



A 50-year history of “zombie firms” in Japan: How banks and shareholders have been involved in corporate bailouts?

Jun-ichi Nakamura

Toyo University, 5–28-20, Hakusan, Bunkyo-ku, Tokyo 112-8606, Japan

ARTICLE INFO

JEL classification:

E44
G21
G32
G33
G34

Keywords:

Zombie firm
Bailout
Main bank
Corporate governance

ABSTRACT

We review long-term changes in “zombie firms” in Japan over this half-century using listed firm data with a framework in which the concept of “zombie firms” includes possible efficient bailouts. The first wave of zombie firms occurred during the period of main banks (hereinafter MBs). MBs were able to actively choose which firms would receive bailouts at the time. However, commonly held beliefs about MBs’ monitoring power and the special role of corporate groups and long-term credit banks for bailouts are not supported. In the largest wave of the lost decade, we find the zombie firm problem in the manufacturing sector was just as serious as the non-manufacturing in terms of firm count. Moreover, the pathological phenomena such as unwilling concentration of loans to MBs were also rather typical in the manufacturing. Soft budget constraints have continued in the manufacturing even after the resolution of banks’ non-performing loans since the bubble burst came to an end, leading to the manufacturing-centered third wave of zombie firms following the Global Financial Crisis.

1. Introduction

The history of bank bailouts of corporations has characterized the postwar Japanese corporate finance system in terms of both benefits and drawbacks. Corporate bailouts and the zombie firm problem are two sides of the same coin. A distinction is simply whether or not the bailouts is desired.¹ Academically, however, nothing is certain to answer the following questions: What distinguishes corporate bailouts by main bank (hereinafter MBs) until 1970 from inefficient zombie lending? Were the problems of zombie firms in the lost decade caused by the deterioration of the MB relationship, which had worked effectively until the 1970 s, or were the inefficiencies and vulnerabilities inherent in the MB relationship simply revealed by the magnitude of the shock of the bubble economy’s collapse? Has shareholder discipline been effective in preventing inefficient bailouts since the mid-2000 s, when MB governance gave way to market governance?

To address these questions, we must generate long-term data for at least 50 years since the 1970 s using a unified framework in which the concept of “zombie firms” includes possible efficient bailouts. Moreover,

we must analyze which firms became “zombie firms” being financially supported in terms of firm–bank relations and shareholder composition. By introducing a definition of “zombie firms” appropriate for this purpose and an analytical approach that addresses the issue of selection bias, this study uncovers the following facts: The presence of a MB with a loan ratio above a certain level increased the likelihood of a bailout in the 1970 s, but the prevalent belief about the MB’s monitoring power and the role of corporate groups and long-term credit banks is exaggerated. Pathologies identified during the lost decade, such as problem procrastination and unwilling concentration of loans to the MB, are more common in the manufacturing sector, whereas foreign investor discipline has only worked in the non-manufacturing sector. Since the mid-2000 s, soft budget constraints have continued in the manufacturing sector, in the sense that over-indebted firms that are no longer competitive with declining sales receive financial support as a legacy of the past.

The primary contribution of this paper is to visualize the dynamics of zombie firms from a very long-term perspective for the first time. In Japan, the zombie ratio of publicly traded firms has experienced three

E-mail address: nakamura004@toyo.jp.

¹ Hoshi (2006) and Caballero et al. (2008), which are seminal works on zombie firms in Japan’s lost decade, define “zombie firms” as firms that are surviving thanks to financial support from banks but are in fact unlikely to revive (virtually dead). However, the identification of zombie firms in empirical studies including above two papers is basically based on the solvency perspective of “whether or not the firm is likely to become insolvent if financial support is stopped now.” In other words, there is no forward-looking perspective of “whether or not the firm has prospects for revival in the future. Hence, in an analytical sense, corporate bailouts and zombie firms are roughly equivalent.

waves over the last 50 years. Unlike previous zombie firm studies, which only focused on the lost decade,² our framework allows us to clearly understand the quantitative and qualitative relative relationships among the three waves. During the MB era, the wave was small, and the burden on the banks' health was not so severe that they could intervene proactively and boldly to rescue financially troubled firms. In the second and largest wave of the lost decade, attention was solely focused on the problem of zombie firms in the non-manufacturing sector, which had a huge impact on banks' health due to their large amount of borrowing, but the problem in the manufacturing sector was equally serious in terms of firm count. The structural problems in the manufacturing sector became clear in the third peak, following the Global Financial Crisis (hereinafter GFC), and approached the severity of the lost decade. However, the magnitude of the third peak was underestimated because the concentration of risk in the banking sector has been reduced compared to the past. The existence of the third peak is consistent with recent international research showing the emergence of zombie firms even in a market-centered financial system in response to aggressive monetary easing measures.

The second contribution is to dispel the stereotypical view of Japanese corporate bailouts and zombie firms, allowing for a consistent understanding over the last 50 years. Although all the dominant theories are reasonably consistent with the situation in each period, they fail to provide a consistent long-term view because the studies only cover about 10 years. Results of this study show that the presence of an MB with a loan ratio above a certain level increased the probability of bailouts in the 1970 s. Banks actively chose who would receive bailouts. However, in retrospect, they did not select superior companies to those that were not targeted for bailouts. Even if anecdotal stories about the success of MB corporate bailouts at that time were true, the widely held understanding that generalized them was quantitatively and qualitatively greatly exaggerated. The zombie firm problem of the lost decade's three nonperforming loan (NPL) industries (i.e., construction, real estate, and wholesale/retail) simply indicates the impact of interest-bearing debt. Results reveal that the ratio of zombie in terms of the number of firms in the manufacturing sector was the same. MBs no longer took the initiative in bailout actions, and the procyclical nature of the Basel I regulation led further to pathological phenomena, such as procrastination of problems and unwilling concentration of loan to the MB as is well known. However, they were typically observed in the manufacturing industry, not in the non-manufacturing industry. The peak after the GFC was comparable to the lost decade in the manufacturing sector, albeit for a shorter time. The Financial Revitalization Program (commonly known as "Takenaka Plan"), which was introduced in October 2022 and required banks to dispose of bad loans and tighter financial supervision, was said to have ended the zombie firms' problem. However, in the aftermath, firms became overly conservative in their investment and financial behavior, avoiding bank intervention and drastic reforms. In some ways, Takenaka Plan was sowing the seeds of the next zombie firms' problem.

Overall, the findings of this paper challenge the conventional view that the zombie firm problem is a transitory phenomenon caused by an outdated, bank-centric financial system. Zombie firm issues arose not only in the lost decade but in both the 1970 s, when the MB relationship was functional, and since the late 2000 s, when the transition to market-centered governance occurred. They occurred whether banks and shareholders were actively involved in the bailout, and under both the tight monetary environment in the beginning of the lost decade and the

strong easing measures after the GFC. Another contribution of this study is that it shows that zombie firms are not only a problem in the non-manufacturing sector but also frequently exacerbated in the manufacturing sector.

The existing literature has two major conflicting views on the evaluation of the MB relationship and the zombie firm problem of the lost decade, which have not been resolved since then. First, the MB relationship's once-effective bailout function has deteriorated as the environment has changed, resulting in the zombie firm problem. In previous times, MBs disciplined firms as monitors based on their affiliation with the *keiretsu* business group, which originated from prewar *zaibatsu*, capital, and long-term business relationships (Hoshi et al., 1990). When firms were in financial distress, MBs quickly put together reorganization agreements with other creditors to reduce adjustment costs. In such cases, the MB provided funds and intervened in company management by sending executives to fill the missing external markets for corporate control (Sheard, 1989). However, if banks' power over corporations declines and cozy ties form, this bailout function based on long-term relationships can quickly lead to "soft budget constraints" (Sheard, 1994). Hoshi and Kashyap (2004) discovered that managerial intervention by the MB decreased in frequency and effectiveness over time, based on case studies of financially distressed firms from the 1960 s to the early 1990 s. Meanwhile, Aoki et al. (1994) pointed out banks' inclination to lend to speculative projects and exacerbate asset price bubbles as financial liberalization reduced lending opportunities to traditional customers. Such inclination demonstrates a deterioration in banks' monitoring power. Peek and Rosengren (2005) empirically demonstrated in a seminal paper on bank misallocation of resources that the worse a firm's financial condition, the lower the bank's capital adequacy ratio, and the more the firm and bank belong to the same business group, the more likely the firm was to receive evergreen loans. Hoshi et al. (2018) examined how bank-led rescue operations in Japan have changed between 1981 and 2010 and found that the frequency and the intensity of restructuring by distressed firms has declined after the 1990 s, which can be interpreted as strong indicators of changing corporate governance in Japan, in particular in terms of the decline in corporate monitoring functions of main banks.

A few studies, however, are skeptical of the "myth" of MBs. For instance, Weinstein and Yafeh (1998) showed empirically that, even during periods of high growth, the growth and profitability of firms with high reliance on their MBs were not necessarily high. Hanazaki and Horiuchi (2000, 2001) argued insufficiency of the evidence of the bank monitoring function's effectiveness that has once existed. The MBs were able to embark on corporate bailouts not because they managed risk through appropriate information production, but because they were endowed with excess profits from the convoy system. Our empirical findings back up the latter point of view.

This paper focuses on key elements of the changes that have occurred in Japan's firm-bank relationship and corporate governance system over the past 50 years, particularly main banks, corporate bailouts, and zombie firms. It also discusses, in part, the impact of *keiretsu* business relationships and cross-shareholdings. In this respect, this study will serve as a complement to the literature that more comprehensively discusses the Japanese finance and corporate governance system. For example, with respect to the situation up to the 1990 s, the papers collected in Aoki and Saxonhouse (2000) cover a wide range of topics, including the role of securities markets, the government, and the legal system, and examine the background to the impasse of the once well-functioning Japanese economic system. Regarding the change of corporate governance and its impact in the lost decade, the papers compiled in Aoki et al. (2007) discusses the issues including corporate organization, employment, and boards with the perspective of institutional complementarities. In addition, Tomeczek (2022) uses a unique approach of text network analysis together with an extensive literature survey to clarify the function and evolution of the Japanese financial market and corporate governance system over a very long period of time

² Research on zombie firms since the GFC has been conducted mostly overseas. In the context of Japan, Nakamura and Fukuda (2013) and Nakamura (2017) provided estimates up to 2008, but the main focus of their analysis is on the causes of the recovery of zombie firms. Some newer studies explored small and medium-sized firms, with Goto and Wilbur (2019) providing estimates up to 2014, but the analysis period is short, up to six years.

since the Meiji era.

