal*; and "For Europe, Sizable Decline in Bankruptcies Could Bode Ill," *New York Times*, January 25, 2021.

[2] For example, during a recent lecture at NYU's Stern School of Business, Judge Robert Drain, a bankruptcy judge at the Southern District of New York, White Plans Division, recalled that at a number of meetings with bankruptcy judges, academics and ministry officials in China in 2015, the subject of zombie firms often came up as to their relevance to the health of the economy.

[3] See Caballero, Hoshi, and Kashyap (2009); Lam, Schipke, Tan, and Tan (2017); Acharya, Crosignani, Eisert, and Eufinger (2020); Acharya, Eisert, Eufinger, and Hirsch (2019), and Acharya, Lenzu, and Wang (2021), for example.

the major world economies, and (2) what economic forces and legal institutions contribute to the extent of zombieism.

For this study, we compile a comprehensive data sample that encompasses all publicly traded nonfinancial firms from 1990 to 2020 in the World Bank's top 20 economies by GDP at the beginning of 2020. Financial data on individual firms are retrieved from Compustat/CRSP for US-based firms and Worldscope/Datastream for non-US-based firms. Our sample consists of 431,093 firm-year observations.

We adopt a two-step filtering process to identify zombie firms in these countries over time. First, we calculate the interest coverage ratio (i.e., EBITDA to interest payment) for each firm in a year. Because it is not uncommon for some firms to continue to operate for several years after their earnings or cash flows fall below the interest expense (i.e., interest coverage ratio less than one), the interest coverage ratio test alone is "aggressive" in identifying zombie firms. A low-interest coverage ratio can be associated with temporary shocks to sales and earnings and a short-term increase in total interest payments, which may not be severe enough to cause a firm to default. Therefore, we adopt a second filter using the Z-score model developed by Altman (1968) and a modified version, the Z"-score model, developed for international and privately owned firms (Altman et al., 1995), both of which account for firms' accounting health, such as profitability, insolvency, and liquidity. To smooth out short-run fluctuations, a firm is treated as a zombie if its three-year moving average interest coverage ratio is less than one *and* either the three-year moving average Z-score or Z"-score is below zero.

Using this double-filtering procedure, we find that the average number of zombie firms as a percentage of listed firms in the world's 20 largest economies increased significantly from 1990 to 2020, up from just under 1.5% in 1990 to 6.8% in 2003, a transitory high. The percentage was then halved between 2003 and 2007 (immediately before the 2008–2009 financial crisis) but returned to above 7.0% in 2020. Interestingly, the zombie ratio barely changed from the year before the COVID-19 pandemic started (2019) to one year later. This finding is attributed to the presence of two opposing forces during the pandemic period. On the one hand, numerous large businesses declared bankruptcy following a severe economic downturn.

In the United States, for example, a record number of large companies filed for bankruptcy in 2020 (Altman, 2021). On the other hand, the unprecedented central bank intervention in financial markets and government support such as moratorium on interest payments for financially distressed companies, particularly small and medium-sized businesses, helped to defer corporate bankruptcy worldwide.

We find considerable cross-country variations in the share of zombie firms. Importantly, there is a clear monotonic upward trend in the fraction of zombie firms in the United States in recent decades, but it has trended down in countries like China, Japan, and Germany. Overall, among the 20 countries in our sample, Canada, Australia, and France have the highest fraction of zombie firms, while Japan, Saudi Arabia, and Mexico have the lowest fraction in 2020. We also find that smaller enterprises (those with sales below $50 million) have a much greater likelihood of being zombie firms. The firm size effect perhaps reflects banks' "too small to fail" strategy, which results in lower bank write-offs, especially during stressed economic periods. There are also government incentives for banks to subsidize small firms (Acharya et al., 2020), which was observed during the COVID-19 pandemic in many countries.

The second part of this study explores the determinants of cross-country differences in the extent of zombieism using multivariate regressions. First, we investigate whether financial market developments contribute to a rise of zombie firms globally. In the past two decades, corporate debt instruments, especially high-yield bonds and leveraged loans, experienced a tremendous growth worldwide. The growth is partly attributed to institutional investors such as pension funds and insurance companies taking on high-yield investments to meet future obligations in a low-interest-rate environment. The tremendous growth of the high yield debt markets likely provided an ideal environment for the survival of zombie firms.

To construct country-year measures of debt financing activities, we collect global bond issuance by more than 9,000 issuers in the 20 largest economies in our sample period using S&P's RatingsXpress and global syndicated loan issuance from Thomson Reuters' LPC Dealscan database. Using these two sources, we are able to construct a set of measures on annual country-level debt issuance, including total bond issuance, high-yield bond issuance,

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total loan issuance, and leveraged loan issuance in US dollars, scaled by a country's nominal GDP. In addition, we calculate the total market capitalization in each country and year using financial reports of all firms in our data sources to measure equity market development.

We perform ordinary least squares (OLS) regressions of the fraction of listed zombie firms in a country-year on financial market development and a set of control variables that measure economic growth, firm size, age, and industry composition, interest rate environment, and differences in legal institutions. We find a strong positive relationship between the extent of zombieism and debt issuance activity in a country. The size of the high-yield bonds and leveraged loans markets are especially important for the growth and persistence of zombie firms over time. In economic terms, a one-standard-deviation increase in high yield bond issuance leads to an 0.6-percentage-point higher zombie ratio. The results are intuitive because zombie firms need to access the high-yield financing markets to stay afloat. The loan market activities are equally important at explaining cross-country variations of zombie ratios. Moreover, despite strong statistical significance of the size of equity markets in explaining the zombie ratios, the economic effects are relatively small. The evidence together suggests that development of the financing markets, especially high-yield markets, is an important driver for cross-country variations in zombie ratios.

Among control variables, the fraction of zombie firms is lower in countries with higher GDP growth, larger stock returns, and investment-grade sovereign credit ratings. Countries that have a higher fraction of small firms or young firms listed on the public exchange and countries with lower manufacturing activities have higher zombie ratios. Furthermore, zombie ratio is higher in an accommodating interest rate environment (i.e. when central bank's discount rates are lower). Moreover, a country's legal system has a strong association with zombie ratios—the fraction of listed zombie firms in common-law countries is about one percentage point higher than that in French- and German- law countries.

We next examine whether cross-country variations in creditor rights and debt enforcement efficiency explain zombie ratios. Our results show that countries with stronger creditor rights have a lower fraction of zombie firms. The evidence suggests that because lenders in countries with strong creditor control rights are equipped with adequate tools for liquidating

or restructuring distressed businesses before they run to the ground, zombie ratios are lower in those countries. Additionally, we demonstrate that the extent of zombieism is lower in countries with more efficient debt enforcement procedures. That is, when bankruptcy courts operate efficiently and debt enforcement time is short, firms are more likely to use the judicial process to resolve financial distress through restructuring, resulting in lower zombie ratios.

In the last section of our analysis, we disentangle the effect of bankruptcy law on resolving zombie problems from other legal institutions and economic factors. Specifically, we rely on prior research to identify significant bankruptcy code reforms in our sample countries for identification. Using bankruptcy reforms in eight countries, including Brazil, China, France, India, Japan, Italy, Spain, and the United Kingdom between 2000 and 2009, we perform difference-in-differences tests to examine whether the fraction of zombie firms increases/declines after reforms. Our specifications include year and country fixed effects to account for unobserved time and country-specific heterogeneity.

We find that countries that make major reforms to their bankruptcy law on average experience a 1.3-percentage-point reduction in the fraction of zombie firms, representing a 25–30% reduction in the historical average across countries. Furthermore, examining the time-series dynamics of zombie ratios around the bankruptcy reforms, we find no significant differences in zombie ratios between reformed countries and other countries in the three years before the reform took place, alleviating the concern that bankruptcy reforms are endogenous responses to zombie problems in those countries. Finally, we investigate whether zombie ratios evolve differently after the reform for countries that adopt more creditor friendly bankruptcy laws versus those that adopt more debtor friendly laws. We find that the adoption of more creditor friendly bankruptcy laws leads to a 1.6 percentage points larger reduction in zombie ratios than the adoption of more debtor friendly laws.

Our study offers new insights into a growing literature on zombieism in global economies. Prior studies such as those by Caballero, Hoshi, and Kashyap (2009), Lam, Schipke, Tan, and Tan (2017), Banerjee and Hofman (2018), Acharya, Crosignani, Eisert, and Eufinger (2020), and Acharya, Eisert, Eufinger, and Hirsch (2019) argue that zombie firms' presence distorts credit allocation and impedes real economic growth. Subsidized credit to zombie

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firms has real effects on corporate investment, employment, productivity, profits, and price deflation in various countries. In contrast to these studies, which focus on the actual effects of zombieism using either a country-specific measure or a more "liberal" measure such as the interest coverage ratio,[4] we propose a more holistic insolvency filtering process for identifying zombie firms in the world's 20 largest economies.

This paper also adds to our understanding of how financial markets affect real economic activities. Compared to prior studies that document the positive effects of financial market development on investments, innovation, and economic growth (e.g., Greenwood and Jovanovic, 1990; Guiso, Sapienza, and Zingales, 2004; Bekaert, Harvey, and Lundblad, 2005; Brown, Fazzari, and Petersen, 2009; Hsu, Tian, and Xu, 2014; Philippon, 2015), we examine the effect of financial markets on zombie problems. Our findings suggest that the survival of zombie firms over time may be an unintended consequence of the development of debt financing markets, especially the high-yield corporate debt markets around the world. The availability of cheap credit to risky firms as a result of both unconventional monetary policies and the growth of yield-seeking institutions not only allows low-rated and young firms to innovate and grow (Robb and Robinson, 2014; Hochberg et al., 2018) but also provides an accommodating environment for zombie firms to survive.

Finally, our study contributes to the literature on creditor rights and insolvency law reforms. Prior studies show that bankruptcy law reforms and the associated changes in creditor rights affect corporate investment, innovation, risk-taking, capital structure, loan contracting, banking competition, and economic growth.[5] We examine the impact of bankruptcy law on the resolution of zombie problems. We demonstrate that as creditor rights strengthen after law reforms, distressed firms likely end up in bankruptcy and the number of zombie firms declines as a result. Our paper is closely related to Becker and Ivashina (2021), who show that efficient insolvency resolution procedures lead to more use of bankruptcies to resolve

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[4]For example, a research report by the Bank of International Settlements (Banerjee and Hofman, 2018) defines zombie firms as those with an interest coverage ratio of less than one for three consecutive years.

[5]See, Djankov et al. (2008); Davydenko and Franks (2008); Acharya and Subramanian (2009); Bae and Goyal (2009); Gilson et al. (2010); Acharya et al. (2011a); Vig (2013); Pontcelli and Alencar (2016); Rodano et al. (2016); Gopalan et al. (2017); Gormley et al. (2018); John et al. (2020); Li and Pontcelli (2021), for example

distress and lower zombie lending in economic downturns. Furthermore, examining a long time series of business credit in 17 advanced economies, Jordà, Kornejew, Schularick, and Taylor (2021) show that efficient restructuring procedures reduce the macroeconomic fallout of corporate debt booms. Different from these studies, we take advantage of bankruptcy reforms in eight major economies not only for identifying the effects of the modernization of bankruptcy law on addressing zombie problems across countries but also for zooming in on laws that strengthen creditor rights. Our findings have direct implications for policymakers seeking to mitigate the domestic zombie problem and enterprises pursuing a conducive legal environment to survive.

2   Data Sample and Variable Construction

2.1   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 beginning of 2020.[6] We collect annual financial statements on US firms from Compustat and non-US firms from Worldscope from 1990 to 2020. 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

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[6]Although data sources such as Bureau van Dijk Orbis and S&P Capital IQ contain records of private firms, there are large cross-country variations in disclosure regulations and thus information availability for private firms. For example, private firms in the United States are not required to disclose their financials unless seeking capital in the bond markets. European regulators require financial disclosure of many private firms, mostly after the adoption of the International Financial Reporting Standards (IFRS) in 2005. Those regulation-driven differences lead to an endogenous heterogeneity in the availability of accounting items needed for calculating the Z"-score. Furthermore, financial disclosure of certain private firms, such as the unlimited liability entities in Europe, are mostly voluntary, resulting in a selection basis in the analysis of private firms. For these reasons, we do not study private firms in this paper.

items required to calculate Altman Z- and Z"-scores.[7] We use the following formulas to determine these scores:

$$Z - Score = 1.2 \times \frac{Current\ assets{-}Current\ liabilities}{Total\ Assets} + 1.4 \times \frac{Retained\ Earnings}{Total\ Assets}$$
$$+ 3.3 \times \frac{EBIT}{Total\ Assets} + 0.6 \times \frac{Market\ Value\ of\ Equity}{Total\ Liabilities} + 1.0 \times \frac{Sales}{Total\ Assets} \tag{1}$$

$$Z" - Score = 3.25 + 6.56 \times \frac{Current\ assets{-}Current\ liabilities}{Total\ Assets} + 3.26 \times \frac{Retained\ Earnings}{Total\ Assets}$$
$$+ 6.72 \times \frac{EBIT}{Total\ Assets} + 1.05 \times \frac{Book\ Value\ of\ Equity}{Total\ Liabilities}. \tag{2}$$

We remove observations in a given year for a country if our sources contain fewer than 50 firms in the year so as to ensure that we have enough observations and statistical power to draw reasonable country-level inferences. We further remove firms that have an S&P rating of D (default) or SD (select default) because such firms are already in a restructuring mode. Our final sample has 431,093 unique firm-year observations from 1990 to 2020 in the 20 largest world economies.

2.2   How to measure zombie firms: A two-step filtering process

In this section, we propose a two-step filtering process to determine zombie firms using an accounting-based measure and a default predictor. Although no commonly accepted method for defining zombie firms exists, a number of studies have relied on firms' interest coverage ratios, probably due to calculation simplicity and data availability. In these settings, zombie firms refer to those with *less-than-one* interest-coverage ratio, defined as EBIT/Interest or EBITDA/Interest (e.g., Banerjee and Hofman, 2018; Adalet McGowan et al., 2018).[8] Intu-

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[7]The Z" model is similar to the Z model and was first proposed for firms from emerging markets (Altman et al., 1995). The model is applicable internationally to both publicly and privately held businesses and to all types of nonfinancial businesses as well as manufacturing and non-manufacturing industries (Altman et al., 2017, 2019)

[8]For example, Banerjee and Hofman (2018) indicate that coverage ratios less than one are observed for 16–20% of listed firms in the United States, and the press has reported similar or higher percentages of firms.

itively, a firm that is unable to create sufficient earnings or cash flows to meet its interest payments, but is able to survive for a few years, should be classified as a zombie. However, the interest coverage criteria can be "aggressive" for determining zombie firms, resulting in substantial overestimation of the zombie problem.[9]

A special report by S&P's (2011) demonstrates this point. Among a set of companies rated by the agency from 2005 to 2007, the median EBIT interest coverage ratio was 0.4, and the median EBITDA interest coverage ratio was 1.1. More than half of all CCC-rated firms, and many B-rated companies, have interest coverage ratios less than 1.0 for several consecutive years and would, therefore, be classified as zombies by the interest coverage criterion. In addition, with leverage ratios exploding in recent decades in countries like the United States, it is reasonable to expect that the number of firms not able to generate enough operating income to cover their interest payments, even in the relatively low-interest-rate period, also increases. As a result, the interest coverage test alone would result in an overestimation of the number of zombies, and we, therefore, only employ it as one of two combined filters for measuring zombie firms.

For our second filter, we choose one of the most popular default/bankruptcy prediction models, the Z-score model and the Z"-score model. These models help one accurately identify financially distressed firms that are close to being in default. To assess the validity of the two models for zombie designation, we build bond rating equivalent (BRE) values of the two measures by using US firms. Appendix Table 1 presents the median Z-score by ratings of all US firms rated by S&P from 1992 to 2020 (in Panel A) and the median Z"-score by ratings of all US firms rated by S&P from 1996 to 2020 (in Panel B). The table clearly shows that the BRE for defaulted bonds has a Z-score or Z"-score of approximately zero.[10]

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[9]A few earlier studies such as those by Caballero, Hoshi, and Kashyap (2009) and Giannetti and Simonov (2013) rely on interest rate subsidization for zombie designation. While this is an acceptable definition, it is too restrictive and difficult to monitor with a high degree of accuracy, especially across multiple regulatory and financial regions in different economic development stages. Additionally, a firm is more likely to be labeled as a zombie during a particularly stressful period, such as the collapse of financial institutions or a pandemic, and then it would revert to generally successful operations once the adverse scenario passes.

[10]Note that the defaulting firm sample that is used to calculate the median Z"-score of a defaulted firm includes a large sample of firms that have gone bankrupt, missed interest or principal payments, or been restructured out-of-court, known as a distressed debt exchange (Altman and Kuehne, 2020).

Based on these observations, we designate any firm with a three-year moving average of interest coverage (IC) less than one, and a three-year moving average Z-score (Z) or Z"-score (Z") below zero, as a zombie firm to avoid measurement error resulting from temporary fluctuations of firm performance. Table 2 presents country-level summary statistics of the two zombie measures based on IC and Z and IC and Z". The average fraction of zombie firms in 20 countries from 1990 to 2020 is about 5%, regardless of which Z-score measure is used. In contrast, the average fraction of zombie firms would be 16% if only the IC test is used.[11]

2.3 Country-year measures

The first set of country-level measures that we construct is for measuring a country's present economic conditions and fiscal strength and growth perspectives. The three measures are: 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 (*Sovereign rating (investment grade)*) or not. The data sources for GDP growth, stock returns, and sovereign credit ratings are the IMF, Datastream, and the S&P Global Credit Ratings database (RatingsXpress), respectively.

Because small enterprises may be more likely than large firms to get subsidies from governments and their cooperating financial institutions for social, cultural, and economic reasons, 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 those firms with $50 million or lower in revenue using the Basel standard.[12] *Fraction of small firms* is defined as the number of small publicly traded firms scaled by the total

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[11]In Appendix A, we assess the performance of the distance-to-default (DTD) measure developed by Merton, and commercially implemented by Moody's KMV, in estimating the extent of zombieism in our sample. Because of the extremely volatile pattern and thus potential large errors in identifying zombie firms using DTD, we focus mainly on the two-step filtering process in our analysis.

[12]We do not refer to small firms by their market capitalization because some of the small-cap firms performed exceptionally well in some developed economies throughout the pandemic. The so-called small-cap label can include firms with up to $6 billion in market cap, as evidenced by the Russell 2000 Small-Cap Index with an average (median) firm market cap of about $2 billion ($600 million).

number of listed firms. Similarly, we measure the fraction of young firms in all listed firms (*Fraction of young firms*) because young firms are more risky due to lower capitalization and less buildup in retained earnings than mature firms. Young firms are defined as those that have an age of less than the sample median (12 years). Firm age is determined by the number of years since its financial statements and stock trading records became publicly available. In addition, we construct a measure to proxy for an individual country's industry composition. *Fraction of manufacturing sales* 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.

We next build a country-year measure for whether a country's central bank has a lenient monetary policy. 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 start 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 on the value of one if a country's central bank rate in a given year is below the sample median.

We obtain information on global bond issuance for the 20 largest economies in our sample from S&P's RatingsXpress, which comprises a complete history of credit rating records for over 9,000 global issuers. To construct a country-year measure on the aggregate issuance of corporate bonds by their ratings (i.e., whether they are investment grade or non–investment grade), we focus on the rated corporate bond–like instruments, including bonds, notes, debentures, and medium-term notes. That is, we do not include other forms of corporate debt, such as first mortgage bonds, because these instruments are secured and not usually rated. We then use the initially issued amount of each debt instrument to calculate the annual issuance amount of investment-grade bonds and high-yield bonds (i.e., those rated non–investment grade) in each country and year. Similar to Becker and Josephson (2016), for comparison across countries, we convert local currencies to US dollars using spot foreign exchange rates obtained from Datastream. To measure loan issuance activities, we resort to Thomson Reuters' LPC Dealscan database, which contains detailed facility-level information of syndicated loans issued in different countries and currencies. We obtain all loans issued by firms in the top 20 economies after 1994. We also convert each loan facility

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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.

We build five sets of measures for a country's debt financing activities. First, we calculate the total annual amount of corporate bond issuance, including both investment-grade and high-yield bonds, in each country and scale it by GDP level. Second, considering that high-yield financing markets are perhaps more relevant to the survival of zombies, we calculate the annual amount of high-yield corporate bond issuance in each country and scale it by the GDP level. Next, we use total loan issuance and leveraged loan issuance to construct similar measures. Finally, we follow prior studies to construct a proxy for equity market development (e.g., Hsu et al., 2014). We calculate the total market capitalization of all listed firms in each country-year with available accounting information. Similar to debt financing activity measures, we scale the total market capitalization by GDP level.

We obtain the creditor rights index proposed by La Porta, Lopez-de Silanes, Shleifer, and Vishny (1998) (LLSV) and Djankov, McLiesh, and Shleifer (2007) (DMS) and debt enforcement time from Djankov, La Porta, Lopez-de Silanes, and Shleifer (2003) (DLLS) and Djankov, Hart, McLiesh, and Shleifer (2008) (DHMS). In addition, we 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.

Table 1 provides detailed variable definitions. The summary statistics of country-level measures are presented in Table 2. Appendix Table 2 presents the correlation matrix of the variables.

3   An overview of zombie firms around the world

In this section, we present the time series of the fractions of zombie firms globally, and discuss the impact of the COVID-19 pandemic on the extent of zombieism and the firm size effect on fractions of zombie firms across countries.

3.1 Time-series patterns

Figure 1 presents the average annual percentage of zombie firms, based on our double-filter approach, in the population of public firms of the 20 largest economies. It shows that the fraction of zombie firms around the world was under 2% in the early and mid-1990s, before rising to 6.8% in 2003, a transitory high. The fraction was then halved between 2003 and 2007, just before the 2008–2009 financial crisis, following which there was a growing trend of zombieism worldwide. The percentage of zombie firms returned to 7% in 2017 and then increased to slightly above that level in 2020.

Figure 2 shows the fraction of zombie firms for the top four economies, the United States, China, Japan, and Germany. Each country exhibits unique patterns in how zombieism has evolved over time. The fraction of zombie firms in the United States shows an increasing secular trend since 1990. It increased from less than 4% in the mid-1990s to more than 8% in 2002. At the end of 2020, the fraction of zombie firms in the United States stands at close to 9% when zombie firms are determined using IC and Z-score and at 10% if IC and Z"-score are used.

Zombies in China, on the other hand, exhibited an inverse V-shape from 1998 (when there are at least 50 firm observations) to 2017. The fraction of zombie firms peaked in 2006, reaching above 6%, before a decline over the next 10 years, followed by a slight reversal from 2018 to 2020. The timing of the start of the decrease in zombieism coincides with the modernization of China's Enterprise Bankruptcy Law in 2007.

Japan's fraction of zombie firms experienced a steady increase from 1990 (0.1%) to the mid-2000s (0.8%), coinciding with economic stagnation. It is worth noting that Japan's absolute value of the zombie ratio based on the double filter is low compared to that of almost all other countries in our sample, possibly due to the country's intra-firm accounting subsidies, especially for listed firms. Importantly, in Appendix Table 3, we find that the zombie ratio based only on interest coverage ratio was more than 9% in the 1990s and increased to 14% by early 2000s in Japan. In fact, our zombie statistics based on interest coverage ratio only are comparable to those of prior studies such as Nakamura (2016), who

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proposes a modified method of Caballero et al. (2009) to measure zombie firms in Japan. Our evidence suggests that most listed Japanese firms may have enough liquidity and profitable margins for not being recognized as zombies according to the double filter method, but they have low interest coverage ratios.

Finally, despite a comparable increase in zombie firms from 1990 to the early 2000s, Germany had a secular reduction in zombieism beginning in 2004, eventually falling to less than 4% in 2020.

3.2   Impact of the COVID-19 pandemic

Various intriguing phenomena in 2020 make assessing the pandemic's impact on zombieism challenging. On the one hand, despite an economic rebound in the latter part of the year, most firms in the world 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 policy in many countries, the financial markets performed well, which directly improved the Z-scores of firms in several countries. Moreover, government support for small and medium-sized firms, such as moratoriums on interest payments, likely delayed their bankruptcy filings. Hence, marginal firms that may have failed under normal conditions continued to survive. Similarly, due to record-low interest rates and direct central bank liquidity injections into many nations' primary and secondary debt markets, global corporate debt also increased significantly in 2020. In total, all of these dynamics increased zombie populations in several countries, but the level of zombies actually decreased in almost half of the top 20 countries.[13]

To assess the impact of the COVID-19 pandemic and government responses in 2020 on zombieism worldwide, Table 3 compares the country-level fractions of zombie firms in

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[13]Global debt of all types as a percentage of global GDP increased by a record one-year amount of $29 trillion to $282 trillion, and global nonfinancial corporate debt increased by $6.6 trillion, also a record increase amount based on data from the Federal Reserve of St. Louis, the IMF, and the BIS. Corporate debt increases were found in both investment-grade and high-yield sectors; the latter enjoyed a record annual amount of new issuance of $435 billion in 2020, an astounding amount during a financial crisis. This trend has continued in 2021, with new issuance reaching a new record of $455 billion, according to Bank of America.

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individual countries between 2019 and 2020. Due to conflicting factors, we find that the overall change in the global zombie rate from 2019 to 2020 is relatively small. When zombie firms are measured by a combination of IC and Z-score, 12 countries showed an increase in zombie rates, led by France (+2.25%), Russia (+1.57%), Australia (+1.38%), the United Kingdom (+1.24%), and Mexico (+1.19%).

The United States experienced a slight increase in the zombie ratio from 2019 to 2020 due to two opposing forces. On the one hand, government policies particularly assisted firms deemed systemically and strategically crucial, such as airlines and small and medium-sized firms, to maintain employment to mitigate the economic impact of the pandemic. Many distressed firms avoided bankruptcy as a result. On the other hand, many large firms— mostly in less strategically important sectors—did not receive these direct supports. Hence, the overall default rate on high-yield bonds increased to 6.7% in 2020 compared to 2.8% in 2019 and was about twice the historic average of 3.3%, and a record number of large US firms filed for bankruptcy (Altman, 2021). The public firm bankruptcy rates increased from less than 1% in 2019 to almost 2% in 2020 (Figure 3). The relatively large number of bankruptcies help reduce zombie ratios, as these firms undergo restructuring and are no longer classified as listed zombie firms.[14]

In other countries, especially in Europe, the moratorium on interest payments and even on bankruptcy petitions helped to explain the decrease in the zombie metrics. For example, in countries like Germany, Italy, and Spain, the zombie ratio, based on the interest coverage ratio, actually decreased in 2020 compared to 2019. In conclusion, we find that due to the uniqueness of the pandemic's dynamics, the zombie ratios of our sample of large countries did not significantly change from 2019 to 2020.

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[14]It is worth noting that the small changes also reflect the dynamics of our measures that captured the reduction in cash flows and profits (two of the factors of the Z-score model) due to COVID-19, but also the increases in market value of equity and corporate leverage, another important factor in the Z-score.

3.3 Firm size effect

Except for systemically important firms, 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 lower bank write-offs (Peek and 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; moratoriums on small business debt payments were imposed, and bankruptcy was even prohibited in some countries. Therefore, it is crucial to examine the zombieism phenomenon in our sample of countries by firm size to shed light on the cross-country variations.

Table 4 presents the fraction of zombie firms by firm size in 2019. We use 2019 rather than 2020 since the latter year may be an aberration due to the pandemic. We focus on zombie firms based on the three-year moving average of an interest coverage less than one and a Z"-score less than zero because the Z"-score is a better predictor of default by small enterprises than the Z-score. 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 proportion of small enterprises in listed firms (76% for Canada and 73% for Australia, respectively).[15] Although the fraction of listed small enterprises is small in the United States (16%), at 42.5% the zombie rate for small enterprises is also high for this subsample of firms. Not surprisingly, zombies in many European countries, such as Germany, the United Kingdom, and France, concentrate in small enterprises.

Perhaps surprising, 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, as shown in Table 3. This can be partially due to the high failure rate of small Indian firms, which paradoxically lowers the surviving zombie rate. When a country has a high default/failure rate with high nonperforming loans and bonds, like India, the failed companies become

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[15]When smaller enterprises are removed, the zombie ratios in 2019 in the two countries decline from 28.7% and 20.78%, respectively, to about 4%.

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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%), partially influenced by the unusual designation of persistent unprofitable firms that are often relegated to a delisted status—ST (Special Treatment)—reducing the percentage of listed zombies (Altman et al., 2010).