With regard to the background of excessive lending by Japanese banks, the impact of monetary policy, demographics, and mergers among financial institutions must also be considered. Shioji (2019) examined how banks increased lending in response to expanded reserves under quantitative easing in Japan. Fukuda and Okumura (2021) examined the impact of population aging on regional savings rates in Japan, with particular attention to the regional flow of funds. Uchino and Uesugi (2022) examined the effects of bank merger on unlisted firms' financing by focusing on firm-bank relationships. While each of these issues is important, they are beyond the scope of this study. The impact of those factors will be partially controlled for by year dummies in the following regression analysis.

Since FY 2020, which is beyond the scope of this paper, concerns have been growing that government support for firms damaged by COVID-19 would become a new source of zombie firms. Honda et al. (2023) and Hoshi et al. (2023), both of which examined the application of COVID-19 business support programs for SMEs in Japan, found that companies with low credit scores tended to use such programs even before the pandemic. Furthermore, Honda et al. (2023) concluded, based on the subsequent situation of firms that used the support programs, that such government support, while effective in preventing a surge in business failures, may have prolonged the lives of firms that were not viable in the long run.

The remainder of this paper is structured as follows. Section 2 describes the framework we used in the long-run analysis of this paper, which is based on empirical studies that have improved the method for identifying zombie firms. Section 3 examines the data from 1970 to 2019, focusing on changes in the zombie firm ratio and changes in corporate governance, such as MB relationships and shareholder composition. It also identifies issues for further investigation in the regression analysis. Section 4 describes the regression analysis framework and the explanatory variables used to elucidate which firms receive bailouts. Section 5 summarizes the main estimation results and discusses how to interpret them. Finally, Section 6 concludes the paper.

2. Definition of zombie firms and methods of empirical research

The first academic researches to define zombie firms were Hoshi (2006) and Caballero et al. (2008). They defined "zombie firms" as effectively bankrupt firms that are surviving by receiving financial assistance from banks because the term "zombie" implies "living dead." However, as Fukuda and Nakamura (2011) determined, only few firms considered to be zombie firms by Hoshi (2006) and Caballero et al. (2008) went bankrupt in reality, which is equivalent to "death" as a firm. Most of these firms finally recovered to the point where they could stand on their own without financial support. Therefore, strictly speaking, zombie firms as described by Hoshi (2006) and Caballero et al. (2008), are not "the living dead," but rather "dying" firms that would fail without financial support.³ The MB's bailout function up until 1970 s has been, in principle, considered positive in that it saved adjustment costs when an inherently efficient firm that deserved to continue was on the verge of becoming insolvent due to temporary shock, but it appeared no different from a zombie firm in that it provided financial assistance to a dying company. The only difference is whether the bailout target is an efficient or inefficient firm that deserves to have its life extended.

³ The origin of the term "zombie firm," has various views, but one of them is that the term "zombie firm" was coined in newspaper articles in late 1990 s which reported the fact that some distressed construction firms that had been relieved of their debt burden through legal reorganization had resumed getting orders of public works projects, whereas peer firms that were not in legal reorganization were excluded from bidding because of their heavy debt burden and complained unfairness. The image of zombie firms as "the living dead" is thought to have its origins in such case.

Whether many firms that bailed out during the lost decade were really inefficient, whereas many were efficient until the 1970 s, when the MBs were operating reasonably well, is a question that needs to be empirically investigated using uniform criteria.

To conduct empirical studies on zombie firms, we must properly identify firms that meet the definition using publicly available data, specifically firm financial data. Hoshi (2006) and Caballero et al. (2008) proposed a simple method for this purpose. First, they obtained a "theoretical value of the minimum interest to be paid (minimum interest expense)" by multiplying and summing the short- and long-term prime lending rates in the previous year, and the minimum coupon rates of convertible bonds issued in the previous five years by the corresponding balance of interest-bearing debt at the start of the period (end of the previous period). Specifically, the theoretical minimum interest expense in year t for firm i is defined by the following equation:

$$R_{i,t}^* = rs_{t-1}BS_{i,t-1} + \left(\frac{1}{5} \sum_{j=1}^5 rl_{t-j} \right) BL_{i,t-1} + rcb_{\text{minover last5years},t} \times Bonds_{i,t-1}$$

where rs is the short-term prime rate, rl is the long-term prime rate, $rcb_{\text{min over last 5years}}$ is the lowest coupon rate for convertible bonds issued in the past five years, BS is the outstanding short-term debt, BL is the outstanding long-term debt, and $Bonds$ is the outstanding bonds.⁴ Then, they identified "zombie firms" with only one point; the actual interest expense was less than that amount (hereafter, the "CHK method").⁵ However, as they admit in their paper, this definition has two obvious flaws. First, there is a risk of identifying firms that should be identified as "zombie firms" as not being "zombie firms" if they are paying interest as contracted, thanks to "evergreen lending" (Type I error). Second, good firms offered low interest rates below the prime rate due to their extremely low-risk premium will be misidentified as "zombie firms" (Type II error). According to Fukuda and Nakamura (2011), Types I and II errors are of non-negligible magnitude, particularly in the 2000 s, when Type II errors became more serious and the ratio of zombie firms was clearly overestimated concerning movements in banks' NPL ratios.

Fukuda and Nakamura (2011) proposed the following changes to the CHK method for identifying zombie firms to address these two issues (hereinafter the "FN method"). To avoid Type II error, the first modification is to add a profitability criterion. The profitability criterion specifically excludes from zombie firms those with earnings that can cover the theoretical minimum interest payment, that is, earnings before interest and tax (EBIT) above the theoretical minimum interest payment. The interest coverage ratio (ICR) is the value obtained by dividing EBIT by actual interest expense, and whether or not the ICR exceeds 1 is used as an important threshold for solvency in credit ratings. When substituting a theoretical value for the interest paid in the denominator, we will refer to it as "theoretical ICR" hereafter. The profitability criterion of the FN method can be expressed as whether or not the theoretical ICR exceeds 1.⁶ To avoid Type I error, the second modification is to regard firms with the following characteristics as receiving evergreen lending support and include them as zombie firms: firms that pay interest above the theoretical minimum but have a theoretical ICR of less

⁴ These authors applied the interest rate of convertible bonds to all types of bonds and ignored the interest rate on commercial paper to estimate the minimum interest payment as conservatively as possible.

⁵ They did not use data that directly capture inefficiencies to avoid the endogeneity problem that would arise when testing the hypothesis that the profitability of industries with many zombie firms and the profitability of healthy firms in those industries is lower than in industries with few zombie firms.

⁶ Nakamura and Fukuda (2013) and Nakamura (2017), which extended Fukuda and Nakamura (2011), in addition to the profitability criterion, also excluded from zombie firms whose external debt to total assets ratio at the beginning of the period was less than 0.2.

than 1; firms whose external debt to total assets ratio was above a certain high level at the beginning of the period;⁷ and firms whose borrowings have increased since the beginning of the period.⁸

Although the zombie firm ratio calculated using the FN method is now much more plausible and consistent with changes in the NPL ratio, Imai (2016) raised another issue in his first study of Japanese SMEs. That is, whether the CHK and FN methods are overly sensitive to temporary fluctuations in earnings caused by exogenous shocks, because they essentially judge zombie firms solely on current-period financial indicators. This point was also acknowledged by Nakamura and Fukuda (2013) and Nakamura (2017). They treated companies determined to be zombies in only one year during the analysis period as being due to contingent factors and thus excluded them from zombie firms. However, Imai (2016) proposed a more radical modification in which the theoretical ICR is calculated using the cumulative values of the past three fiscal years for both the denominator and numerator (hereinafter the “Imai method”). This would smoothen the impact of contingent factors and make identifying firms with chronically low profitability as zombies easier. Goto and Wilbur (2019), who also studied Japanese SMEs, compared the ratio of zombie firms using the CHK, FN, and Imai methods and found no essential difference between the FN and Imai methods. However, they noted that the Imai method, which uses cumulative values, is prone to problems in regression analysis, such as multicollinearity, when the data are constrained in the time-series column direction, and they adopted the FN method.

Compared to these studies focusing on Japan, foreign studies on the problem of zombie firms as a negative effect of unconventional monetary policy after the GFC used the following three characteristics in identifying zombie firms. First, they focus solely on interest-paying ability, such as ICR or theoretical ICR, rather than examining the specific support provided by the banks, such as interest rate reductions and evergreen lending. Second, they are more careful than Japanese studies in removing the effects of temporary earnings fluctuations. Third, in some cases, a forward-looking perspective of the stock market, such as Tobin's q , is incorporated. For example, Adalet McGowan et al. (2018) identified zombie firms using only a simplified version of theoretical ICR as a criterion, classifying a firm as a zombie if its theoretical ICR fell below 1 for three consecutive years.⁹ The first and second characteristics are combined in their method. Banerjee and Hofmann (2022) added the criterion that Tobin's q must be below the median in the sector to the condition that the actual ICR be below 1. They explain that using Tobin's q incorporates a market perspective on future profitability, and using the “below the median” criterion eliminates the impact of overall market fluctuations. Furthermore, to eliminate the impact of short-term fluctuations in profits and stock prices, they ensure robustness of zombie in “two-ways”. Specifically, they classify a firm as a zombie after the aforementioned conditions are met for two years. Moreover, they declassify only after the aforementioned conditions are not met for two years. Their method combines all three characteristics.

These three characteristics of recent foreign studies essentially reflect differences in the structure of the financial system and the financial environment of the countries studied compared to Japan. Regarding the first characteristic, this should be because foreign firms tends to be less reliant on bank debts than Japanese firms. Moreover,

⁷ The threshold for the external debt to total assets ratio was set at 0.5 in Fukuda and Nakamura (2011), but it was reset at 0.2 in Nakamura and Fukuda (2013), referring to the median value of the analysis period. This is to avoid targeting only extremely over-indebted firms, which has been followed in subsequent studies such as Imai (2016) and Nakamura (2017).

⁸ In the case of debt forgiveness during the period, the amount equivalent to the forgiven amount is added back to the end of the period outstanding loan balance before applying the criterion.

⁹ They tested even four- and five-year consecutive criteria as a robustness check.

recent foreign studies have been more interested in the side effects of comprehensive central bank support rather than selective MB support. Furthermore, the first characteristic should be also due to greater data limitations in corporate financial data in foreign countries or when comparing international data. The second characteristic reflects the fact that foreign firm management is less concerned with profit smoothing than Japanese firm management, making the effects of temporary fluctuations in earnings more severe. The third characteristic reflects the greater importance of capital market discipline in foreign corporate governance.