4 Financial Market Development

In the past two decades, unconventional monetary policies significantly increased both demand and supply of corporate debt. Particularly, the extraordinary market turmoil during the 2008 financial crisis and a slow subsequent economic recovery compelled central banks around the world to maintain low interest rates. 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 and leveraged loans, offer an attractive option for traditional asset managers to boost expected returns. The growing demand of yield-seeking institutions prompted fast growth of the high-yield bond markets around the world.[16] We posit that the tremendous growth of the high-yield debt markets, coupled with low-interest rates in the past two decades, provided an ideal environment for the survival of low-productivity businesses, leading to the growing number of zombie firms.[17]

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

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[16]In the United States, the annual issuance of high-yield corporate bonds increased from $55 billion in 2008 to a whopping $435 billion in 2020, and the annual issuance amount in Europe increased from just under $4 billion in 2008 to almost $120 billion in 2020, according to statistics compiled by Bank of America.

[17]With the fast development of finance markets, out-of-court restructuring has been increasingly used by financially distressed firms in the United States in the past decade (Altman and Kuehne, 2020). Although compared to bankruptcy, out-of-court restructuring is less costly and favored by investors, firms that restructure out of court are more likely to become distressed again (Altman and Karlin, 2009; Gilson, 1997). Hence, this may make zombie ratios persist, at least in the short run. We do not empirically examine the impact of out-of-court restructuring in our paper because of the limited time-series and cross-section information.

(OLS) regression specification on country-year observations:

$$ZombieFraction_{i,t} = \beta X_{i,t-1} + \delta Controls_{i,t-1} + YearFE + LawOriginFE + \epsilon_{i,t}. \quad (3)$$

The dependent variable $ZombieFraction_{i,t-1}$ 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 activities across countries. As described in Section 2.3, the 10 measures we adopt are *Bond issuance, Bond issuance/GDP, HY bond issuance, HY bond issuance/GDP, Loan issuance, Loan issuance/GDP, Leveraged loan issuance, Leveraged loan issuance/GDP, Market cap*, and *Market cap/GDP*.

$Controls_{i,t-1}$ in Equation (3) is a set of additional explanatory variables for zombie ratios, including GDP growth rate and stock index returns (both are proxies for economic growth); sovereign credit rating, which measures a country's debt capacity and fiscal strength; the fraction of small firms, the fraction of young firms, and the fraction of manufacturing revenue, which are critical for adjusting for cross-country variations in the size and age distribution of publicly traded firms and economic activities by industries; and the interest rate set by the central banks, which measures the leniency of monetary policies. We include year fixed effects to control for secular trend and fixed effects by law origin (i.e., common law, French, and German) because a country's legal origin has been shown to be an important determinant of both creditor rights and the availability of private credit (e.g., La Porta et al., 1998; Djankov et al., 2007). Standard errors are clustered at the year level. The coefficient β captures how cross-country differences in financing activities are associated with zombie problems.

The regression results are in Table 5, with Panel A presenting the results for zombie ratios determined by IC and Z-score and Panel B showing the results when firms' zombie status is based on IC and Z"-score. Our results show that all measures for financial market development have strong explanatory power for the zombie ratios across countries and over time. First, on the relation between the overall bond issuance and loan issuance activities in a country and the zombie ratio, column (2) of Panel A shows that a one-standard-deviation increase in the total corporate bond issuance as a fraction of GDP results in a 0.6-percentage-point-higher zombie ratio. Similarly, column (6) shows that a one-standard-deviation increase in

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the total loan issuance as a fraction of GDP results in a 0.6-percentage-point-higher zombie ratio. Second, columns (3), (4), (7), and (8) in both panels present the results showing the effects of high-yield bond and leveraged loan market activities on zombie ratios. Using estimates in column (4) of Panel A, we find that a one-standard-deviation increase in the high-yield bond issuance as a fraction of GDP results in an almost 0.7-percentage-point-higher zombie ratio. The leveraged loan market development has a similar but smaller effect on the growth of zombies. A one-standard-deviation increase in the leveraged loan issuance as a fraction of GDP results in an almost 0.2-percentage-point-higher zombie ratio, according to the estimates in column (8) of Panel A.

We investigate whether the development of the equity markets explains cross-country differences in zombie problems and report the results in the last two columns in both panels of Table 5. The results show that countries with larger equity markets have more zombie firms as a fraction of publicly traded firms. The results are intuitive, as better-developed equity markets help listed firms raise equity capital; however, the economic effects are relatively small. Considering the highly skewed distribution of market capitalization, we use estimates in column (10) to infer that an interquartile change in the market capitalization as a percentage of GDP leads to only a 0.1-percentage-point increase in the zombie ratio.[18]

Among other explanatory variables, the coefficients for GDP growth are negative and statistically significant at the 5% level or lower in all columns, suggesting that high 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 ratio. Countries that are rated investment grade have zombie ratios that are 2–4 percentage points lower than those rated junk, based on the estimates in both panels.

The positive and significant coefficients for *Fraction of small firms* indicate that countries with a higher number of small firms listed 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. The coefficient estimates for *Fraction of young firms* are positive and statistically significant at the 10% level or better across all columns. The results show that

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[18]Our results stay qualitatively the same when we include country fixed effects to account for unobserved country-specific heterogenity. The results are in Appendix Table 4.

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countries that have a greater number of young listed firms have a higher fraction of zombie firms. The coefficient estimates for *Fraction of manufacturing revenue* are negative and statistically significant at the 1% level, but their economic effects are small. Furthermore, lenient monetary policy has an important effect on the zombie ratio. Using estimates across all columns in both panels, we find that the low-interest environment results in 0.5–1.2 percentage points higher zombie ratios. Finally, the coefficients for indicators of legal origins suggest that common-law nations have a greater tolerance for zombies on average.[19]

In summary, the results in Table 5 show that financial market development, particularly the growth of high-yield debt markets, contributes to the growth of zombie firms. In the next section, we explore whether creditor rights and debt enforcement efficiency can help reduce the extent of global zombieism.

5 Creditor Rights and Debt Enforcement

In this section, we examine whether country differences in creditor rights and debt enforcement quality explain the zombie phenomenon across countries. 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 (bankruptcy) court. There are large cross-country variations on whether the bankrupt law in a country is creditor-friendly (i.e., has strong creditor rights) or debtor-friendly (i.e., has weak creditor rights). For example, Djankov et al. (2007) show that the German bankruptcy code is more creditor-friendly than the US bankruptcy code, although both countries have a reorganization-based procedure. Davydenko and Franks (2008) further show that the British code is more senior-creditor-friendly than the German code. Prior studies show that heterogeneity in creditor rights among countries shapes credit availability, loan contracting and pricing, and economic growth (Qian and Strahan, 2007; Bae and Goyal, 2009; Houston, Lin, Lin, and Ma, 2010;

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[19]To show the robustness of our results, in Appendix Table 5, we show that all explanatory variables that are important to determining cross-country variations in zombie ratios when zombie firms are determined by the double-filtering method also help to explain cross-country variations if using the interest coverage ratio as the only filter to define zombie firms.

Cumming, Lopez-de Silanes, McCahery, and Schwienbacher, 2020; Beyhaghi, Dai, Saunders, and Wald, 2021).

Strong creditor rights grant creditors legal and institutional tools to allow them to not only gain possession of collateral but also influence the bankruptcy restructuring or liquidation process to improve their recovery rates. We anticipate a pronounced presence of zombie firms in countries with weak creditor rights, because creditors in those countries are less able to recover their debt by foreclosing collateral or pushing delinquent borrowers into bankruptcy (Claessens, Djankov, and Klapper, 2003).

Following prior literature, we adopt two measures of creditor rights to examine whether cross-country variations of creditor rights can explain cross-country differences in zombie ratios. We first use the time-invariant index of La Porta et al. (1998) (LLSV) to measure a country's overall level of creditor rights. The index starts at zero and adds one for each of the following conditions that holds: (1) there are restrictions such as creditors' consent for a debtor to file for reorganization; (2) secured creditors gain possession of assets once a bankruptcy petition receives approval (i.e., there is no automatic stay on creditors' ability to seize collateral); (3) secured creditors are ranked first in the distribution of proceeds; and (4) incumbent management does not stay in control of the firm during the reorganization. A higher score indicates stronger creditor rights. As an alternative measure, we adopt the creditor rights index of Djankov et al. (2007) (DMS), who use similar measures as LLSV, to build a time-varying index up to the year 2003. We use the index value as of 2003 to fill in for all subsequent years.

Table 6 presents the results using our baseline specification (3). Columns (1), (2), (5), and (6) show that if the creditor rights index in a country increases by 2, the zombie ratio in that country decreases by about a percentage point, when zombies are measured using the interest coverage ratio and the Z-score. The results show that firms are less likely to operate in zombie status in countries with more substantial creditor rights.

Besides rights granted to creditors, debt contract enforcement efficiency is important for creditors to exercise their rights to recover debt at low transactional costs. Following similar logic for how zombieism is related to the strength of creditor rights, we investigate whether

the efficiency of law enforcement explains cross-country differences in zombie ratios. We adopt two measures of debt enforcement time to gauge the enforcement efficiency. The first measure is the natural logarithm of the number of days it takes for a creditor to enforce a simple debt contract, constructed by DLLS and measured as of 2003. The second is the natural logarithm of the number of years of insolvency developed by DHMS.

Column (3) of Table 6 shows that when zombies are determined by IC and Z-score, a one-standard-deviation reduction in the natural logarithm of contract enforcement days translates into a 0.3-percentage-point decrease in zombie ratios (i.e., $-0.826 \times 0.317 = -0.3$). Similarly, column (4) shows that a one-standard-deviation reduction in enforcement time translates into a 0.6-percentage-point reduction in zombie ratios. (i.e., $-0.452 \times 1.448 = -0.6$). Columns (7) and (8) provide similar results despite slightly weaker statistical significance.

6 Bankruptcy Law Reforms

Recognizing the importance of a modern and comprehensive bankruptcy law to contracting efficiency and economic growth, many of our sample countries 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. Prior studies show that the primary goal of the bankruptcy law reforms in those countries was to make major updates to an outdated bankruptcy code so as to better facilitate and improve the efficiency of the restructuring process (Djankov et al., 2007; Pontcelli and Alencar, 2016; Rodano et al., 2016; Gopalan et al., 2017; John et al., 2020; Li and Pontcelli, 2021). Moreover, many of these law changes resulted in strong creditor control rights in the bankruptcy process (e.g., Brazil and Spain).[20]

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[20]Appendix Table 6 provides a list of these countries and the year when their modern bankruptcy code was enacted or a major revision to existing bankruptcy code was made. 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 for two reasons. First, the major changes made by BAPCPA focus on consumer bankruptcies, despite that some changes apply to corporations, such as limiting the debtors' exclusivity period for proposing a reorganization plan. Second, the strengthening

Because the bankruptcy reforms in the eight countries in our sample are enacted in different years, we follow prior studies to take advantage of these cross-country and time variations to examine the causal effect of the modernization of bankrupt law on zombieism.[21] Specifically, we adopt the following difference-in-differences specification:

$$ZombieFraction_{i,t} = \gamma PostReform_{i,t} + \beta Control_{i,t-1} + YearFE + CountryFE + \epsilon_{i,t} \qquad (4)$$

where $PostReform_{i,t}$ takes on the value of one 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. The advantage of this approach is that it allows for exploitation of within-country cross-time 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 1.3 percentage points, regardless of how zombie firms are classified. The economic magnitude of the decline in zombie ratios is large given the average zombie ratio across our sample countries and years at 5%. The results suggest that modernization of the bankruptcy code has possibly encouraged zombie firms to seek in-court restructuring, and the zombie ratio in those countries declines as a result. Our results support those of Becker and Ivashina (2021), 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 address this concern, we investigate the time-series dynamics of zombie

of creditor rights in the US bankruptcy process started in the late 1990s with frequent use of debtor-in-possession financing (Ayotte and Morrison, 2009) and active involvement by hedge funds (Jiang, Li, and Wang, 2012) and was not dramatically changed by BAPCPA.

[21]A few studies exploit bankruptcy reforms and the strengthening of creditor rights in our sample countries to study their causal effects on firm investment, innovation, and growth (e.g., Acharya and Subramanian, 2009; Acharya et al., 2011b; Favara et al., 2017).

ratios around reforms. Specifically, we adopt the following specification:

$$ZombieFraction_{i,t} = \gamma_1 ReformYear(-3) + \gamma_2 ReformYear(-2) + \gamma_3 ReformYear(0)$$
$$+ \gamma_4 ReformYear(1) + \gamma_5 ReformYear(2) + \gamma_6 ReformYear(3)$$
$$+ \gamma_7 ReformYear(4) + \beta Control_{i,t} + YearFE + CountryFE + \epsilon_{i,t} \quad (5)$$

where *ReformYear(-3)*, *ReformYear(-2)*, *ReformYear(0)*, *ReformYear(1)*, *ReformYear(2)*, *ReformYear(3)*, and *ReformYear(4)* equal one for more than two years before, two years before, the year of, one year after, two years after, three years after, and more than three years after reforms, respectively, and zero otherwise. The year before the reform is the benchmark year. 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 secular decline in zombie ratios after the reforms. Zombies ratios are more than two percentage points lower in reformed countries from the third year after the reform, according to estimates in column (3). The delayed response in zombie reduction after the reforms is related to our use of a three-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 parallel trend shows that bankruptcy reforms are not likely a direct response to the sudden rise in zombie ratios in reformed countries.

We next investigate whether zombie ratios change differently after a country adopts a more creditor-friendly law versus a more debtor-friendly law. We follow prior studies to determine whether a reform leads to a more creditor-friendly procedure (see Appendix Table 6). We replace $PostReform_{i,t}$ in model (4) 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 the reformed countries experience the same changes in zombie ratios after the reforms. Countries that adopt more creditor-friendly laws see a 1.6-percentage-point-larger reduction in zombie ratios than countries that adopt debtor-friendly laws. Our results, based on a completely

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different research design, are consistent with those in Section 5. Firms are more likely to be pushed into bankruptcy for restructuring/liquidation in countries with strong creditor rights. Hence, firms are more likely to go out of existence rather than remain zombies in a more creditor-friendly environment.

7   Conclusion

Zombie firms in various countries are receiving increased scrutiny and attention from both academics and practitioners. Yet, the definition and cross-country measurement proposed is based mainly on a single accounting measure and thus captures firms that are not true zombies. Our study presents a two-step filtering approach based on interest coverage ratios *and* default prediction models to assess the degree of zombieism: the fraction of insolvent businesses in a country that continue to operate thanks to the support of financial institutions, investors, or the government. 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 percent in 1990 to 3.4 percent in 2007 and 7 percent in 2019. However, the proportion remained remarkably stable during the COVID-19 pandemic in 2020, despite substantial cross-country variations. Our multivariate analysis shows that the expansion of the high-yield debt market contributes to global zombieism, while strong creditors' rights and debt enforcement efficiency help to reduce zombie ratios. Importantly, we find that the zombie ratio fell substantially in countries following their bankruptcy law modernization that strengthen creditor rights.