Interestingly, the third characteristic includes perspectives that can contribute to the study of zombie firms. Previous zombie firm studies on Japanese firms and foreign firms using Japanese methodology have essentially evaluated zombie firms from the backward-looking perspective of ICR, regardless of whether the emphasis is on productivity or solvency. Numerous external parallels exist between the MB bailout loans of the 1970 s and the zombie firms of the lost decade when viewed in retrospect. In other words, the backward-looking perspective has long been the dominant mindset in the bank-centered financial system in Japan, regardless of whether the outcome is positive or negative. In contrast, recent corporate governance reforms in Japan have focused on the type of firm that have a solid financial position (e.g., effective zero leverage) but poor profitability and growth potential, owing to their conservative management. This type of firm is not a zombie as long as it is evaluated from a backward-looking perspective. However, it should be regarded as a zombie in terms of capital market discipline because its corporate value tends to be depressed. As a result, incorporating a forward-looking perspective is a crucial new development in the study of zombie firms, but it is beyond the scope of this paper and will be left for future research.

The zombie criterion used in this study is based on the FN method with the following three modifications to analyze the 50 years since the 1970 s with a unified standard and incorporate the points discussed in previous studies after FN.¹⁰ The first consideration is the inflation rate in the evergreen lending criterion: an increase in outstanding borrowings on a nominal basis is a necessary condition in the FN and Imai methods for identifying evergreen lending. This is reasonable for the 1990 s and beyond, when inflation was typically close to zero. However, because of the first oil shock in the early 1970 s, the Japanese economy experienced inflation that peaked at 20% and averaged around 10%. Even if the size of business remains constant in real terms in an inflationary economy, sales and assets in nominal terms increase in line with the rate of inflation, and thus, the size of borrowings grows. Therefore, in this paper, comparisons of outstanding borrowings are made in real terms adjusted for inflation in the core consumer price index (excluding the effect of the consumption tax), so that the effect of inflation does not overstate the amount of evergreen lending in the 1970 s

The second modification is that EBIT, used as the numerator in calculating the theoretical ICR, is replaced by EBITDA, which includes depreciation and amortization. EBITDA divided by actual interest expense is sometimes simply referred to as ICR, as in the case where EBIT is used as the numerator, but hereafter it will be called EBITDA-ICR to distinguish it from ordinary ICR. Moreover, when a theoretical value replaces interest expense in the denominator, it will be referred to as “theoretical EBITDA-ICR.” The theoretical EBITDA-ICR is used in this paper for two reasons: First, we aim to clarify that the definition of a zombie firm since CHK is an insolvent firm rather than an unproductive firm. Caballero et al. (2008) defined zombie firms as follows (italicizing by the author): “Large Japanese banks often engaged in sham loan restructurings that kept credit flowing to otherwise *insolvent borrowers*

¹⁰ Similarly with the FN method, EBIT in this study is calculated by adding back taxes and interest expense to final profits. Thus, it includes extraordinary incomes and losses, but excludes gains on debt forgiveness from extraordinary incomes.

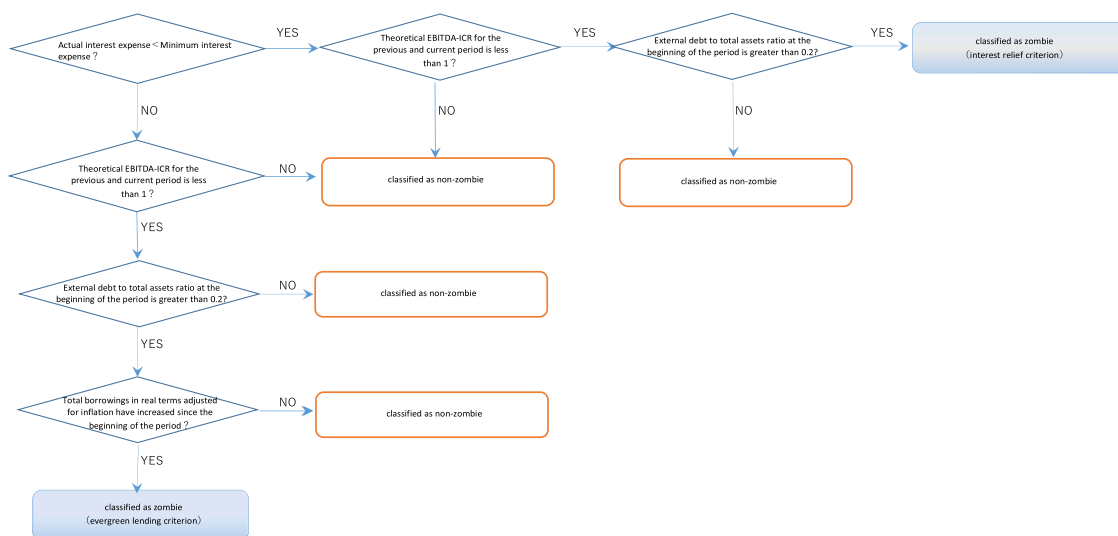


Fig. 1. Flowchart of zombie firm identification in this study.

(which we call zombies).” Depreciation is a typical item in the accounting valuation allowance and is a non-cash outflow expense. If we are to evaluate solvency rather than productivity, depreciation that has already been deducted from EBIT should be reversed back because it is part of the cash inflow that can be used to pay interest¹¹. Another reason for using theoretical EBITDA-ICR is comparability with the 1970s: many Japanese firms in the 1970s were still in the growth stage and made many upfront investments compared to today or even the 1990s firms, so depreciation and amortization as a percentage of value added is typically high. Consequently, when measured by EBIT, firms are more likely to be identified as a zombie in the 1970s than in the 1990s and beyond. This problem is avoided using EBITDA rather than EBIT.

The third modification concerns removing the effects of temporary earnings fluctuations: the FN method performs primary zombie identification using the theoretical ICR for the current year. Through the primary identification, firms that were classified as zombies for only one year during the analysis period were reclassified as non-zombies because they were thought to be affected by temporary earnings fluctuations. However, because the analysis period spans 50 years, this two-step method does not work in this study. Therefore, we use the current and the previous period’s theoretical EBITDA-ICR in our identification. Specifically, of the firms paying only less than the theoretical minimum interest payment, zombie firms are those whose theoretical EBITDA-ICR for the previous and current fiscal year is less than 1 and whose external debt to total assets ratio at the beginning of the period is greater than 0.2 (interest relief criterion).¹² Furthermore, even if the firm pays more interest than the minimum interest payment, it is classified as a zombie firm if all the following three conditions are met: (1) theoretical EBITDA-ICR is less than 1 for the previous and current periods; (2) external debt to total assets ratio is greater than 0.2 at the beginning of the period; and (3) total borrowings in real terms adjusted for inflation have increased

since the start of the period (evergreen lending criterion). The Imai method of classification based on cumulative values over several years is also effective at eliminating the effects of temporary fluctuations in earnings. However, the concept of cumulative values does not fit banking practice of managing lender risk. Our criterion based on two consecutive years is more consistent with real-world banking behavior.¹³ Stronger persistence criteria, such as the three-year criterion used by *Adalet McGowan et al. (2018)* or the two-way two-year criterion used by *Banerjee and Hofmann (2022)*, are also not applicable to this study because they result in time differences between the waves of calculated zombie firm ratios and the waves of banks’ NPL ratios and other real-world economic events.¹⁴

3. Overview of the data: zombie firm ratio, main bank relationship, and shareholder composition

We examine the changes in the zombie firm ratio calculated using the definition adopted in the previous section from a data set spanning half a century since the 1970s and changes in the circumstances surrounding corporate discipline and bailouts, such as MB relationships and shareholder composition. We also identify issues that should be investigated further in the regression analysis in this section. The analysis covers non-consolidated financial data for more than 3000 companies in the manufacturing, construction, real estate, wholesale and retail (excluding the former nine major trading companies), and service industries that are currently or were previously listed on the first or second section of each stock exchange.¹⁵ Data for each firm’s accounting period is treated as data for the fiscal year to which its closing month belongs.

Fig. 2 depicts the evolution of the zombie firm ratio (in terms of the number of firms) from 1970 to 2019 using this study’s definition. We can

¹¹ Indeed, depreciation is a provision for future reinvestment, and using depreciation to cover interest payments is not sustainable as a going concern. In this regard, one could argue that EBIT considers long-term solvency. However, this only just paraphrases the normative proposition that an unproductive firm should be removed from the market if it cannot earn a return above the theoretical value of interest expense, which corresponds to a specific type of cost of capital. In fact, if a company can pay interest on its cash flow, it is unlikely to seek financial assistance from a bank, and even less likely for the bank to accept it.

¹² Threshold levels follow *Nakamura and Fukuda (2013)* and *Nakamura (2017)*.

¹³ In empirical studies, considering a firm in financial crisis when its ICR is below 1 for two consecutive periods is a method that has been generalized since *Hoshi et al. (1990)*.

¹⁴ See Fig. 1 for an overall logic of zombie firm identification used in this study.

¹⁵ Specifically, our data set includes firms whose data are recorded in the Development Bank of Japan’s “Corporate Financial Data Bank” for at least two consecutive fiscal years between FY1969 and FY2019. Firms in industries that are highly regulated and financially specialized, such as energy, transportation, and telecommunications, and companies listed on emerging markets, such as JASDAQ (formerly OTC-registered issues) and TSE Mothers, are excluded from the analysis. However, data from the emerging market period is included for companies that were promoted from emerging markets.

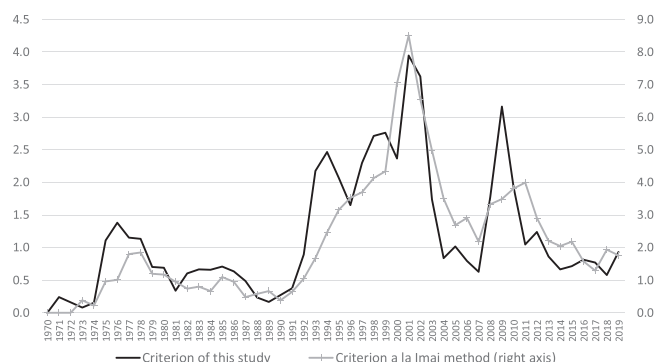


Fig. 2. Evolution of zombie firm ratio (based on number of firms, %).

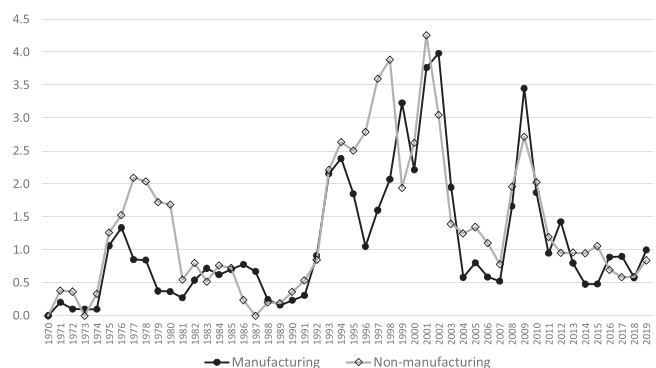


Fig. 3. Evolution of zombie firm ratio by industry (based on number of firms, %).