Our methodology and cross-country results have profound implications for policymakers, especially in countries where there is a serious attempt to balance the needs of the overall economic growth of the nation versus those of businesses and individuals who make up the workforce. A good example is what happened during the COVID-19 pandemic, with the looming specter of economic recession and large spikes in unemployment. Most policymakers opted for highly subsidized interest rates and government stimuli to maintain employment, which is a potential catalyst for large increases in zombie firms. In less dramatic times,

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our metrics and results could help guide those concerned with government's misallocation of resources in the assessments of zombie problems versus the less severe unemployment consequences of low interest rates and subsidies.

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Figure 1: Fraction of Zombie Firms—Global Evidence

The figure shows the average fraction of zombie firms of the 20 largest GDP countries in the world from 1990 to 2020. A zombie firm is defined as a firm with a three-year moving average interest coverage ratio that is less than one and has either a three-year average Z-score or Z"-score that is less than zero.
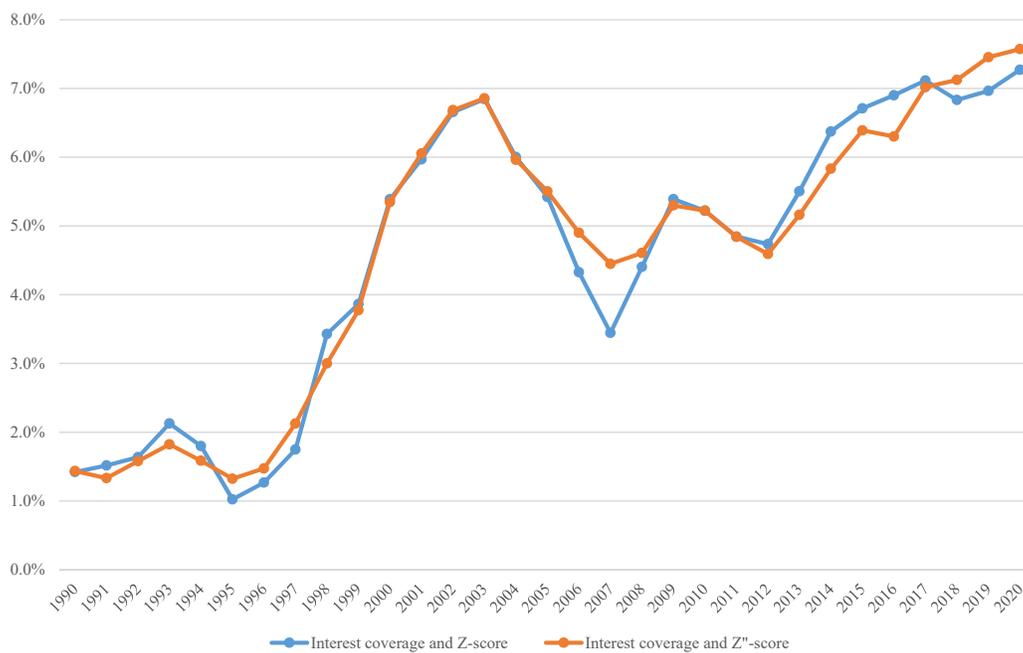
Figure 2: Fraction of Zombie Firms in the Top Four Economies

The figure shows the fraction of zombie firms in the four largest economies in the world from 1990 to 2020. A zombie firm is defined as a firm with a three-year moving average interest coverage ratio that is less than one and has either a three-year average Z-score or Z''-score that is below zero.
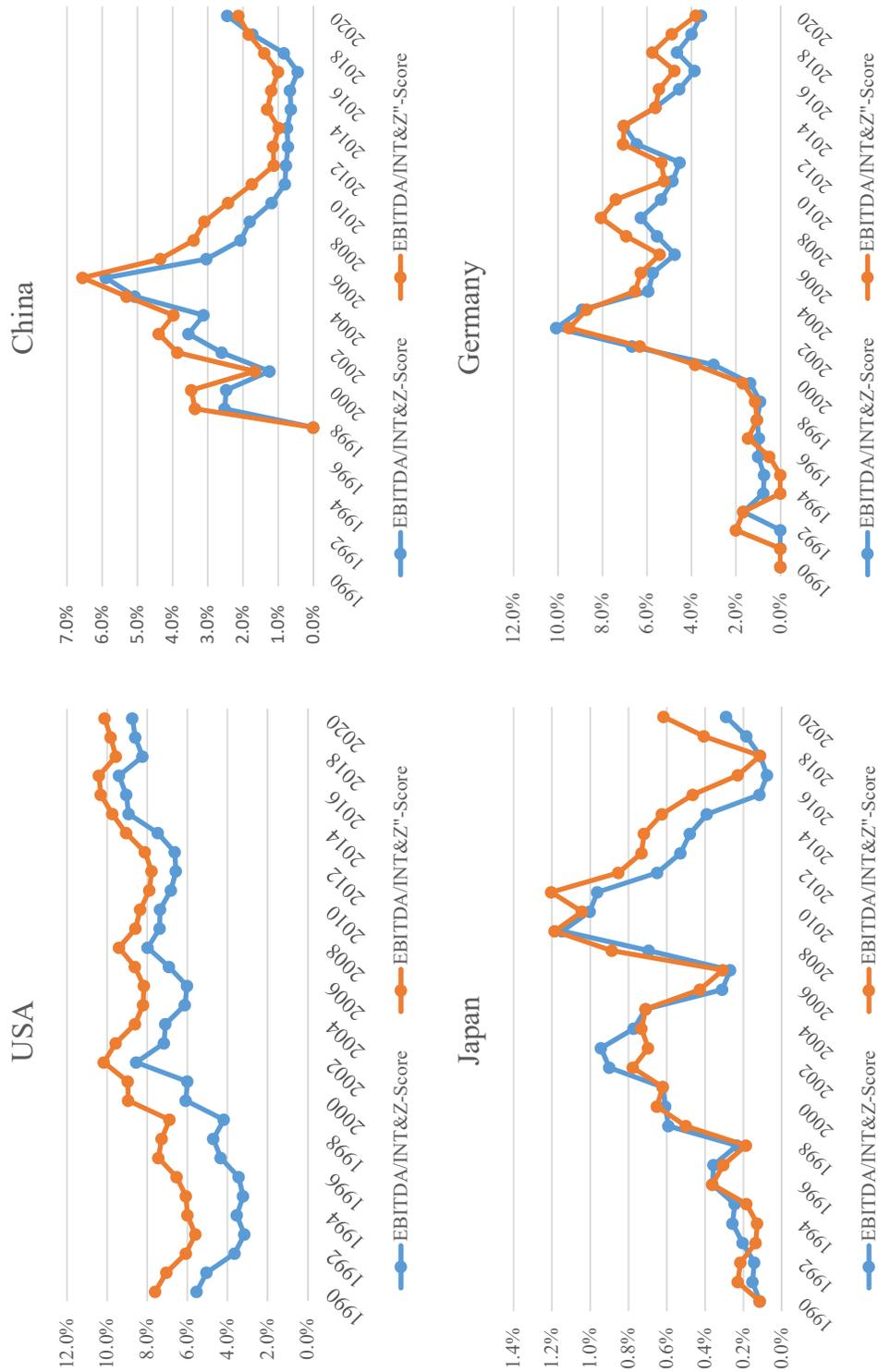
Figure 3: US Bankruptcy Filing Rate

The figure shows the US public firm bankruptcy filings (including both Chapter 7 and 11) as a fraction of total number of public firms each year from 1990 to 2020. Public firm bankruptcy filings were retrieved from Bankruptcydata.com.
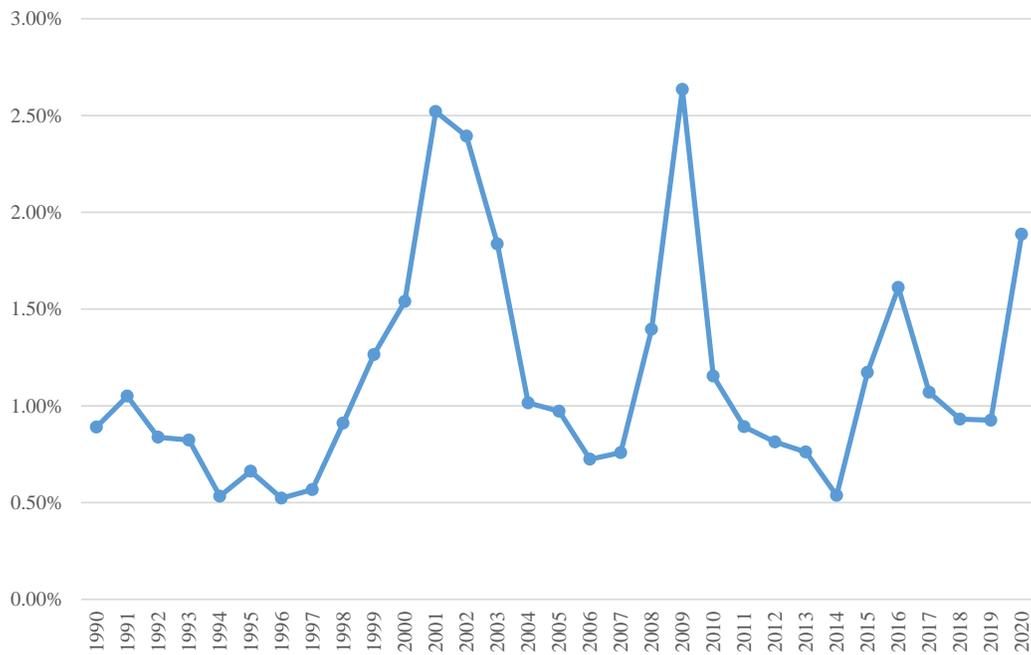
Table 1: Variable Definitions

Variable	Definition	Source
Zombie (IC)	Fraction of zombie firms in a country and year, where a zombie firm is defined as a firm with a three-year moving average interest coverage ratio (EBITDA/interest) less than one.	Compustat; Worldscope; Datastream
Zombie (IC & Z)	Fraction of zombie firms in a country and year, where a zombie firm is defined as a firm with a three-year moving average interest coverage ratio (EBITDA/interest) less than one and three-year average Z-score below zero.	Compustat; Worldscope; Datastream
Zombie (IC & Z")	Fraction of zombie firms in a country and year, where a zombie firm is defined as a firm with a three-year moving average interest coverage ratio (EBITDA/interest) less than one and a three-year average Z"-score below zero.	Compustat; Worldscope; Datastream
GDP	The gross domestic product in trillions of US dollars.	IMF
GDP growth	The annual percentage change in the GDP at purchaser's prices (in USD).	IMF
Stock index returns	The annual value-weighted portfolio return of all stocks primarily listed in a country.	Datastream
Sovereign rating (investment grade)	A binary variable equal to one if a country's S&P sovereign credit rating at each calendar year-end is BBB- or higher, zero otherwise	S&P RatingsXpress
Fraction of small firms	The annual number of listed small firms (with sales < \$50 m) as a percentage of total number of listed firms.	Compustat; Worldscope; Datastream
Fraction of young firms	The annual number of listed small firms (with age < 12 years) as a percentage of total number of listed firms. Age is measured by the number of years since a firm first year in which its financial reports and stock trading records become available.	Compustat; Worldscope; Datastream
Fraction of manufacturing revenue	The annual sales of manufacturing firms (with SIC between 2000 and 3999) as a percentage of total sales of listed firms.	Compustat; Worldscope; Datastream
Interest rate	The year-end discount rate or an equivalent rate set by a central bank; if not available, the Treasury Bill rate	Global Financial Data, Datastream
French law	A binary variable equal to one if a country has a French law origin, zero otherwise.	Djankov et al. (2008)
German law	A binary variable equal to one if a country has a German law origin, zero otherwise.	Djankov et al. (2008)
Bond issuance	The annual amount of bond issuance in USD\$ billion by all firms domiciled in a country.	S&P RatingsXpress
Bond issuance/GDP	The annual amount of bond issuance in USD\$ billion by all firms domiciled in a country as a percentage of a country's GDP.	S&P RatingsXpress
HY bond issuance	The annual amount of high-yield bond issuance in USD\$ billion by all firms domiciled in a country	S&P RatingsXpress
HY bond issuance/GDP	The annual amount of high-yield bond issuance in USD\$ billion by all firms domiciled in a country as a percentage of a country's GDP.	S&P RatingsXpress
Loan issuance	The annual amount of loan issuance in USD\$ billion by all firms domiciled in a country.	LPC Dealscan
Loan issuance/GDP	The annual amount of loan issuance in USD\$ billion by all firms domiciled in a country as a percentage of a country's GDP.	LPC Dealscan
Leveraged loan issuance	The annual amount of leveraged loan issuance in USD\$ billion by all firms domiciled in a country.	LPC Dealscan
Leveraged loan issuance/GDP	The annual amount of leveraged loan issuance in USD\$ billion by all firms domiciled in a country as a percentage of a country's GDP.	LPC Dealscan
Market cap	Market capitalization of all stocks listed by firms domiciled in a country in USD\$ trillion.	Datastream
Market cap/GDP	Market capitalization of all stocks listed by firms domiciled in a country as a percentage of a country's GDP.	Datastream
Exchange rate	Daily spot foreign exchange rate of local currencies to USD	Datastream
Creditors' rights (LLSV)	An index aggregating different creditor rights. The index is formed by adding 1 when (1) the country imposes restrictions, such as creditors'consent or minimum dividends to file for reorganization; (2) secured creditors are able to gain possession of their security once the reorganization petition has been approved (no automatic stay); (3) secured creditors are ranked first in the distribution of the proceeds that result from the disposition of the assets of a bankrupt firm; and (4) the debt or does not retain the administration of its property pending the resolution of the reorganization. The index ranges from 0 to 4.	La Porta et al. (1998)
Creditors rights (DMS)	An updated time-varying version of creditors' rights (LLSV).	Djankov et al. (2007)
Contract enforcement time (DLLS)	The natural logarithm of the number of days taken to resolve the insolvency process in a country.	Djankov et al. (2003)
Contract enforcement time (DHMS)	The natural logarithm of the number of year taken to resolve a bankruptcy procedure.	Djankov et al. (2008)

Table 2: **Summary Statistics of Zombie Proportion and Related Characteristics**

This table reports mean, median, standard deviation, and 25th and 75th percentile values of zombie proportion and related characteristics. Our sample includes all publicly traded firms with nonmissing three-year moving average of EBITDA interest coverage, Z-score, and Z"-score from 1990 to 2020 in 20 countries that have the largest nominal GDP in 2019. Definitions of variables are provided in Table 1.

	Obs.	Mean	Std.	P25	P50	P75
(1) Zombie (IC)	529	16.108	10.275	8.333	15.044	20.764
(2) Zombie (IC & Z))	529	4.932	5.189	1.136	3.529	6.892
(3) Zombie (IC & Z")	529	4.953	5.490	1.121	3.465	6.928
(4) GDP growth	529	2.935	3.078	1.400	2.600	4.500
(5) Stock index returns	529	0.140	0.430	-0.038	0.117	0.243
(6) Sovereign rating (investment grade)	529	0.849	0.359	1.000	1.000	1.000
(7) Fraction of small firms	529	27.189	19.166	12.195	22.887	37.430
(8) Fraction of young firms	529	52.165	22.024	34.579	48.231	62.222
(9) Fraction of manufacturing revenue	529	46.607	16.672	34.172	47.838	55.979
(10) Interest rate	529	6.050	8.795	1.250	3.500	7.250
(11) Common law	529	0.382	0.486	0.000	0.000	1.000
(12) French law	529	0.516	0.500	0.000	1.000	1.000
(11) German law	529	0.102	0.303	0.000	0.000	0.000
(14) Bond issuance	529	44.731	137.205	1.024	7.433	29.323
(15) Bond issuance/GDP	529	1.340	2.171	0.125	0.533	1.762
(16) HY bond issuance	529	12.460	44.012	0.000	0.950	5.612
(17) HY bond issuance/GDP	529	0.308	0.515	0.000	0.090	0.409
(18) Loan issuance	475	159.633	411.172	16.999	38.166	106.888
(19) Loan issuance/GDP	475	5.458	4.902	1.479	4.021	8.100
(20) Leveraged loan issuance	475	45.353	170.970	0.000	0.520	16.681
(21) Leverage loan issuance/GDP	475	0.866	1.523	0.000	0.051	1.253
(22) Market cap	529	1.540	3.272	0.191	0.496	1.268
(23) Market cap/GDP	529	65.094	186.706	21.859	39.621	68.691
(24) Creditors rights (LLSV)	477	1.912	1.259	1.000	2.000	3.000
(25) Creditors rights (DMS)	529	1.951	1.070	1.000	2.000	3.000
(26) Contract enforcement time (DLLS)	529	5.440	0.826	5.056	5.521	5.886
(27) Contract enforcement time (DHMS)	508	0.986	0.452	0.652	0.916	1.311

Table 3: Zombie Firms Around the World in 2019 and 2020

This table reports numbers of public firms and the fractions of zombie firms in the population of public firms defined by different criteria in the 20 largest economies between 2019 and 2020. Our sample includes all publicly traded firms with nonmissing three-year moving average of EBITDA interest coverage, Z-score, and Z"-score from 1990 to 2020 in 20 countries that have the largest nominal GDP in 2019. Definitions of variables are provided in Table 1.

GDP Rank(2019)	Nation	# Firms 2019	# Firms 2020	IC 2019	IC 2020	IC Diff	IC & Z 2019	IC & Z 2020	IC & Z Diff	IC & Z" 2019	IC & Z" 2020	IC & Z" Diff
1	United States	1,976	1,914	17.89%	19.54%	1.65%	8.59%	8.74%	0.15%	9.82%	10.12%	0.30%
2	China	3,818	3,806	11.27%	14.72%	3.46%	1.73%	2.44%	0.72%	1.83%	2.13%	0.30%
3	Japan	2,711	2,759	3.95%	5.12%	1.16%	0.18%	0.29%	0.11%	0.41%	0.62%	0.21%
4	Germany	451	421	17.07%	16.39%	-0.68%	3.99%	3.56%	-0.43%	4.88%	3.80%	-1.08%
5	India	2,397	2,398	17.07%	18.16%	1.09%	7.85%	7.60%	-0.25%	7.01%	6.93%	-0.08%
6	United Kingdom	903	850	27.24%	30.00%	2.76%	8.53%	9.76%	1.24%	10.63%	11.41%	0.78%
7	France	498	467	27.97%	28.02%	0.05%	10.46%	12.72%	2.25%	11.27%	11.21%	-0.06%
8	Italy	274	262	11.72%	11.11%	-0.61%	2.56%	3.07%	0.50%	3.30%	3.07%	-0.23%
9	Brazil	147	147	20.69%	18.62%	-2.07%	11.03%	9.66%	-1.38%	8.97%	8.28%	-0.69%
10	Canada	1,664	1,751	49.97%	52.35%	2.38%	28.90%	28.64%	-0.26%	31.91%	32.02%	0.11%
11	Russian Federation	148	144	11.72%	12.06%	0.33%	5.52%	7.09%	1.57%	4.14%	6.38%	2.25%
12	Korea, Rep.	2,054	2,001	22.20%	22.94%	0.74%	2.92%	2.10%	-0.82%	3.65%	2.90%	-0.75%
13	Australia	1,320	1,252	45.34%	51.72%	6.38%	21.00%	22.38%	1.38%	25.25%	27.02%	1.77%
14	Spain	125	120	16.13%	14.29%	-1.84%	2.42%	3.36%	0.94%	3.23%	4.20%	0.98%
15	Mexico	86	90	1.20%	4.76%	3.56%	0.00%	1.19%	1.19%	0.00%	0.00%	0.00%
16	Indonesia	479	470	14.26%	16.05%	1.80%	5.53%	5.86%	0.32%	3.19%	4.12%	0.93%
17	Netherlands	87	82	18.39%	16.05%	-2.34%	5.75%	4.94%	-0.81%	8.05%	6.17%	-1.87%
18	Saudi Arabia	129	127	10.85%	11.81%	0.96%	0.00%	0.79%	0.79%	0.00%	0.00%	0.00%
19	Turkey	266	257	21.80%	21.09%	-0.71%	6.39%	5.86%	-0.53%	5.64%	5.08%	-0.56%
20	Switzerland	168	167	17.26%	18.67%	1.41%	5.95%	5.42%	-0.53%	5.95%	6.02%	0.07%

Table 4: Zombie Firms Around the World by Firm Size in 2019

This table reports the fraction of zombie firms by firms size using interest coverage ratio (IC) 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 three-year moving average of EBITDA interest coverage, Z-score, and Z"-score from 1990 to 2020 in 20 countries that have the largest nominal GDP in 2019. Definitions of variables are provided in Table 1.

Nation	2019 GDP Rank	Small–Medium Firms (SMEs)			Large Firms			Fraction of
		N. Firms	IC	IC & Z"	N. Firms	IC	IC & Z"	SMEs
United States	1	315	60.00%	42.54%	1,641	9.81%	3.53%	16.10%
China	2	369	34.42%	10.84%	3,448	8.79%	0.87%	9.67%
Japan	3	352	17.33%	2.27%	2,356	1.95%	0.13%	13.00%
Germany	4	136	39.71%	13.24%	315	7.30%	1.27%	30.16%
India	5	1,279	23.46%	9.38%	1,117	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	1,257	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%	1,422	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%

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Table 5: Financing Channel and the Presence of Zombie Firms

This table reports estimates from the following regression:

$$ZombieFraction_{i,t} = \beta X_{i,t-1} + \delta Controls_{i,t-1} + LawOriginFE + YearFE + \epsilon_{i,t}$$

where $ZombieFraction_{i,t}$ of country i in year t is measured as the number of zombie firms, those with three-year moving average EBITDA interest coverage less than one and Z-score (or Z''-score) less than zero, scaled by the number of publicly traded firms. $X_{i,t-1}$ measures country-level annual bond, high-yield bond, loan, and leveraged loan issuance amounts, as well as total stock market capitalization in trillions of dollars, and these figures as fraction of GDP in year $t-1$. *GDP growth, Stock market return, Fraction of small firms, Fraction of young firms, Fraction of manufacturing revenue, Low interest rate dummy, Year fixed effects,* and *Legal origin (French legal origin, and German legal origin)* are included as controls. Variables are defined in Table 1. Robust standard errors clustered by year are reported in brackets. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Panel A: IC & Z

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Bond issuance	0.004*** [0.000]									
Bond issuance/GDP		0.270*** [0.053]								
HY bond issuance			0.012*** [0.001]							
HY bond issuance/GDP				1.322*** [0.258]						
Loan issuance					0.001*** [0.000]					
Loan issuance/GDP						0.130*** [0.025]				
Leveraged loan issuance							0.003*** [0.000]			
Leverage loan issuance/GDP								0.122** [0.057]		
Market cap									0.167*** [0.019]	
Market cap/GDP										0.003*** [0.000]
GDP growth	-0.212*** [0.069]	-0.212*** [0.067]	-0.214*** [0.069]	-0.215*** [0.069]	-0.191** [0.074]	-0.180** [0.072]	-0.194** [0.073]	-0.194** [0.073]	-0.215*** [0.070]	-0.214*** [0.069]
Stock index returns	-0.831** [0.334]	-0.820* [0.334]	-0.831** [0.331]	-0.798** [0.322]	-0.837** [0.335]	-0.767** [0.330]	-0.844** [0.335]	-0.817** [0.331]	-0.831** [0.337]	-0.838** [0.325]
Sovereign rating (investment grade)	-3.614*** [0.660]	-3.955*** [0.628]	-3.574*** [0.659]	-3.650*** [0.611]	-3.885*** [0.691]	-4.320*** [0.666]	-3.832*** [0.686]	-3.943*** [0.673]	-3.488*** [0.641]	-3.423*** [0.590]
Fraction of small firms	0.163*** [0.013]	0.153*** [0.012]	0.164*** [0.013]	0.156*** [0.011]	0.166*** [0.012]	0.148*** [0.011]	0.167*** [0.012]	0.160*** [0.012]	0.168*** [0.013]	0.160*** [0.012]
Fraction of young firms	0.018** [0.007]	0.025*** [0.007]	0.018** [0.007]	0.023*** [0.007]	0.015* [0.008]	0.019* [0.008]	0.015* [0.008]	0.016* [0.008]	0.016* [0.007]	0.017** [0.007]
Fraction of manufacturing revenue	-0.071*** [0.008]	-0.067*** [0.009]	-0.071*** [0.008]	-0.066*** [0.009]	-0.074*** [0.009]	-0.070*** [0.009]	-0.075*** [0.009]	-0.076*** [0.010]	-0.070*** [0.009]	-0.071*** [0.009]
Low interest rate	0.664** [0.319]	0.617** [0.320]	0.677** [0.320]	0.623* [0.313]	0.929*** [0.326]	0.918*** [0.316]	0.907*** [0.322]	0.901** [0.327]	0.675*** [0.315]	0.730** [0.307]
French law	-1.603*** [0.318]	-2.156*** [0.288]	-1.589*** [0.322]	-1.995*** [0.286]	-1.829*** [0.335]	-2.276*** [0.274]	-1.884*** [0.335]	-2.253*** [0.297]	-1.415*** [0.324]	-1.958*** [0.288]
German law	-1.135** [0.427]	-1.417*** [0.392]	-1.146** [0.428]	-1.346*** [0.401]	-1.287*** [0.450]	-1.361*** [0.411]	-1.311*** [0.450]	-1.569*** [0.429]	-1.165*** [0.410]	-1.435*** [0.402]
Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Nobs	529	529	529	529	475	475	475	475	529	529
Adj. R^2	0.645	0.646	0.645	0.651	0.645	0.647	0.645	0.638	0.644	0.644

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Table 5: Financing Channel and the Presence of Zombie Firms (Cont.)

					Panel B: IC & Z"					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Bond issuance	0.006***									
	[0.001]									
Bond issuance/GDP		0.418***								
		[0.057]								
HY bond issuance			0.019***							
			[0.002]							
HY bond issuance/GDP				1.986***						
				[0.258]						
Loan issuance					0.002***					
					[0.000]					
Loan issuance/GDP						0.215***				
						[0.029]				
Leveraged loan issuance							0.004***			
							[0.001]			
Leverage loan issuance/GDP								0.333***		
								[0.074]		
Market cap									0.272***	
									[0.029]	
Market cap/GDP										0.003***
										[0.001]
GDP growth	-0.200***	-0.201***	-0.204***	-0.206***	-0.179***	-0.161***	-0.185***	-0.172***	-0.204***	-0.206***
	[0.047]	[0.044]	[0.048]	[0.047]	[0.051]	[0.046]	[0.050]	[0.048]	[0.049]	[0.045]
Stock index returns	-0.582**	-0.563**	-0.582**	-0.530**	-0.574**	-0.458*	-0.583**	-0.541**	-0.584**	-0.575**
	[0.252]	[0.249]	[0.249]	[0.240]	[0.252]	[0.251]	[0.251]	[0.251]	[0.262]	[0.255]
Sovereign rating (investment grade)	-2.298***	-2.828***	-2.236***	-2.355***	-2.556***	-3.276***	-2.473***	-2.712***	-2.093***	-2.108***
	[0.551]	[0.515]	[0.546]	[0.486]	[0.578]	[0.538]	[0.566]	[0.562]	[0.532]	[0.499]
Fraction of small firms	0.189***	0.173***	0.190***	0.177***	0.189***	0.160***	0.190***	0.181***	0.196***	0.182***
	[0.012]	[0.012]	[0.012]	[0.011]	[0.012]	[0.011]	[0.012]	[0.012]	[0.012]	[0.012]
Fraction of young firms	0.014*	0.025***	0.014*	0.022***	0.012	0.017*	0.012	0.014	0.011	0.013*
	[0.007]	[0.007]	[0.008]	[0.008]	[0.008]	[0.009]	[0.008]	[0.009]	[0.007]	[0.008]
Fraction of manufacturing revenue	-0.082***	-0.077***	-0.083***	-0.075***	-0.088***	-0.082***	-0.089***	-0.089***	-0.081***	-0.083***
	[0.008]	[0.010]	[0.008]	[0.009]	[0.009]	[0.009]	[0.009]	[0.010]	[0.009]	[0.010]
Low interest rate	1.045***	0.977**	1.069***	0.994***	1.305***	1.288***	1.274**	1.215***	1.061***	1.169***
	[0.377]	[0.363]	[0.377]	[0.353]	[0.382]	[0.342]	[0.386]	[0.392]	[0.369]	[0.376]
French law	-1.806***	-2.687***	-1.796***	-2.440***	-2.038***	-2.794***	-2.186***	-2.692***	-1.492***	-2.424***
	[0.271]	[0.256]	[0.271]	[0.258]	[0.246]	[0.215]	[0.257]	[0.223]	[0.288]	[0.260]
German law	-0.660	-1.120**	-0.690	-1.018**	-0.850	-0.983**	-0.931*	-1.280**	-0.700	-1.200**
	[0.493]	[0.448]	[0.492]	[0.461]	[0.500]	[0.461]	[0.511]	[0.473]	[0.481]	[0.481]
Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Nobs	529	529	529	529	475	475	475	475	529	529
Adj. R^2	0.705	0.706	0.706	0.715	0.703	0.706	0.698	0.690	0.705	0.692