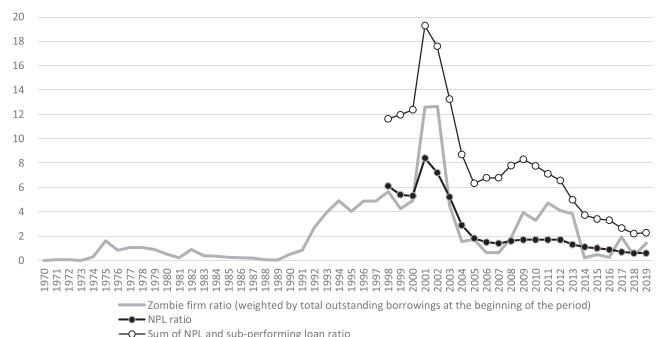


Fig. 4. Zombie firm ratio (weighted by total outstanding borrowings) and NPL and sub-performing ratio of major banks (%).

see three major waves in the time-series evolution of zombie firms over the last 50 years. The first wave started with the first oil shock and centered on the period from 1975 to 1979, when the zombie firm ratio peaked at 1.5%. The second is the massive wave of the “lost decade,” which began with the bursting of the bubble economy and lasted until the banks’ NPL problem was resolved (around 1993–2002), at which point the zombie firm ratio peaked at about 4%. The third is a sharply incisive wave that occurred between 2007 and 2013, triggered by a sharp decline in external demand due to the GFC, with the ratio of zombie firms peaking at just greater than 3%. Nakamura and Fukuda (2013), who used the theoretical ICR of the current year to identify zombie firms, discovered that the ratio at the peak of the second wave reached more than 15%, whereas the ratio is less than one-third of that

level under the criteria in this paper. The difference between the two can be mainly explained by two factors: the difference between ICR and EBITDA-ICR and the difference between the single-year and two-year basis. In Fig. 2, for comparison, the ratio a la Imai method is also shown on the right scale, when zombie firms are classified by whether the theoretical EBITDA-ICR with both the denominator and numerator calculated using the cumulative values of the previous three years is less than 1. The difference between the left and right scales indicates that the level of the zombie firm ratio a la Imai method is roughly double the ratio in this paper. Furthermore, the ratio a la Imai method has a smoother curve, with minor fluctuations smoothed out. However, the two trends are undeniably consistent.

Fig. 3 depicts the trends in the zombie firm ratio for the manufacturing and non-manufacturing sectors. The movements of the manufacturing and non-manufacturing sectors are generally synchronized, with one- or two-year peak gaps and temporary exceptions. In the first wave, the manufacturing sector peaked first, followed by the non-manufacturing sector, resulting in a larger wave than the manufacturing sector. During this period, the zombie firms in the manufacturing industry were small, such as those listed on the second section of the stock exchange. Firms in industries with high demand fluctuations in nature, such as steel and machine tools, stood out among them. Overall, these characteristics of manufacturing zombie firms are likely to go well with the MB’s bailout function. Non-manufacturing zombie firms were primarily found in construction and real estate industries. In the second wave, the manufacturing sector’s zombie ratio entered a temporary lull in the mid-1990s, whereas the non-manufacturing sectors continued to rise, and the manufacturing sector eventually followed suit, peaking in 2001–2002; thus, the manufacturing and non-manufacturing sectors reached roughly the same level. The characteristics of zombie firms in the manufacturing industry are similar to those of the 1970s until the mid-1990s, with relatively small firms of the industries exposed to demand fluctuations standing out. However, after the banking crisis began in earnest at the end of the 1990s, they spread across industries, with larger firms becoming more prominent. Since the 1990s, zombie firms in the non-manufacturing sector have been dominated by the so-called three NPL industries, namely, construction, real estate, and wholesale and retail, and are characterized by their large size. In contrast, in the third wave, the non-manufacturing sector is dominated by small firms in construction and real estate, whereas the manufacturing sector is dominated by larger firms, particularly in electric machinery.

The zombie firm ratio in terms of firm counts may give the impression that the criteria in this paper underestimate the problems of the second wave, particularly the non-manufacturing sector, based on the absolute value of the ratio, the relative relationship with the first and third waves, and the relative relationship with manufacturing sectors. However, this only reflects the fact that non-manufacturing zombie firms and related NPLs were often huge in size per case during the second wave. In fact, when weighted by total outstanding borrowings at the beginning of the period, the zombie firm ratio jumped to just under 13% at the peak of the second wave in 2001–2002, indicating that the impact of bailout loans on bank health was far greater than in the first wave (Fig. 4). When comparing banking behavior toward distressed companies during the lost decade to that of MBs until the 1970s, we must consider this scale difference. Fig. 4 clearly shows that the levels and trends of the zombie firm ratio weighted by total outstanding borrowings from 1998 to the mid-2000s were generally consistent with the NPL ratio and the sum of NPL and sub-performing loan ratio of the major bank statistics by the Financial Services Agency (FSA),¹⁶ indicating that our criterion does not undervalue the second wave of loans. Since the late 2000s, however, a clear divergence has been existing between the

¹⁶ “Sub-performing” refers to loans classified as “need attention” but not classified as “special attention” by the self-assessment of assets by banks.

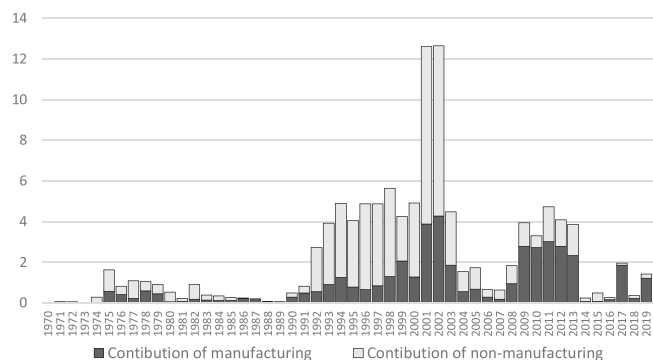


Fig. 5. Contribution decomposition of zombie firm ratio (weighted by total outstanding borrowings) by industry (% point). Notes 1) NPL ratios are based on disclosed claims under the Financial Reconstruction Law. 2) Sub-performing loan ratios are estimated by first calculating the value of the amount of claims in need of caution / (amount of claims in need of caution + amount of claims in danger of bankruptcy or below) based on the self-assessment of assets by major banks, and then multiplying it by the NPL ratio. Source: For NPL and sub-performing loan related figures, major bank statistics published by the Financial Services Agency.

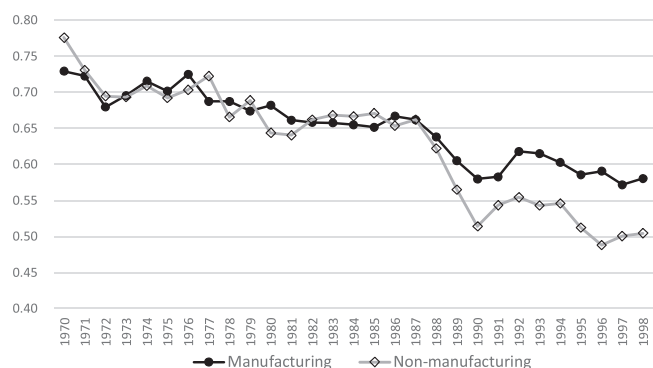


Fig. 6. Ratio of firms with MB.

two: the zombie firm ratio has shown clear troughs and peaks, whereas the NPL ratio continues to decline at a low level. Moreover, the sum of NPL and sub-performing loan ratio has also been essentially on a downward trend, except a small wave caused by the GFC. This discrepancy could be explained by the fact that the SME Financing Facilitation Act, in effect from 2009 to 2013, required banks to be more cautious in recognizing NPLs for SMEs, whereas our zombie firm ratio is calculated for publicly traded companies. By decomposing the contribution of the zombie firm ratio weighted by total outstanding borrowings by manufacturing and non-manufacturing industries, we show in Fig. 5 that the second and third waves are non-manufacturing- and manufacturing-centric problems, respectively.

A major structural change in Japan’s financial system is driving the aforementioned evolution of the zombie firm ratio. The firm–bank relationship and disciplining mechanisms, which were based on cross-shareholdings by MBs and corporate groups, became systemically fatigued because of economic globalization and financial liberalization. The ancient Japanese corporate governance regime either collapsed or underwent a major transformation because of the disposal of bad loans during the lost decade. Arm’s length, market-based mechanisms gradually spread throughout, including the accounting system and the state of financial supervision. We saw some temporary unwinding, such as a

move to re-enforce cross-shareholdings as a defensive measure as activist presence increased in the mid-2000s, and a reappraisal of the importance of banking transactions as a contingency lender when financial markets were affected by the turmoil caused by the GFC. However, the overall trend toward a market-centric system remained unchanged. Meanwhile, with the memories of the lost decade still fresh in Japanese corporate management’s minds, a debt governance behavioral pattern that prioritized cost-cutting and financial soundness over risky investments for growth has taken hold, contributing to long-term stagnation. Considering this situation, corporate governance reform has been identified as a key issue in the Abenomics growth strategy. Moreover, to promote “growth-oriented governance” aimed at sustainable growth and medium- to long-term enhancement of corporate value, the Japanese Stewardship Code was established as a code of conduct for institutional investors in Feb 2014 (subsequently revised in May 2017 and April 2020). Additionally, the Japanese Corporate Governance Code was introduced as a code of conduct for listed firms in June 2015 (subsequently revised in June 2018). To quantify the impact of the aforementioned changes in corporate governance structure on bank bailout behavior, we generated data on bank transaction relationships and shareholder composition from corporate financial data and used them as explanatory variables in the regression analysis. In this section, we review the evolution of the major items among them.

The MB relationship must be identified as the key variable regarding the bank transaction. Information on schedule of short- and long-term borrowings from the annual security report is available for this purpose. The disclosure of borrowing schedules was mandatory only until FY1998; afterward, information on the MB is no longer available. However, MBs’ roles and influence had significantly weakened by this time, and this is not a limitation that undermines the purpose of this study. Many studies have been conducted on the MB relationship in Japan, and the definition of MB varies slightly depending on the period and author. In the empirical analysis, many cases show that the bank with the largest share of loans is simply regarded as the MB. However, more sophisticated approaches identify the MB by examining characteristics other than lending, such as stock ownership and the dispatch of directors, whereas others focus on the firm’s perception (of who is the MB) and use the order of entries in the Japan Company Handbook’s banking transaction column. However, the latter approach is impractical when preparing very long-term data for all listed companies. Hence, as a method of identification that considers a certain degree of continuity while focusing mainly on loan share, the financial institution with the largest share of short-term loans in the borrowing statements for two or more consecutive years is considered the MB. Firms that lack a financial institution that meets this condition are classified as “being without MB.” We calculate the share using short-term loans rather than total loans because the MB’s information advantage is its ability to monitor real-time trends in deposits and withdrawals from checking accounts, and because MB is sometimes not the largest lender until the early 1980s in terms of total borrowing as long-term loans often ballooned immediately after large capital investments under a segregation between long- and short-term loans. Meanwhile, some studies emphasized the role of long-term credit banks in distressed firm bailouts (Packer, 1994). They argued that, although long-term credit banks were not the largest lenders, they played a different role from MBs because of their neutrality from the corporate group and their pipeline to the government. Therefore, we add the financial institution with the largest share of long-term loans for two or more consecutive years as the MB of long-term loans to the list of explanatory variables.¹⁷

Fig. 6 shows the percentage of firms that have an identified MB as

¹⁷ In the following, when we simply refer to the “MB,” we mean the MB as defined by the short-term loan share.

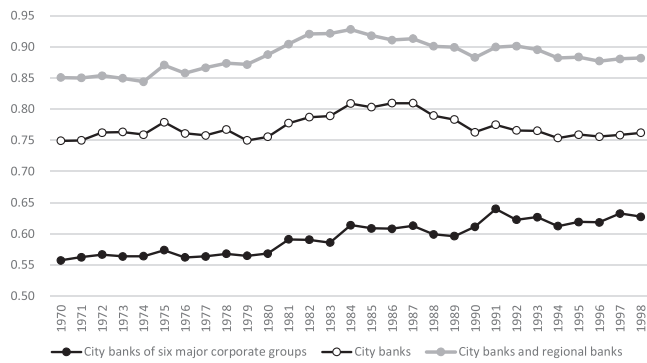


Fig. 7. MB attributes.

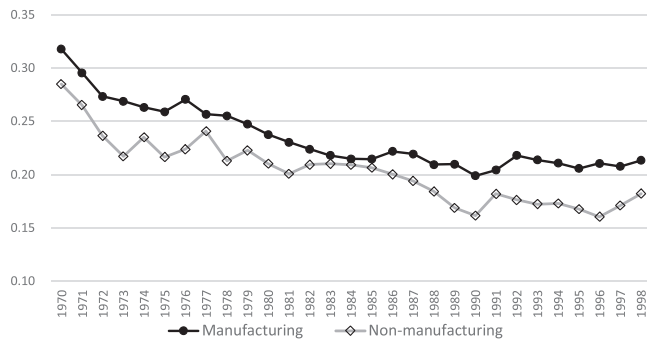


Fig. 8. Average share of MB's loan.

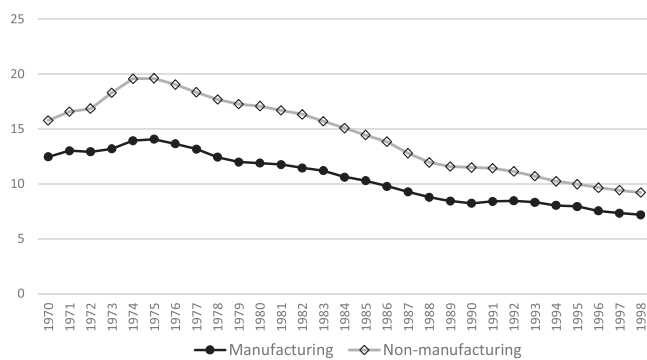


Fig. 9. Average number of lending banks.

defined by the short-term borrowing criteria.¹⁸ In the early 1970 s, around 70% of both manufacturing and non-manufacturing firms had an identified MB. Although the percentage gradually declined, it remained relatively stable at around 65% in the mid-1980 s. It did, however, fall significantly over several years during the formation of the asset price bubble, falling below 60% and nearly 50% in the manufacturing and non-manufacturing sector, respectively. As the number of leading borrowers declined (so-called “large firms’ graduation from bank”), we observed increased competition for loan share in fields of real estate development projects. The ratio of MB ownership recovered slightly

¹⁸ As a variation of MB relations, a type known as “parallel MBs” shows that two banks held the same share of loans. It occurs in various circumstances, such as when a firm’s strategy is to make the two banks compete to get better terms or when it is based on an agreement between the MBs of each firm in the case of equal merger. However, the commitment of parallel MBs is considered relatively weak compared to that of a single MB. Hence, in the identification method used in this paper, cases with parallel MBs are not considered as the MB relationship. The ratio of firms with parallel MBs is not that large, only 2–3%.

during the collapse of the bubble economy, but it has since declined again in the mid-1990 s, indicating that firm–bank relations have become more liquid. When the MB is identified by the share of total loans rather than the share of short-term loans, the ratio of firms with an identified MB rises by about 5–10% points, but the variation has no significant difference over time.

When a firm is in financial distress, the extent to which bailout loans are provided smoothly and lead to subsequent recovery is determined by the existence of an MB. It is also determined by factors such as the MB’s characteristics, the degree of information asymmetry between the firm and banks, and the severity of the free-rider problem among banks in the bailout process. Through empirical analysis, Hoshi et al. (1990) discovered that when the firm and its MB belong to one of the six major corporate groups (Mitsubishi, Mitsu, Sumitomo, Fuyo, Ichiban, and Sanwa), the aforementioned frictions are relatively small, and investment and sales are likely to recover quickly after the distress. The characteristics of MBs should be examined from this perspective. The share of MBs belonging to the six major corporate groups was over 55% in 1970 and remained nearly unchanged throughout the 1970 s. However, it began to rise, albeit gradually, in the 1980 s and remained stable at 60% in the 1990 s (Fig. 7). This can be attributed to the survival of the MB relationships of the six largest corporate groups, which have relatively strong ties, despite an overall trend of dilution of MB relationships. The share of MB loans in short-term borrowings has steadily declined from around 30% in the 1970 s to below 20% in 1990, and then stopped falling (Fig. 8).¹⁹ The number of lending banks can be used as a proxy for the severity of the free-rider problem and the difficulty of renegotiating bailout terms. Fig. 9 shows the evolution of the average number of lending banks, which peaked in the mid-1970 s and then steadily declined until 1998, the last year of the data. Note that the number of lending banks is data with a long tail, and even in the 1990 s, when the average value declined, a certain number of firms still have more than 50 lending banks (Fig. 10–1 and –2).

This section concludes with an overview of how shareholder composition has changed. Our shareholder composition data set is derived from the “ownership and share distribution” section of each firm’s annual security report and is divided into six categories: “national and local governments,” “financial institutions,” “financial instrument dealers (security companies),” “other domestic corporations (non-financial businesses),” “overseas corporations,” and “individuals and others.” Among the shareholder composition, the three types of shareholders we would like to focus on are: 1) MBs and other relationship-oriented lenders, 2) business corporations with cross-shareholdings and 3) foreign investors. From the perspective of corporate governance, Types 1 and 2 place a premium on long-term business relationships and are typical of stable shareholders who are friendly to corporate management as long as the firm is not financially distressed. In contrast, Type 3 has the sole purpose of maximizing the share price and is typical of activist shareholders who do not hesitate to intervene in management or antagonize management. As to the data issue, Type 3 is considered to correspond almost one-to-one to “overseas corporations,” among the six categories for which data are available at the individual firm level. Meanwhile, Types 1 and 2 are only one component of “financial institutions” and “other domestic corporations (non-financial businesses),” respectively, and we can only observe proxy variables with noise.

Based on the JPX’s Share Distribution Survey, Fig. 11 depicts the overall shareholder composition of listed companies. Clearly, the proportion of foreign corporations’ ownership has increased steadily from the early 1990 s to the mid-2010 s. Combined with their aggressive involvement, which differs significantly from that of ordinary Japanese shareholders, this has resulted in a greater presence of foreign

¹⁹ These figures are consistent with Hoshi and Kashyap (2004), which showed MB loans accounted for 24% of the total loans in 1975 (data source: Corporate Group Almanac).

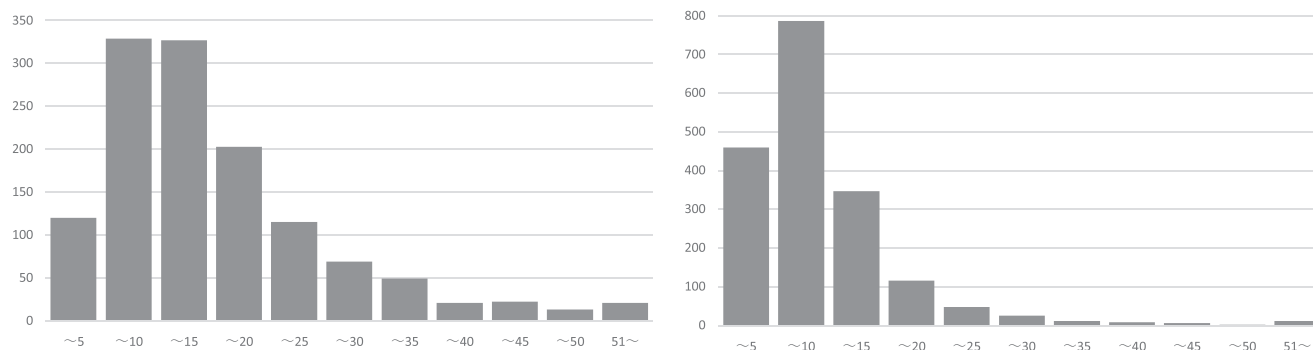


Fig. 10. – 1 (left panel). Histogram of number of lending banks (as of FY1975; Horizontal axis = number of banks; Vertical axis = number of firms). – 2 (right panel). Histogram of number of lending banks (as of FY1998; Horizontal axis = number of banks; Vertical axis = number of firms).

shareholders during this period. Another distinguishing feature of foreign investors was their strong preference for specific stocks. For example, *Miyajima and Kuroki (2007)* stated that they preferred prestige firms that were large, had a high proportion of overseas sales, were profitable, and had high credit ratings. When analyzing how foreign investors' shareholdings have affected corporate disciplining, we must remember the endogeneity issues that arise from this tendency to select stocks. Unlike the annual security report, the shareholding ratio of financial institutions is divided into two categories: "trust banks" and "city banks, regional banks, insurance companies, and other financial institutions." Most trust bank ownership corresponds to "trust accounts" entrusted to them by institutional investors like investment and pension trusts and public institutions like the Banks Shareholding Purchase Corporation. These trust account shareholders are not necessarily activists, but their personalities are clearly distinct from those of Type 1 shareholder.²⁰ Moreover, as shown in the figure, although city bank's shareholding ratios have declined significantly since the late 1990s, trust bank shareholding ratios have increased rapidly during the same period, resulting in their shareholding ratios exceeding those of city banks. Although the firm-level data used in the regression analysis do not provide information on the breakdown, the changes in the breakdown of financial institutions in the aggregate data described above must be considered to properly interpret the impact of financial institution shareholding ratios on distressed company bailouts. Lastly, the shareholding ratios of non-financial domestic corporations fell in the late 1990s and early 2000s, but remained stable compared to city bank shareholding ratios, the consensus is that cross-shareholding dissolution occurred between 1997 and 2004, with a partial resurgence beginning in 2005. Quantitative evidence indicates that cross-shareholdings between banks and non-financial corporations are the primary driver of dissolution, and that dissolution of cross-shareholdings among non-financial corporations is slow.