Table 6: Creditors' Rights, Debt Enforcement Efficiency, and the Presence of Zombie Firms

This table reports estimates from the following regression:

$$ZombieFraction_{i,t} = \beta X_{i,t-1} + \delta Controls_{i,t-1} + LawOriginFE + YearFE + \epsilon_{i,t}$$

where $ZombieFraction_{i,t}$ of country i in year t is measured as the number of zombie firms, those with three-year moving average EBITDA interest coverage less than one and Z-score (or Z''-score) less than zero, scaled by the number of publicly traded firms. $X_{i,t-1}$ measures country i's creditors rights from La Porta et al. (1998) and Djankov et al. (2008), the *Contract enforcement days*, and *debt enforcement efficiency* from Djankov et al. (2003) and Djankov et al. (2008) at year *t-1*. *GDP growth*, *Stock market return*, *Sovereign rating (investment grade)*, *Fraction of small firms*, *Fraction of young firms*, *Fraction of manufacturing revenue*, *Low interest rate dummy*, *Year fixed effects*, and *Legal origin* (*French legal origin*, and *German legal origin*) are included as controls. Variables are defined in Table 1. Robust standard errors clustered by year are reported in brackets. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	IC & Z				IC & Z''			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Creditors rights (LLSV)	-0.432** [0.192]				-0.693*** [0.180]			
Creditors rights (DMS)		-0.500** [0.191]				-0.634*** [0.164]		
Contract enforcement time (DLLS)			0.317** [0.121]				0.157 [0.108]	
Contract enforcement time (DHMS)				1.448** [0.577]				1.218** [0.577]
GDP growth	-0.256** [0.101]	-0.217*** [0.071]	-0.221*** [0.068]	-0.257*** [0.074]	-0.246*** [0.069]	-0.209*** [0.049]	-0.212*** [0.045]	-0.216*** [0.055]
Stock index returns	-0.910** [0.335]	-0.784** [0.333]	-0.815** [0.320]	-0.914*** [0.304]	-0.638*** [0.257]	-0.513** [0.245]	-0.542** [0.245]	-0.612** [0.261]
Sovereign rating (investment grade)	-4.018*** [0.651]	-3.684*** [0.615]	-3.563*** [0.641]	-2.501*** [0.708]	-2.818*** [0.518]	-2.396*** [0.488]	-2.301*** [0.524]	-1.398* [0.685]
Fraction of small firms	0.153*** [0.013]	0.157*** [0.012]	0.155*** [0.012]	0.160*** [0.012]	0.177*** [0.013]	0.179*** [0.012]	0.178*** [0.012]	0.184*** [0.012]
Fraction of young firms	0.027*** [0.009]	0.023*** [0.007]	0.016*** [0.008]	0.016** [0.008]	0.025** [0.009]	0.020** [0.007]	0.013 [0.008]	0.011 [0.009]
Fraction of manufacturing revenue	-0.076*** [0.009]	-0.076*** [0.009]	-0.072*** [0.009]	-0.086*** [0.011]	-0.086*** [0.010]	-0.090*** [0.010]	-0.086*** [0.010]	-0.083*** [0.012]
Low interest rate	0.446 [0.383]	0.804** [0.350]	0.940*** [0.333]	0.891** [0.375]	0.800* [0.435]	1.256*** [0.437]	1.292*** [0.390]	0.958** [0.408]
French law	-2.485*** [0.333]	-2.539*** [0.350]	-2.155*** [0.295]	-2.501*** [0.433]	-3.121*** [0.312]	-3.143*** [0.316]	-2.574*** [0.262]	-3.119*** [0.386]
German law	-1.791*** [0.493]	-1.549*** [0.401]	-1.625*** [0.408]	-1.447*** [0.447]	-1.575*** [0.567]	-1.323*** [0.467]	-1.358*** [0.479]	-1.547*** [0.499]
Year FE	Y	Y	Y	Y	Y	Y	Y	Y
Nobs	477	529	529	508	477	529	529	508
Adj. R^2	0.649	0.645	0.637	0.645	0.712	0.697	0.684	0.696

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Table 7: Bankruptcy Law Reforms and the Presence of Zombie Firms

This table reports estimates from regression $ZombieFraction_{i,t}$ on post-reform variables. $ZombieFraction_{i,t}$ of country i in year t is measured as the number of zombie firms, those with three-year moving average EBITDA interest coverage less than one and Z-score (or Z"-score) less than zero, scaled by the number of publicly traded firms. The *PostReform* is an indicator variable that takes on the value of one for all annual observations of country i after it makes major reforms to its bankruptcy code. *ReformYear(t)*s are indicator variables that takes on the value of one for country i in the tth year relative to the year it makes major reforms to its bankruptcy code, and zero otherwise. Strong debtor(creditor) rights is an indicator variable equal to one if a reform is more debtor (creditor) friendly, and zero otherwise. See Appendix 6 for a list of these events. *GDP growth, Stock market return, Sovereign rating (investment grade), Fraction of small firms, Fraction of young firms, Fraction of manufacturing revenue, Low interest rate dummy, Year fixed effects, Legal origin* (*French legal origin,* and *German legal origin*), and *Country fixed effects* are included as controls. Variables are defined in Table 1. Robust standard errors clustered by year are reported in brackets. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	IC &Z	IC &Z"	IC &Z	IC &Z"	IC &Z	IC &Z"
	(1)	(2)	(3)	(4)	(5)	(6)
PostReform	-1.325**	-1.206**				
	[0.603]	[0.526]				
ReformYear(-3 and before)			-0.629	-0.154		
			[1.005]	[0.747]		
ReformYear(-2)			-0.895	-0.012		
			[1.366]	[1.073]		
ReformYear(0)			0.072	0.488		
			[1.801]	[1.211]		
ReformYear(+1)			-1.129	-0.195		
			[1.997]	[1.286]		
ReformYear(+2)			-1.443	-0.251		
			[1.250]	[1.033]		
ReformYear(+3)			-2.041*	-1.503*		
			[1.042]	[0.776]		
ReformYear(+4 and after)			-2.414**	-1.946**		
			[0.938]	[0.753]		
PostReform*Strong debtor rights					-0.615	-0.553
					[0.518]	[0.441]
PostReform*Strong creditor rights					-2.245**	-2.052**
					[0.860]	[0.765]
P-value of *F*-test					0.011	0.012
Controls	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
Country FE	Y	Y	Y	Y	Y	Y
Nobs	529	529	529	529	529	529
Adj. R^2	0.699	0.768	0.699	0.769	0.701	0.770

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Appendix A

Measuring Zombies Using A Market-based Structural-model

In this appendix, we assess the performance of the distance-to-default (DTD) measure developed by Merton, and commercially implemented by Moody's KMV, in estimating the extent of zombieism in our sample. This technique uses a firm's current market capitalization as a proxy for its economic asset value and the historical volatility of its market cap as a proxy for asset volatility, and compares the implied asset value to its outstanding contractual obligations to measure how much deterioration in asset values could take place before the firm is insolvent: when the asset values drops to the level of its obligations—i.e., a DTD of zero.[22]

To estimate the DTD of our sample firms, we follow the methods illustrated in Crosbie and Bohn (2003) and Bharath and Shumway (2008). DTD in the Merton model is defined as $(\ln(V/F) + (\mu - 0.5\sigma_v^2 T)/\sigma_v\sqrt{T}$, where V is (unobserved) asset value, F is face value of short-term debt and half of long-term debt, T is debt maturity, μ is the expected return on asset, and σ_v is the asset volatility. We use quarterly Compustat and CRSP data for US firms, and Worldscope and Datastream data for non-US firms. When Worldscope quarterly accounting data are not available, we rely on semiannual and annual accounting data from these sources. We exclude all nonprimary issues and require that the stock price's currency be the same as the one used for accounting data items.

We follow the above approach for validating Z-score and Z"-score to determine the bond rating equivalent values of DTD, similar to Appendix Table 1. Given the unavailability of information on company defaults and bankruptcies in many non-US countries, we use information retrieved for US firms for the validation exercises. Specifically, we identify defaulted publicly traded US firms using bankruptcy-related CRSP delisting and Compustat deletion events, S&P ratings (D or SD), Chapter 11 and Chapter 7 filings from bankruptcydata.com, and the list of bankruptcy filings in Capital IQ. There are 1,782 default and bankruptcy events for which the last fiscal year-end DTD value that we can calculate is within 24 months prior to all insolvency events.

Appendix Figure 1 presents the histogram of the last fiscal year-end value of DTD before default or bankruptcy. The mean and median values are –0.26 and –0.70, respectively. The figure shows that more than 60% of the observations have the value zero or below. The value of a zero DTD is therefore a fairly accurate predictor of default. To classify zombie firms, we define three alternative measures: current DTD is less than or equal to zero, DTD is zero or below in at least one of the recent three years, and the three-year moving average DTD is zero or below.

Appendix Figure 2 presents the time series of zombie firms as a fraction of publicly traded firms measured by DTD in the top four GDP countries. The figure shows that the fluctuations in zombie ratios in these countries are largely driven by variations of stock prices and volatilities, which are critical inputs to the estimation of DTD. For example, the fraction of zombie firms in the United States is highly countercyclical based on this measure. The fraction of zombie firms peaked in both 2000–2003 and 2008–2010, when the stock market crashed and the US economy entered into a recession. Similarly, the fraction of zombie firms in China peaked after 2007, when the Chinese stock market reached a historical high and crashed afterward.

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[22]A number of studies have investigated the accuracy of the Merton (1974) model in predicting default and bankruptcy, but the evidence is mixed (see Das, Hanouna, and Sarin (2008); McQuown (1993); Bharath and Shumway (2008) and Altman et al. (2019), for example). Nevertheless, a recent report by McKinsey (2020) shows that Z-score is a better indicator of company strength during a crisis than is stock market performance.

Appendix Figure 1: Distance-to-Default Prior to Default/Bankruptcy Events

This figure reports histogram of the fiscal year-end *Distance-to-Default* value prior to default and bankruptcy events, which occurred within 24 months since the last trading month. Our final sample includes 338 default and 1,444 bankruptcy events in the United States, leading to total 1,509 unique US events among the firms that have common stock records in the CRSP and Compustat universe.

Distance-to-default for US Default/Bankruptcy Firms
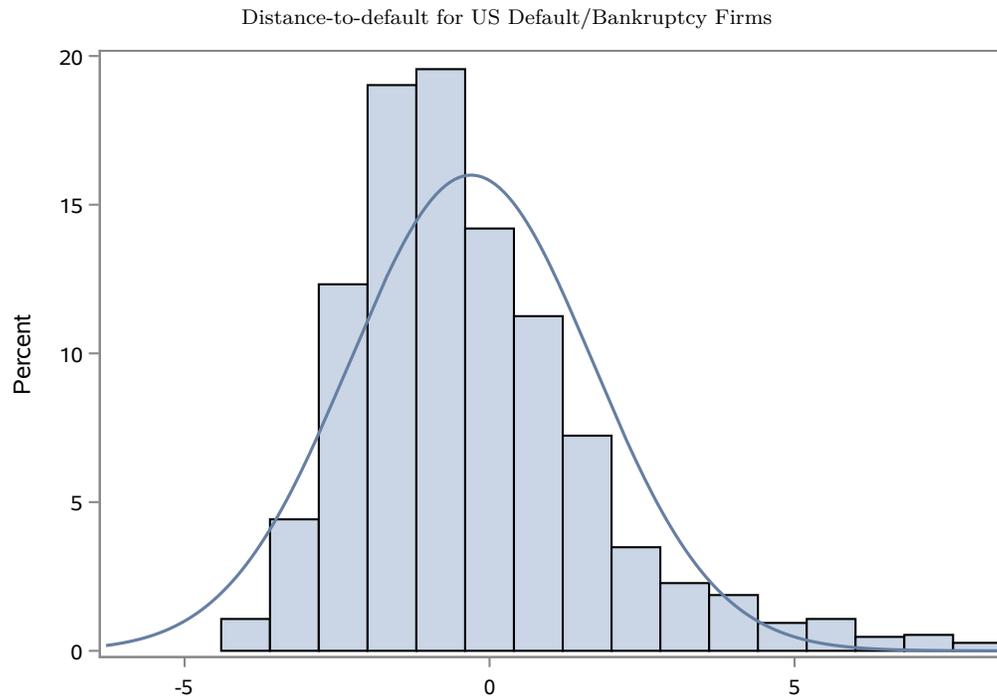
Appendix Figure 2: The Fraction of Zombie Firms Defined by Distance-to-Default