4. Regression analysis framework and explanatory variables

This section describes the regression analysis framework and the explanatory variables that were used to determine which types of firms became zombie firms. The dependent variable is a dummy variable that takes 1 when the firm is classified as a zombie and 0 otherwise, and its determinants are estimated using probit regression. If we use ordinary probit regression on the entire dataset of listed firms, we will directly compare an insignificant number of zombie firms with many non-zombie firms, including excellent firms, a group with very different attributes and compositions. To address this sample selection issue, we use

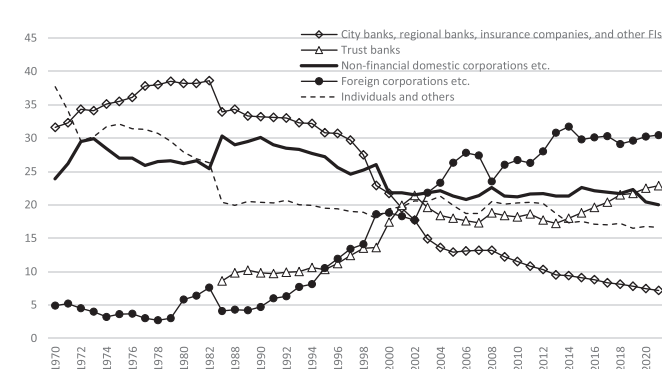


Fig. 11. Ownership structure of listed firms (%). Notes: 1) "Trust banks" are included in "City banks, regional banks, insurance companies, and other FIs" before 1986. 2) Companies listed in JASDAQ stock exchange are included in the survey since FY2004. Source: JPX annual survey.

a weighted probit regression framework with weights calculated using the entropy balancing method to ensure that the sample means of the selected characteristic variables are nearly identical between the treatment groups (financially distressed firms) and the control group (all other firms). This gives us an exact idea of which firms are most likely to receive financial assistance in the event of a crisis. For calculating weights, we set the financially distressed samples as the treatment group, defined as theoretical ICR < 1 for two consecutive periods, and the non-financially distressed samples as the control group. In selecting characteristic variables, it is necessary to balance the advantages of alleviating sample selection problems by imposing many constraints with the disadvantages of reduced freedom in variable selection in probit regression. Hence, we set the characteristic variables as the ratio of interest-bearing debt to book value of total assets at the end of the previous period and the ROA (= EBIT/book value of total assets) of the previous period and the minimum theoretical interest expense to book value of total assets ratio of the previous period. In addition, we add three more ownership variables to the list of characteristic variables: the shareholding ratio of financial institutions, the shareholding ratio of non-financial domestic corporations, and the shareholding ratio of foreign corporations, for which endogeneity is a serious problem, when these data are available.

The explanatory variables for the probit estimation are as follows: (1) total asset book value (natural log); (2) ratio of interest-bearing debt to book value of total asset; (3) ROA(= EBIT/book value of total

²⁰ Introducing a stewardship code in the Abenomics corporate governance reform aims to achieve this type of shareholder dialogue with corporate management to enhance corporate value.

asset),²¹; (4) Tobin's q (natural log);²² (5) TFP growth (natural log difference);²³ (6) sales growth (natural log difference); (7) ratio of net worth in current price to book value of total asset;²⁴ (8) firm age (natural log);²⁵ (9) MB dummy (short-term); (10) share of the largest short-term lender; (11) MB dummy (long-term); (12) share of the largest long-term lender; (13) number of lending banks (natural log);²⁶ (14) change in the number of lending banks; (15) short-term borrowings outstanding to total borrowings outstanding ratio; (16) financial institutions' shareholding ratio; (17) non-financial domestic corporations' shareholding ratio; (18) foreign corporations' shareholding ratio; (19) industry dummies (five categories: manufacturing, construction, real estate, wholesale/retail, and services; and (20) year dummies. To alleviate the simultaneity bias problem, we take all flow variables one period earlier, and all stock variables are collected at the end of the previous period.

The estimated periods are set based on previous discussions on the evolution of the Japanese financial system and zombie firms: (I) FY1972–1979 which corresponds to the wave of zombie firms in the 1970s when the MB function was reasonably effective, (II) FY1993–1998 and (III) FY1997–2002 which correspond to the first half and the second half of the wave of zombie firms in the lost decade respectively, (IV) FY2004–2019 which corresponds to the period after the NPL problem of the lost decade ended and the corporate discipline

²¹ As noted in footnote 10, EBIT includes extraordinary incomes (excluding gains on debt forgiveness) and extraordinary losses, and the ratio of net extraordinary incomes (= extraordinary incomes - extraordinary losses) to book value of total assets is also added to the explanatory variables as necessary.

²² Tobin's q is calculated by (market value of equity + book value of total liabilities) / (book value of total assets excluding land + market value of land). The stock price used to calculate market value of equity is the average of the highest and lowest stock prices during the period, as shown in the "Trends in Stock Prices" section of the Annual Securities Report. We calculate the land market value according to the perpetual inventory method. The benchmark year is FY1965 for firms with data available prior to FY1965, and the year in which the firm first appeared in the Corporate Financial Data Bank for the other firms, and the book value of land multiplied by the market value/book value ratio calculated from the National Accounts is used as the benchmark for the market value of land. Annual land price appreciation rates are based on the average of urban land price indexes for all six major cities published by the Japan Real Estate Institute.

²³ The TFP growth rate is calculated by output growth rate - (intermediate input growth rate × intermediate input cost share) - (capital input growth rate × capital cost share) - (labor input growth rate × labor cost share). Because calculating firm-specific values from financial data would result in large measurement errors, factor input cost shares are calculated using industry-specific data from the JIP database. Deflators for determining output and intermediate inputs are also calculated using JIP Database industry-specific data. For the growth rate of capital input, we obtained the real capital stock using the perpetual inventory method benchmarked to FY1965 for each type of capital good (buildings, structures, machinery and equipment, vehicles and transport equipment, tools, furniture and fixtures, leased assets, and land) and used the growth rate (natural log difference) of the total value of these goods. Labor input was obtained by multiplying each firm's number of employees by the number of hours worked per worker by industry in the JIP database.

²⁴ Net worth in current price is calculated by the book value of total assets excluding land + market value of land - book value of total liabilities.

²⁵ Data on the effective date of establishment from the Nikkei NEEDS Financial Quest corporate database were used to calculate firm age.

²⁶ The number of lending banks is the number of lending banks (city banks, long-term credit banks, trust banks, regional banks, and second-tier regional banks) whose individual bank names are specified in the schedule of borrowings in the securities reports and whose total borrowing balance is positive, and does not include non-banks such as insurance companies, government financial institutions, and public corporations, as well as other banks whose breakdown is not clear because they are aggregated in the "Other" category. The following analysis is also performed on the total number of lenders, including non-banks, to ensure no essential impact on the results.

through the market mechanism prevailed, (V) FY2004–2013 which corresponds to the first half of the estimation period (IV) and the period before introduction of corporate governance reform under Abenomics, (VI) FY2007–2013 which corresponds to the third wave of zombie firms related to the GFC, (VII) FY2014–2019 which corresponds to the second half of the estimation period (IV) and the period before introduction of corporate governance reform under Abenomics, and (VIII) FY2017–2019 which corresponds to the period after the revision of the stewardship code and the corporate governance code to further promote the corporate governance reform. Of these, explanatory variables (9) through (15) related to firm–bank relationships are available only for estimation periods (I) and (II), whereas explanatory variables (16) through (18) related to shareholder composition are available only for estimation periods (II) and later.

Each explanatory variable has the following analytical meanings and sign conditions. (1) The book value of total assets (natural log) is a variable used to determine whether the size of a firm increases the likelihood of bailouts. If the coefficient of (1) is positive and significant, the Too Big To Fail (TBTF) bailout motive is at work.²⁷ (2) The interest-bearing debt-to-total-asset-book-value ratio is a variable that examines whether the degree of excess debt influences the likelihood of a bailout. This ratio comprises the conditions of the evergreen lending criteria in zombie identification; thus, it was chosen as an explanatory variable after incorporating it as a characteristic variable in advance to balance the mean values of the treatment and target groups. If the coefficient of (2) is positive and significant, it indicates that of the companies meeting certain high debt ratio conditions, those with more serious excessive debt levels are more likely to be bailed out. (3) ROA (= EBIT/book value of total assets) is a variable used to determine whether more profitable firms are more likely to be bailed out. ROA is closely related to ICR, which is used in zombie identification, and thus, it is also used as a characteristic variable in advance to balance the mean values of the treatment and target groups. As a result, if the coefficient of (3) is positive and significant, it indicates that of the companies meeting certain low profitability conditions, those with relatively high profitability are more likely to be bailed out. Note that the numerator of ROA, EBIT, includes unusual incomes and losses, excluding debt forgiveness gains. Hence, we adjusted for this factor as needed by including the "net extraordinary income to book value of total assets ratio," calculated by dividing extraordinary incomes minus extraordinary losses, excluding debt forgiveness gains by book value of total assets. (4) Tobin's q (natural log) is treated primarily as a control variable, with no special interpretation assigned to it. Indeed, Tobin's q contains information of a company's future prospects that differs from previous studies of Japanese zombie firms, including this paper. However, only because it includes a forward-looking perspective, Tobin's q likely also incorporates the likelihood of the firm receiving financial support or debt forgiveness (income transfer from creditors to shareholders) in the near future.

²⁷ For banks, there were generally two motives in TBTF bailout. The first was concern about a repercussion effect on the bank's own financial problems. If loans to over-indebted companies with large assets turn into NPLs, the bank's capital adequacy ratios would be severely damaged, and this could lead to a financial crisis for the bank itself. On the contrary, if the bank avoided turning these loans into NPLs by providing financial support, it could have waited for asset prices and the economy to recover, as well as for possible tax incentives from the government. The fact that the accounting system and financial supervision at the time allowed banks a great deal of discretion in recognizing NPLs likely contributed to such a motive. Another motive was the fear of social and political criticism that banks would face if they did not provide financial support and went into bankruptcy. In general, companies with larger assets have more employees and more clients, then the impact of bankruptcy on the macroeconomy, such as mass unemployment and chain reaction bankruptcies, would be greater. Triggering such an event would be a major blow to the bank's reputation, and was a more serious problem at the time when, unlike today, the social status of banks was a special one.

Therefore, the positive and significant coefficient of (4) does not necessarily imply that promising firms are being bailed out. (5) TFP growth (natural log difference) and (6) sales growth (natural log difference) need to be interpreted as a set of related variables. An increase in TFP growth can, by definition, result from sales growing more than factor cost growth or from factor costs decreasing more than sales decreasing. If both the coefficient of TFP growth and the coefficient of sales growth are positive and significant, we can say that MB has performed its ideal bailout function. Conversely, if both the coefficient of TFP growth and the coefficient of sales growth are negative and significant, the interpretation would depend on the circumstances. If the bank clearly foresaw that the decline in TFP and sales was a temporary demand shock, then it could be interpreted as a reasonable bailout. In this case, the bailed-out firms should be able to recover quickly and the number of zombie firms should not increase. On the other hand, if such estimates were obtained during a phase in which the number of zombie firms was increasing, it would be a typical case of the so-called unnatural selection process. Another possible case is that the coefficient of TFP growth rate is positive, but the coefficient of sales growth rate is negative. This could be interpreted as the result of banks agreeing to bailouts conditioned on the companies' commitment to downsize. (7) The ratio of net worth in current price to book value of total asset is a variable reflecting the distance to insolvency while accounting for unrealized gains on land, and if this coefficient is positive and significant, it can be interpreted that the size of the financial buffer influences bailout decisions. (8) Firm age (natural log) investigates whether the firm's life stage influences bailouts; if positive and significant, it indicates that an unnatural selection has occurred. Firm-bank relationships are influenced by the following variables: (9) MB dummy (short-term), (10) share of the largest short-term lender, (11) MB dummy (long-term), (12) share of the largest long-term lender, (13) number of lending banks (natural log), (14) change in the number of lending banks,²⁸ and (15) short-term borrowings outstanding to total borrowings outstanding ratio. (9) MB dummy (short-term) is a dummy variable that takes the value 1 when the financial institution with the highest share of short-term loans exists for two consecutive years and zero otherwise. If this coefficient is positive and significant, it can be deduced that the bailout is carried out as part of the MB function. Meanwhile, (10) is a variable to reflect the influence of the largest lender of short-term loans, regardless of whether the MB defined earlier exists or not. Only (9) would be positively significant if the continuity of transactions is more important than the share of loans, and only (10) would be positively significant if the most recent share of loans is more important than the continuity of transactions. Moreover, (11) the MB dummy (long-term) and (12) the maximum lender share of long-term loans are added to determine if the above relationship holds true for long-term loans. (13) The number of lending banks (natural log) is a variable reflecting the difficulty and cost of renegotiating the troubled debt. When the MB function was reasonably effective, MB acted as a coordinator in arranging agreements among the syndicated banks before bailout measures. Here, the coefficient would be negative because a smaller number of syndicated banks would be easier to agree upon, resulting in relief. However, during the lost decade, financial assistance became an unavoidable measure to postpone the problem. Here, the coefficient would be positive because the more lending banks, the more difficult it is to renegotiate for drastic reform, and the more likely the troubled firms are bailed out because of problem procrastination. Furthermore, under the weakened MB-led lending system, the phenomenon of unwilling loan concentration was highlighted, in which banks other than the MB withdrew loans, forcing the MB to pick up the slack. In such a case, the coefficient of the number

of lending banks would be positively significant while the coefficient of (14) change in the number of lending banks would be negatively significant. (15) The short-term borrowings outstanding to total borrowings outstanding ratio is a variable to reflect the effect of differences in debt maturity structure across firms that the industry dummies cannot absorb. The arbitrage between Japan's short-term and long-term lending markets worked only very imperfectly until the 1970 s, owing primarily to financial regulation. As a result, firms with capital-intensive technologies and firms with abundant investment opportunities and high growth potential tended to rely on long-term debt more heavily. In these circumstances, if the coefficient on the short-term borrowing ratio is negative and significant, it could be interpreted because the MB's bailout function effectively identifies temporal financial distress. However, during the formation of the asset price bubble in the late 1980 s, long-term loans tended to be used for real estate investment and speculative financial investment, which contributed to the NPL problem after the bubble burst. As a result, if the coefficient of the short-term borrowing ratio is negative and significant in the lost decade, it suggests that the bailout was a way to postpone the disposal of troubled assets while waiting for prices to rise again. (16) financial institutions' shareholding ratio, (17) non-financial domestic corporations' shareholding ratio, and (18) foreign corporations' shareholding ratio are added to the explanatory variables to see how the roles in bailout decisions were different and changed in friendly shareholders based on long-term business relationships like (16) and (17) and activist-type shareholders like (18), particularly before and after the bailout.

5. Estimation results and interpretation

This section examines the estimation results and how they should be interpreted. In terms of the summary statistics of the main variables because aggregate values over 50 years are not particularly meaningful, and because time-series changes in the MB variables and shareholder composition have already been reviewed in the previous section, we will present the summary statistics for each sample period, dividing the sample into distressed (treatment group) and non-distressed (control group), identified by the criterion of theoretical ICR for the latest two periods.

5.1. FY1972–79: Wave of zombie firms in the era of main banks

Table 1–1 shows the means and standard deviations of the main variables for the distressed and non-distressed groups over the estimation period. According to the dependent variable column, approximately 54% of the distressed firms met the criteria for zombie firms by receiving financial assistance during this period. Compared to non-distressed firms, distressed firms are smaller in size and have a higher debt burden. Furthermore, their ROA is negative on average, their TFP growth rate is negative by a larger margin, their sales growth rate is negative by more than 10%, and their financial buffer, including unrealized gains on land, is poor. However, their firm's age is slightly younger, and Tobin's q is slightly higher.²⁹ This implies that a certain proportion of companies in financial distress were growing firms with relatively abundant investment opportunities, implying that banks had the rationality and externalities to decide on bailouts. For the distressed group, the share of firms with a MB as defined by short-term borrowings is higher, as is the share of the largest short-term lender, whereas the share of firms with a MB as defined by long-term borrowings is lower, as is the share of the largest long-term lender. The number of lender banks was slightly lower and has decreased compared to the previous year. The

²⁸ The number of lending banks has a long tail distribution as seen in Figs. 10–1 and 10–2, and as a result, outliers can be seen in change in the number of lending banks. Therefore, we use a value that winsorize the upper and lower 1% of the distribution.

²⁹ Tobin's q is below 1 even for the distressed group, which is low compared to the lost decade. However, it would not be appropriate to simply interpret this as a low market valuation, since the mechanism of stock price formation at that time is considered to have been very different from that of today.

Table 1–1
Summary statistics (FY1972–1979).

	Non-distressed samples			Distressed samples		
	Obs.	Mean	Std. Dev.	Obs.	Mean	Std. Dev.
Zombie status dummy (dependent variable)	10,223	0	0	142	0.5423	0.5000
Total assets (book value of total assets in natural log)	10,223	16.8280	1.3681	142	16.3612	1.2861
Interest-bearing debt to total assets ratio (ratio of interest-bearing debt to book value of total assets)	10,223	0.3338	0.1719	142	0.5745	0.2443
ROA (EBIT/ book value of total assets)	10,223	0.0799	0.0488	142	-0.0561	0.1338
Tobin's q (in natural log)	10,223	0.9857	0.2579	142	0.9991	0.2579
TFP growth (change in natural log of TFP)	10,223	-0.0047	0.1365	142	-0.0729	0.1264
Sales growth (change in natural log of total sales)	10,223	0.1037	0.1686	142	-0.1235	0.2726
Net worth to total assets ratio (ratio of net worth in current price to book value of total assets)	10,223	0.4948	0.2924	142	0.3668	0.3655
Firm age (in natural log)	10,223	3.5714	0.3766	142	3.5101	0.3399
MB dummy (short term)	10,223	0.7053	0.4559	142	0.7465	0.4366
Share of the largest short-term lender	10,223	0.3317	0.2101	142	0.4361	0.2583
MB dummy (long term)	10,223	0.7348	0.4415	142	0.6690	0.4722
Share of the largest long-term lender	10,223	0.3108	0.2023	142	0.2725	0.1766
Number of lending banks (in natural log)	10,223	2.4948	0.7995	142	2.4728	0.6325
Change in number of lending banks	10,223	0.1980	2.2562	142	-0.2606	2.2303
Short-term to total borrowings ratio (ratio of short-term borrowings to total borrowings outstanding)	10,223	0.4360	0.2779	142	0.4330	0.2632

Note: All explanatory variables are as of the previous period (the end of the previous period, for stock variables).

ratio of short-term borrowings is almost identical to that of non-distressed.

The baseline result of weighted probit regression to estimate what types of troubled companies are bailed out and become zombies is shown in Table 1–2, in which the treatment (distressed) and control (non-distressed) groups are pooled with weights optimized using the entropy balancing method to make the mean values of the three

variables, interest-bearing debt to book value of total assets ratio, ROA, and theoretical minimum interest expense to book value of total assets ratio, equivalent between the two groups. The signs of the estimated coefficients and the signs of the marginal effects are all consistent, and we will proceed without distinguishing between the two unless otherwise specified. Statistical significance is determined at the 10% level. The coefficient on total asset book value is positive and significant, indicating that the TBTF bailout motive was already at work during this period. The ratio of interest-bearing debt to the book value of total assets is not statistically significant, despite its positive sign, in part because it was adjusted for treatment and control groups. However, when the non-manufacturing dummy is included in the cross term, the coefficient on the cross term is positive and significant, indicating that the degree of excess debt affected bailout likelihood in the non-manufacturing sector. However, ROA, Tobin's q, TFP growth rate, sales growth rate, net worth to total assets ratio, and firm age were not significant. In other words, no factors influence the bailout decision systematically in terms of financial performance or stock price. Meanwhile, when it comes to firm–bank relationships, the MB dummy (short-term) and the share of the largest short-term lender are both positively significant, whereas the number of lending banks is negatively significant. This means that the presence of the MB in terms of relationship continuity, a large share of the largest lender in terms of recent influence, and a smaller number of lending banks in terms of renegotiation ease all increased the likelihood of bailouts. This suggests that, during this period, the MB proactively decided which firms should be bailed out rather than putting off the problem.