The figure shows the fraction of zombie firms, based on the distance-to-default measure, of the four largest economies in the world from 1990 to 2020. A zombie firm is defined as a firm (1) with a zero or negative distance-to-default in at least one year over the past three years, (2) with a zero or negative three-year moving average distance-to-default or less, or (3) with a zero or negative distance-to-default or less in the current year.
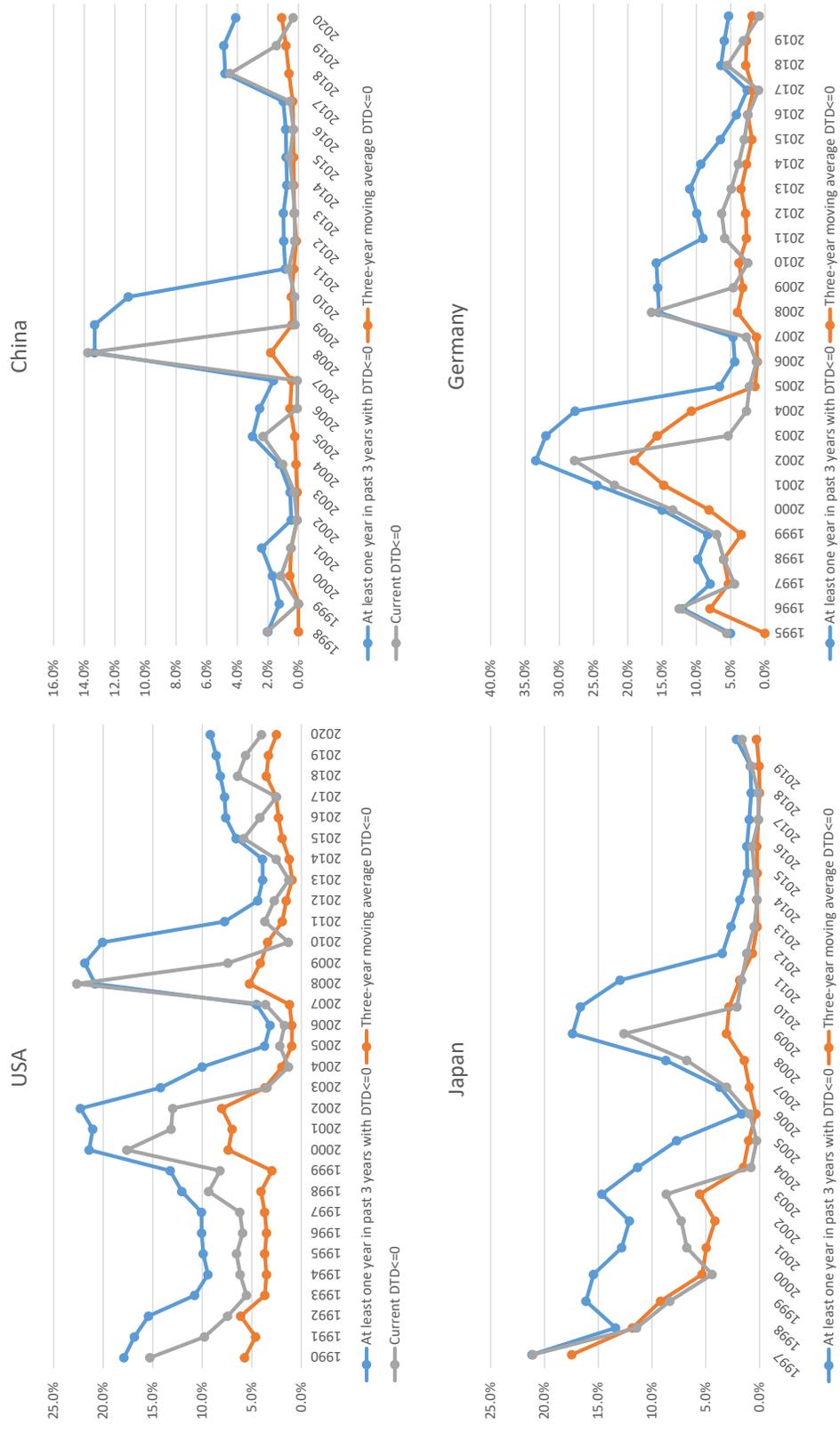
Appendix Table 1: US Bond Rating Equivalents Based on Z-Score and Z"-Score Models

This table describes the median Z– and Z"–scores across major credit rating categories. It combines and expands Figures 10.7 and 10.15 from Altman et al. (2019). The authors gathered the underlying data from S&P Global.

	Panel A: Z-Score Model					
Rating	2018–2020(No.)	2017(No.)	2013 (No.)	2004–2010	1996–2001	1992–1995
AAA/AA	4.74 (14)	4.20 (14)	4.13 (15)	4.18	6.20*	4.80*
A	4.03 (67)	3.85 (55)	4.00 (64)	3.71	4.22	3.87
BBB	2.87 (222)	3.10 (137)	3.01 (131)	3.26	3.74	2.75
BB	2.29 (270)	2.45 (173)	2.69 (119)	2.48	2.81	2.25
B	1.27 (203)	1.65 (94)	1.66 (80)	1.74	1.8	1.87
CCC/CC	0.47 (23)	0.73 (4)	0.23 (3)	0.46	0.33	0.4
D	−0.20 (41)	−0.10 (16)	0.01 (33)	−0.04	−0.2	0.05

	Panel B: Z"-Score Model				
Rating	2018-2020 (No.)		2013 (No.)	2006 (No.)	1996 (No.)
AAA/AA+	7.92 (4)		8.80 (15)	7.51 (14)	8.15 (8)
AA/AA-	7.60 (10)		8.40 (17)	7.78 (20)	7.16 (33)
A+	7.49 (19)		8.22 (23)	7.76 (26)	6.85 (24)
A	7.20 (17)		6.94 (48)	7.53 (61)	6.65 (42)
A-	6.90 (31)		6.12 (52)	7.10 (65)	6.40 (38)
BBB+	6.52 (56)		5.80 (70)	6.47 (74)	6.25 (38)
BBB	6.23 (104)		5.75 (127)	6.41 (99)	5.85 (59)
BBB-	6.02 (62)		5.70 (96)	6.36 (76)	5.65 (52)
BB+	5.81 (94)		5.65 (71)	6.25 (68)	5.25 (34)
BB	5.60 (96)		5.52 (100)	6.17 (114)	4.95 (25)
BB-	5.22 (86)		5.07 (121)	5.65 (173)	4.75 (65)
B+	4.80 (81)		4.81 (93)	5.05 (164)	4.50 (78)
B	4.45 (73)		4.03 (100)	4.29 (139)	4.15 (115)
B-	4.20 (48)		3.74 (37)	3.68 (62)	3.75 (95)
CCC+	3.95 (19)		2.84 (13)	2.98 (16)	3.20 (23)
CCC	3.57 (4)		2.57(3)	2.20 (8)	2.50 (10)
CCC-	2.90 (5)		1.72 (-)	1.62 (-)	1.75 (6)
D	0.20 (94)		0.05 (94)	0.84 (120)	0 .00 (14)

Appendix Table 2: Correlation of Key Variables

This table reports correlation coefficients among the key country-level characteristics. Our sample includes all publicly traded firms with nonmissing three-year moving average of EBITDA interest coverage, Z-score, and Z"-score from 1990 to 2019 in 20 countries that have the largest nominal GDP in 2019. Definitions of variables are provided in Table 1.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(2) Zombie (IC & Z))	0.890												
(3) Zombie (IC & Z")	0.903	0.960											
(4) GDP growth	-0.145	-0.099	-0.091										
(5) Stock index returns	-0.101	-0.052	-0.056	0.051									
(6) Sovereign rating (investment grade)	-0.092	-0.174	-0.056	-0.124	-0.218								
(7) Fraction of small firms	0.755	0.705	0.750	0.099	0.005	-0.062							
(8) Fraction of young firms	-0.154	-0.144	-0.158	0.161	0.113	-0.091	-0.079						
(9) Fraction of manufacturing revenue	-0.340	-0.323	-0.334	0.230	0.064	-0.052	-0.085	0.028					
(10) Interest rate	-0.084	-0.037	-0.092	0.094	0.339	-0.601	0.013	0.336	0.096				
(11) Common law	0.415	0.330	0.400	0.022	-0.066	0.223	0.434	-0.317	0.073	-0.202			
(12) French law	-0.346	-0.247	-0.338	-0.144	0.072	-0.303	-0.392	0.148	-0.193	0.269	-0.812		
(13) German law	-0.096	-0.123	-0.085	0.202	-0.012	0.142	-0.051	0.264	0.201	-0.120	-0.265	-0.348	
(14) Bond issuance	0.115	0.142	0.205	-0.089	-0.043	0.132	-0.028	-0.220	-0.074	-0.150	0.282	-0.222	-0.086
(15) Bond issuance/GDP	0.249	0.236	0.306	-0.168	-0.093	0.214	0.120	-0.316	-0.239	-0.224	0.113	-0.011	-0.163
(16) HY bond issuance	0.096	0.132	0.190	-0.076	-0.023	0.104	-0.039	-0.192	-0.056	-0.127	0.268	-0.217	-0.071
(17) HY bond issuance/GDP	0.212	0.245	0.301	-0.140	-0.026	0.071	0.068	-0.257	-0.215	-0.126	0.109	-0.019	-0.143
(18) Loan issuance	0.137	0.143	0.218	-0.068	-0.043	0.155	0.004	-0.168	-0.068	-0.134	0.318	-0.275	-0.053
(19) Loan issuance/GDP	0.443	0.356	0.458	-0.112	-0.083	0.250	0.373	-0.144	-0.264	-0.167	0.294	-0.174	-0.181
(20) Leveraged loan issuance	0.069	0.101	0.155	-0.068	-0.028	0.118	-0.060	-0.176	-0.052	-0.113	0.259	-0.219	-0.052
(21) Leverage loan issuance/GDP	0.165	0.102	0.183	-0.197	-0.079	0.245	0.020	-0.221	-0.182	-0.224	0.152	-0.107	-0.067
(22) Market cap	0.108	0.109	0.168	-0.036	-0.010	0.086	-0.089	-0.181	-0.052	-0.126	0.294	-0.289	0.005
(23) Market cap/GDP	0.153	0.120	0.104	-0.032	0.060	-0.149	-0.041	0.012	-0.092	0.071	-0.017	0.054	-0.061
(24) Creditors rights (LLSV)	0.010	0.021	-0.024	0.251	0.033	-0.149	0.200	0.056	0.238	0.015	0.185	-0.295	0.228
(25) Creditors rights (DMS)	0.107	0.044	0.064	0.073	-0.017	0.124	0.171	0.072	0.007	-0.079	0.295	-0.405	0.197
(26) Contract enforcement time (DLLS)	0.045	0.132	0.065	0.080	0.086	-0.310	0.087	0.206	-0.147	0.278	-0.226	0.247	-0.045
(27) Contract enforcement time (DHMS)	-0.205	-0.091	-0.188	0.227	0.194	-0.627	-0.151	0.166	0.179	0.470	-0.567	0.626	-0.133

	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)
(15) Bond issuance/GDP	0.413												
(16) HY bond issuance	0.969	0.353											
(17) HY bond issuance/GDP	0.520	0.805	0.539										
(18) Loan issuance	0.929	0.303	0.888	0.413									
(19) Loan issuance/GDP	0.352	0.437	0.309	0.311	0.468								
(20) Leveraged loan issuance	0.903	0.269	0.846	0.362	0.961	0.379							
(21) Leverage loan issuance/GDP	0.584	0.446	0.518	0.359	0.683	0.661	0.692						
(22) Market cap	0.863	0.241	0.826	0.373	0.864	0.255	0.847	0.516					
(23) Market cap/GDP	0.034	0.028	0.035	0.093	0.027	0.019	0.029	0.016	0.391				
(24) Creditors rights (LLSV)	-0.167	-0.167	-0.186	-0.200	-0.139	-0.100	-0.112	0.029	-0.148	-0.097			
(25) Creditors rights (DMS)	-0.166	0.021	0.008	-0.150	-0.135	0.155	-0.121	0.127	-0.152	-0.078	0.756		
(26) Contract enforcement time (DLLS)	-0.045	-0.321	0.008	-0.080	0.000	-0.138	0.005	-0.147	-0.041	0.041	0.153	-0.113	
(27) Contract enforcement time (DHMS)	-0.014	-0.197	0.025	-0.045	-0.046	-0.292	-0.014	-0.234	-0.017	0.084	-0.019	-0.339	0.310

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Appendix Table 3: Fraction of Public Zombie Firms by Country in Five-Year Intervals

This table reports the country-level percentage of zombie firms in 2020, 2015, 2010, 2005, 2000, and 1995. Our sample includes all publicly traded firms with nonmissing three-year moving average of EBITDA interest coverage, Z-score, and Z"-score from 1990 to 2019 in 20 countries that have the largest nominal GDP in 2020. To classify a zombie firm, we adopt three sets of measures, including three-year moving average of EBITDA interest coverage less than one, both three-year moving average of EBITDA interest coverage and Z-score less than zero, and both three-year moving average of EBITDA interest coverage and Z"-score less than zero. The countries are ordered by their 2019 GDP. Definitions of variables are provided in Table 1.

	2020				2015				2010			
Nation	#Firms	IC	IC & Z	IC & Z"	#Firms	IC	IC & Z	IC & Z"	#Firms	IC	IC & Z	IC & Z"
						Panel A						
United States	1,914	19.54%	8.74%	10.12%	2,336	18.22%	8.92%	9.74%	2,766	15.80%	7.36%	8.34%
China	3,806	14.72%	2.44%	2.13%	2,829	6.90%	0.64%	1.31%	1,942	6.64%	1.18%	2.42%
Japan	2,759	5.12%	0.29%	0.62%	2,562	4.03%	0.39%	0.63%	2,497	8.26%	1.00%	1.04%
Germany	421	16.39%	3.56%	3.80%	463	17.71%	5.62%	5.62%	541	18.11%	5.36%	7.39%
India	2,398	18.16%	7.60%	6.93%	2,138	19.83%	6.50%	5.14%	248	10.89%	2.42%	2.02%
United Kingdom	850	30.00%	9.76%	11.41%	953	25.50%	7.87%	9.55%	1,093	27.36%	9.97%	10.98%
France	467	28.02%	12.72%	11.21%	549	23.91%	4.56%	4.93%	526	16.41%	2.10%	2.48%
Italy	262	11.11%	3.07%	3.07%	218	16.20%	4.63%	4.17%	197	16.84%	3.06%	2.04%
Brazil	147	18.62%	9.66%	8.28%	146	26.39%	9.72%	7.64%	107	14.02%	4.67%	4.67%
Canada	1,751	52.35%	28.64%	32.02%	1,719	40.97%	26.34%	24.53%	1,999	40.63%	16.38%	17.79%
Russian Federation	144	12.06%	7.09%	6.38%	149	21.09%	6.12%	4.08%	157	11.69%	1.30%	0.65%
Korea, Rep.	2,001	22.94%	2.10%	2.90%	1,741	20.56%	2.24%	3.10%	1,514	21.66%	5.02%	3.96%
Australia	1,252	51.72%	22.38%	27.02%	1,300	44.92%	22.46%	21.69%	1,389	38.88%	13.25%	15.26%
Spain	120	14.29%	3.36%	4.20%	131	20.16%	5.43%	5.43%	107	17.76%	1.87%	3.74%
Mexico	90	4.76%	1.19%	0.00%	87	3.57%	2.38%	1.19%	84	13.25%	3.61%	1.20%
Indonesia	470	16.05%	5.86%	4.12%	377	12.50%	4.62%	3.53%	179	13.07%	6.25%	6.82%
Netherlands	82	16.05%	4.94%	6.17%	75	17.33%	6.67%	6.67%	80	16.25%	7.50%	7.50%
Saudi Arabia	127	11.81%	0.79%	0.00%	98	2.04%	0.00%	0.00%	76	3.95%	2.63%	0.00%
Turkey	257	21.09%	5.86%	5.08%	272	22.06%	6.62%	5.15%	220	20.45%	7.73%	5.00%
Switzerland	167	18.67%	5.42%	6.02%	161	13.04%	2.48%	3.73%	171	16.37%	1.75%	1.17%

Appendix Table 3: Fraction of Public Zombie Firms by Country in Five-Year Intervals (Cont.)

Panel B

Nation	2005				2000				1995			
	#Firms	IC	IC & Z	IC & Z"	#Firms	IC	IC & Z	IC & Z"	#Firms	IC	IC & Z	IC & Z"
United States	3,393	18.62%	6.12%	8.20%	4,502	27.87%	6.07%	8.94%	4,948	20.87%	3.21%	6.07%
China	1,301	14.14%	5.07%	5.30%	202	10.89%	2.48%	3.47%	n.a	n.a	n.a	n.a
Japan	2,538	6.47%	0.71%	0.71%	2,305	11.68%	0.61%	0.65%	1,629	9.64%	0.25%	0.18%
Germany	505	20.20%	5.94%	6.53%	590	22.20%	1.36%	1.69%	137	8.03%	0.73%	0.00%
India	136	19.12%	9.56%	6.62%	77	16.88%	9.09%	9.09%	n.a	n.a	n.a	n.a
United Kingdom	1,392	28.30%	8.69%	11.42%	1,279	21.89%	3.28%	5.39%	1,138	11.60%	2.28%	2.81%
France	560	12.86%	2.14%	2.50%	620	11.77%	1.61%	1.77%	292	3.08%	0.34%	0.00%
Italy	183	14.29%	3.30%	1.65%	185	5.95%	0.00%	0.54%	98	6.12%	1.02%	0.00%
Brazil	51	17.65%	7.84%	5.88%	60	31.67%	11.67%	8.33%	n.a	n.a	n.a	n.a
Canada	1,662	34.10%	12.65%	15.12%	712	24.93%	7.04%	8.45%	363	10.47%	0.55%	0.83%
Russian Federation	1,205	16.60%	2.82%	2.99%	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
Korea, Rep.	1,117	35.90%	13.52%	15.76%	558	20.61%	9.50%	6.63%	106	6.60%	0.00%	0.00%
Australia	95	7.37%	1.05%	1.05%	507	27.81%	9.66%	9.07%	193	11.40%	2.59%	3.11%
Spain	83	7.32%	1.22%	1.22%	113	1.77%	0.00%	0.00%	80	8.75%	1.25%	1.25%
Mexico	182	20.67%	10.06%	7.82%	87	11.76%	3.53%	1.18%	53	18.87%	0.00%	1.89%
Indonesia	97	9.38%	0.00%	1.04%	185	40.98%	24.04%	24.04%	94	2.13%	1.06%	1.06%
Netherlands	194	13.40%	5.15%	4.64%	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
Saudi Arabia	170	10.00%	1.76%	0.59%	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
Turkey	0	0.00%	0.00%	0.00%	121	4.96%	1.65%	1.65%	n.a	n.a	n.a	n.a
Switzerland	826	17.02%	5.42%	5.50%	172	5.23%	0.00%	0.00%	118	3.39%	0.00%	0.00%

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Appendix Table 4: Financing Channel and the Presence of Zombie Firms with Country Fixed Effects

This table reports estimates from the following regression:

$$ZombieFraction_{i,t} = \beta X_{i,t-1} + \delta Controls_{i,t-1} + CountryFE + YearFE + \epsilon_{i,t}$$

where $ZombieFraction_{i,t}$ of country i in year t is measured as the number of zombie firms, those with three-year moving average EBITDA interest coverage less than one and Z-score (or Z"-score) less than zero, scaled by the number of publicly traded firms. $X_{i,t-1}$ measures country-level annual bond, high-yield bond, loan and leveraged loan issuance amounts, as well as total stock market capitalization in trillions of dollars, and these figures as fraction of GDP in year $t-1$. *GDP growth, Stock market return, Sovereign rating (investment grade), Fraction of small firms, Fraction of young firms, Fraction of manufacturing revenue, Low interest rate dummy, Year fixed effects,* and *Legal origin (French legal origin, and German legal origin)* are included as controls. Variables are defined in Table 1. Robust standard errors clustered by year are reported in brackets. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Panel A: IC & Z

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Bond issuance	0.006*** [0.001]									
Bond issuance/GDP		0.334** [0.148]								
HY bond issuance			0.018*** [0.005]							
HY bond issuance/GDP				0.614 [0.471]						
Loan issuance					0.002*** [0.001]					
Loan issuance/GDP						0.146*** [0.041]				
Leveraged loan issuance							0.003** [0.001]			
Leverage loan issuance/GDP								0.236 [0.147]		
Market cap									0.177*** [0.056]	
Market cap/GDP										0.001 [0.000]
GDP growth	-0.231** [0.100]	-0.247** [0.098]	-0.232** [0.101]	-0.239** [0.103]	-0.241** [0.107]	-0.244** [0.103]	-0.239** [0.109]	-0.234** [0.108]	-0.230** [0.102]	-0.229** [0.103]
Stock index returns	-0.575* [0.304]	-0.637** [0.294]	-0.575* [0.301]	-0.604* [0.296]	-0.604** [0.287]	-0.552* [0.271]	-0.613** [0.288]	-0.609** [0.286]	-0.601* [0.306]	-0.609* [0.304]
Sovereign rating (investment grade)	-3.935*** [0.705]	-4.027*** [0.693]	-3.916*** [0.704]	-3.914*** [0.690]	-3.676*** [0.699]	-3.745*** [0.678]	-3.691*** [0.703]	-3.699*** [0.694]	-3.873*** [0.693]	-3.936*** [0.702]
Fraction of small firms	0.155*** [0.017]	0.133*** [0.013]	0.153*** [0.017]	0.134*** [0.013]	0.149*** [0.022]	0.138*** [0.018]	0.148*** [0.022]	0.141*** [0.021]	0.148*** [0.015]	0.132*** [0.012]
Fraction of young firms	0.038*** [0.010]	0.041*** [0.010]	0.039*** [0.010]	0.042*** [0.010]	0.028*** [0.010]	0.028*** [0.010]	0.029*** [0.011]	0.029** [0.011]	0.040*** [0.010]	0.044*** [0.010]
Fraction of manufacturing revenue	-0.070*** [0.017]	-0.076*** [0.017]	-0.072*** [0.017]	-0.075*** [0.018]	-0.063*** [0.020]	-0.060*** [0.021]	-0.066*** [0.020]	-0.064*** [0.022]	-0.069*** [0.017]	-0.072*** [0.018]
Central bank rate	0.719 [0.542]	0.860 [0.581]	0.697 [0.546]	0.763 [0.590]	1.500** [0.571]	1.792*** [0.605]	1.480** [0.592]	1.527** [0.600]	0.795 [0.561]	0.801 [0.589]
Country FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Nobs	529	529	529	529	475	475	475	475	529	529
Adj. R^2	0.712	0.708	0.711	0.706	0.720	0.721	0.718	0.717	0.708	0.705

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Appendix Table 4: Financing Channel and the Presence of Zombie Firms with Country Fixed Effects (Cont.)

					Panel B: IC & Z"					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Bond issuance	0.006*** [0.001]									
Bond issuance/GDP		0.308** [0.140]								
HY bond issuance			0.017*** [0.004]							
HY bond issuance/GDP				0.706 [0.439]						
Loan issuance					0.002*** [0.001]					
Loan issuance/GDP						0.108*** [0.038]				
Leveraged loan issuance							0.002** [0.001]			
Leverage loan issuance/GDP								0.169 [0.130]		
Market cap									0.156** [0.059]	
Market cap/GDP										0.000 [0.001]
GDP growth	-0.118 [0.084]	-0.133 [0.083]	-0.118 [0.085]	-0.128 [0.086]	-0.140 [0.087]	-0.143 [0.084]	-0.139 [0.089]	-0.136 [0.088]	-0.116 [0.087]	-0.115 [0.088]
Stock index returns	-0.241 [0.260]	-0.297 [0.251]	-0.240 [0.258]	-0.269 [0.252]	-0.285 [0.242]	-0.247 [0.233]	-0.292 [0.244]	-0.290 [0.242]	-0.264 [0.260]	-0.268 [0.258]
Sovereign rating (investment grade)	-3.423*** [0.575]	-3.507*** [0.566]	-3.404*** [0.573]	-3.386*** [0.558]	-3.167*** [0.557]	-3.223*** [0.545]	-3.182*** [0.560]	-3.190*** [0.554]	-3.369*** [0.559]	-3.433*** [0.565]
Fraction of small firms	0.191*** [0.015]	0.171*** [0.012]	0.189*** [0.016]	0.172*** [0.012]	0.182*** [0.020]	0.173*** [0.016]	0.181*** [0.020]	0.175*** [0.019]	0.184*** [0.015]	0.171*** [0.012]
Fraction of young firms	0.039*** [0.010]	0.042*** [0.010]	0.040*** [0.009]	0.043*** [0.010]	0.031*** [0.010]	0.031*** [0.010]	0.032*** [0.011]	0.033*** [0.011]	0.041*** [0.010]	0.045*** [0.010]
Fraction of manufacturing revenue	-0.064*** [0.016]	-0.070*** [0.017]	-0.066*** [0.017]	-0.069*** [0.017]	-0.057*** [0.020]	-0.055*** [0.020]	-0.060*** [0.020]	-0.059*** [0.021]	-0.063*** [0.017]	-0.066*** [0.017]
Central bank rate	0.501 [0.527]	0.629 [0.558]	0.479 [0.530]	0.529 [0.564]	1.254** [0.549]	1.474** [0.564]	1.241** [0.570]	1.278** [0.576]	0.569 [0.544]	0.577 [0.570]
Country FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Nobs	529	529	529	529	475	475	475	475	529	529
Adj. R^2	0.780	0.777	0.779	0.776	0.784	0.784	0.783	0.782	0.777	0.774

Appendix Table 5: Robustness—Zombieism by Interest Coverage Only

This table reports estimates from regressing $ZombieFraction_{i,t}$ of country i in year t on *Financing channels, Creditors' rights,* and *Debt enforcement efficiency*. $ZombieFraction_{i,t}$ is defined as the proportion of firms with three-year moving average EBITDA interest coverage less than one scaled by the number of publicly traded firms. The explanatory variable of *Financing channels* include country-level annual bond, high-yield bond, loan and leveraged loan issuance amounts, as well as total stock market capitalization in trillions of dollars, and these figures as fraction of GDP in year $t-1$. The *Creditor's right* and *Debt enforcement efficiency* variables include country level creditors rights from La Porta et al. (1998) and Djankov et al. (2008), the *Contract enforcement days*, and *debt enforcement efficiency* from Djankov et al. (2003) and Djankov et al. (2008) at year *t-1*. Control variables include *GDP growth, Stock market return, Sovereign rating (investment grade), Fraction of small firms, Fraction of young firms, Fraction of manufacturing revenue, Low interest rate dummy, Year fixed effects,* and *Legal origin* (*French legal origin,* and *German legal origin*) in year $t-1$. Variables are defined in Table 1. Robust standard errors clustered by year are reported in brackets. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Bond issuance	0.003*** [0.001]						
Bond issuance/GDP		0.426*** [0.092]					
HY bond issuance			0.009*** [0.003]				
HY bond issuance/GDP				1.605*** [0.421]			
Loan issuance					0.001*** [0.000]		
Loan issuance/GDP						0.331*** [0.045]	
Leveraged loan issuance							0.002*** [0.001]
Year FE	Y	Y	Y	Y	Y	Y	Y
Controls	Y	Y	Y	Y	Y	Y	Y
Nobs	529	529	529	529	475	475	475
Adj. R^2	0.743	0.748	0.743	0.747	0.743	0.757	0.741

	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Leverage loan issuance/GDP	0.463*** [0.124]						
Market cap		0.218** [0.081]					
Market cap/GDP			0.007*** [0.002]				
Creditors rights (LLSV)				-1.091*** [0.165]			
Creditors rights (DMS)					-0.651*** [0.155]		
Contract enforcement time (DLLS)						-0.202 [0.237]	
Contract enforcement time (DHMS)							1.360
Year FE	Y	Y	Y	Y	Y	Y	Y
Controls	Y	Y	Y	Y	Y	Y	Y
Nobs	475	529	529	477	529	529	508
Adj. R^2	0.744	0.745	0.758	0.755	0.745	0.742	0.756

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Appendix Table 6: Country and Event List of Formalized/Reformed Bankruptcy Laws Since 2000

Country	Year	Bankruptcy law reforms	Friendly	References
Brazil	2005	Formalizing a new bankruptcy law similar to US Chapter 11 and Chapter 7 (Amends Federal Law 11.101) Federal law 14.112/2020, becoming effective January 23, 2021 (DIP financing, prepacks, cross-border, substantial consolidation, creditors' ability to file a plan in judicial reorganization)	Creditor	Pontcelli and Alencar (2016); John et al. (2020)
China	2007	Enterprise Bankruptcy Law 2007-—Modern bankruptcy law formalized Interpretations by the Supreme People's Court (SPC) in 2011, 2013, and 2015	Debtor	Li and Pontcelli (2021)
France	2006	La Loi de Sauvegarde des Enterprises enacted in 2006—formalizing the bankruptcy law (facilitating debt renegotiations)	Debtor	Gilson et al. (2010); Altman et al. (2019)
India	2002	The Sick Industrial Company Act (SICA) of 1985 established Board for Industrial and Financial reconstruction (BIFR)—firms with greater than 50 employees and 5 years of operations: similar to Chapter 11 The Recovery of Debts due to Banks and Financial Institutions Act (RDDBGI) was established in 1993; it deals with firms with large debt The Securitization and Reconstruction of Financial Assets and Enforcement of Security Interests Act (SARFAESI) of 2002, a major reform to increasing creditor rights by allowing 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); Altman et al. (2019)
Italy	2005	Formalizing organization procedure in 2005 Liquidation procedure reform leading to strengthening of creditor rights in 2006	Creditor	Rodano et al. (2016)
Japan	2009	A quasi debtor-in-possession system introduced in 2009	Debtor	Altman et al. (2019)
Spain	2004	Reform leading to strengthening of creditor rights	Creditor	Djankov et al. (2008)
UK	2002	The Enterprise Act of 2002—closest to U.S. Chapter 11—was adopted Insolvency law based on the Insolvency Act of 1986 and Insolvency Rules of 1986 were replaced by the Insolvency Rules of 2016-—liquidation-based procedures (Administrative Receivorship)	Debtor	Davydenko and Franks (2008); Gilson et al. (2010); Altman et al. (2019)