However, whether the MB proactively decided which firms should be bailed out is a separate issue from whether the decision was appropriate, or in other words, whether bailed-out firms deserved to continue operation. An evaluation must be made based on the information available at the time of the decision to rigorously verify this point. However, because this is nearly impossible, we test this point in hindsight. To this end, the companies that were listed between FY1972 and FY1979 were divided into three groups: 1310 that never experienced financial distress during this period (A), 44 that experienced financial distress but never received financial support (B), and 57 that experienced financial distress and received financial support (i.e., were classified as zombie firms) (C). Then, since the lost decade and on, we have grouped them and tracked their status for each year. Note that as time passes, more firms are delisted due to mergers and acquisitions or bankruptcy, but as far as they remain listed, we can determine whether they are in financial distress. This method is used in Fig. 12 to calculate the percentage of healthy firms in each A-C group that keep listed and are not in financial distress in later years. If the percentage of healthy companies in Group C is higher than the percentage in Group B, it can be determined that the MB has appropriately filtered companies that deserve to be rescued. However, Fig. 12 shows that the group of firms that experienced financial distress in FY1972–79 had a lower percentage of healthy firms after the lost decade than the group that did not, and that among the group of firms that experienced financial distress, whether they were bailed out or not made no significant difference, on average. This finding contradicts the widely held belief that bank discernment and monitoring enabled desirable bailouts even in the 1970 s, when the MB relationship was still in place. Rather, the results can be interpreted as indicating that the number of firms in financial distress and the size of their debt was not at a level that would have seriously affected bank management, and thus firms with an important position in the loan transaction relationship or in the corporate group were rescued.

The MB's share of loans varies greatly. Can we deem that the presence of a MB, regardless of how small its stake, increases the likelihood of a bailout as long as the continuity of transactions exists? To confirm this point, we conducted an estimation using staircase dummy variables corresponding to the MB's share of loans: less than 20%, 20–30%, and 30% or more, instead of the two variables of MB dummy (short-term) and the share of the largest short-term lender (Table 1–3). According to

Table 1-2
Baseline results of weighted probit regression (FY1972–1979, All industries).

Dependent variable: zombie status dummy								
	Coef.	p-value		dp/dx	Coef.	p-value	dp/dx	
Total assets	0.2136	0.006	***	0.0590	0.1941	0.014	**	0.0526
Interest-bearing debt to total assets ratio	0.3438	0.377		0.0950	-0.1101	0.800		-0.0298
Interest-bearing debt to total assets ratio×non-manufacturing dummy					2.4285	0.015	**	0.6576
ROA	-0.4124	0.597		-0.1139	-0.6212	0.427		-0.1682
Tobin's q	-0.3042	0.491		-0.0840	-0.0652	0.882		-0.0177
TFP growth	-0.7410	0.111		-0.2047	-0.6606	0.189		-0.1789
Sales growth	-0.4381	0.271		-0.1210	-0.4743	0.252		-0.1284
Net worth to total assets ratio	-0.0684	0.831		-0.0189	0.0256	0.936		0.0069
Firm age	-0.1305	0.561		-0.0361	-0.1005	0.667		-0.0272
MB dummy (short-term)	0.3912	0.072	*	0.1081	0.3847	0.077	*	0.1042
Share of the largest short-term lender	0.7594	0.080	*	0.2098	0.7260	0.095	*	0.1966
MB dummy (long-term)	-0.4077	0.045	**	-0.1126	-0.4201	0.041	**	-0.1137
Share of the largest long-term lender	0.0447	0.937		0.0123	-0.0739	0.898		-0.0200
Number of lending banks	-0.4770	0.018	**	-0.1318	-0.4746	0.018	**	-0.1285
Change in number of lending banks	0.0088	0.796		0.0024	0.0213	0.533		0.0058
Short-term to total borrowings ratio	-0.5065	0.196		-0.1399	-0.4121	0.283		-0.1116
Obs.	10,365				10,365			
Industry dummies	Yes				Yes			
Year dummies	Yes				Yes			

Notes: 1) ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively. 2) The marginal effect (dp/dx) represents the marginal impact that a small change in an explanatory variable has on the probability of becoming a zombie firm, evaluated at the mean value of the explanatory variable. However, when the explanatory variable is a dummy variable, it represents the difference in probability with the explanatory variable taking the value of 0 and 1.

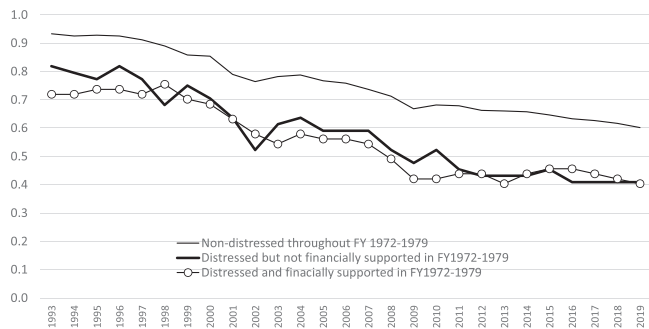


Fig. 12. Ratio of healthy firms (continued listing and non-distressed) since 1990 s by distressed and/or financially supported experience in FY1972–1979. Note: Firms that are distressed in FY1972–1979 and received financial support by banks at least once during the distressed period (i.e., were classified as zombie firms) were classified as "financially supported," even if they had other years in which they were distressed but did not receive support. As a result, 1310 firms were classified into the group of non-distressed, 44 firms into the group of distressed but non-financially supported, and 57 firms into the group of distressed and financially supported.

the findings, the threshold for the loan share at which the presence of a MB increases the likelihood of a bailout is 20%, and the sign is positive for loan shares below this level, but not significantly different from the case without a MB. As shown in Fig. 8, the MB's loan share averaged more than 20% throughout the 1970 s, implying that the MB with an average loan share could have been expected to provide relief to distressed firms.

Prior research on the MB function has frequently emphasized the role of the six largest corporate groups and long-term credit banks in facilitating bailouts. The MB dummy (long-term) added to the explanatory variables as a proxy for the latter was consistently negative and significant. To test the former effect, we ran estimation with a dummy that takes one only if the MB (short-term) is part of one of the six largest corporate groups (Table 1-4). Surprisingly, the dummy for the presence of a MB remains positive and significant, whereas the dummy for the six largest MB groups is negative. The absolute values of the marginal effects of both variables are nearly the same, indicating that the likelihood of bailout when the MB is part of one of the six largest corporate groups is not significantly different from that of companies without a MB. In

Table 1-3
Results using staircase dummies of MB loan ratio in short-term borrowings (FY1972–1979, All industries).

Dependent variable: zombie status dummy				
	Coef.	p-value	dp/dx	
Total assets	0.1956	0.013	**	0.0534
Interest-bearing debt to total assets ratio	-0.0402	0.927		-0.0110
Interest-bearing debt to total assets ratio×non-manufacturing dummy	2.4995	0.012	**	0.6828
ROA	-0.7964	0.318		-0.2175
Tobin's q	0.0196	0.963		0.0054
TFP growth	-0.6549	0.212		-0.1789
Sales growth	-0.5379	0.193		-0.1469
Net worth to total assets ratio	0.1145	0.731		0.0313
Firm age	-0.1131	0.629		-0.0309
Dummy of MB share less than 20%	0.3299	0.370		0.0901
Dummy of MB share 20–30%	0.5842	0.032	**	0.1596
Dummy of MB share more than 30%	0.4769	0.028	**	0.1303
MB dummy (long-term)	-0.3885	0.059	*	-0.1061
Share of the largest long-term lender	-0.0217	0.969		-0.0059
Number of lending banks	-0.6027	0.001	***	-0.1646
Change in number of lending banks	0.0225	0.506		0.0062
Short-term to total borrowings ratio	-0.3872	0.314		-0.1058
Obs.	10,365			
Industry dummies	Yes			
Year dummies	Yes			

Notes: 1) The base case for the dummies of main bank share is no main bank defined by short-term lending. 2) ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively. 3) The marginal effect (dp/dx) represents the marginal impact that a small change in an explanatory variable has on the probability of becoming a zombie firm, evaluated at the mean value of the explanatory variable. However, when the explanatory variable is a dummy variable, it represents the difference in probability with the explanatory variable taking the value of 0 and 1.

other words, the MB that was not part of a group of firms played a significant role in the bailouts during this period. Some anecdotes emphasized the role of corporate groups and long-term credit banks in the MBs' bailouts, which were quantitatively more exaggerated than the reality. However, during this period, the member of six major corporate groups and the main clients of long-term credit banks were a high percentage of the leading companies of the time or types of state-sponsored enterprises, and we can argue that many of them could overcome the financial distress on their own, even if they were temporarily in distress.

Table 1–4
Results using MB attributes dummy of six major corporate group (FY1972–1979, All industries).

Dependent variable: zombie status dummy				
	Coef.	p-value		dp/dx
Total assets	0.2172	0.010	**	0.0574
Interest-bearing debt to total assets ratio	-0.2476	0.569		-0.0654
Interest-bearing debt to total assets ratio×non-manufacturing dummy	2.3326	0.026	**	0.6159
ROA	-0.7408	0.336		-0.1956
Tobin's q	0.0430	0.923		0.0114
TFP growth	-0.7577	0.115		-0.2001
Sales growth	-0.4818	0.247		-0.1272
Net worth to total assets ratio	0.0123	0.969		0.0032
Firm age	-0.0062	0.979		-0.0016
MB dummy (short-term)	0.5930	0.007	***	0.1566
MB attributes dummy of six major corporate groups	-0.5843	0.007	***	-0.1543
Share of the largest short-term lender	0.6690	0.124		0.1767
MB dummy (long-term)	-0.3377	0.096	*	-0.0892
Share of the largest long-term lender	-0.2336	0.676		-0.0617
Number of lending banks	-0.4813	0.019	**	-0.1271
Change in number of lending banks	0.0252	0.454		0.0067
Short-term to total borrowings ratio	-0.4043	0.281		-0.1068
Obs.	10,365			
Industry dummies	Yes			
Year dummies	Yes			

Notes: 1) ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively. 2) The marginal effect (dp/dx) represents the marginal impact that a small change in an explanatory variable has on the probability of becoming a zombie firm, evaluated at the mean value of the explanatory variable. However, when the explanatory variable is a dummy variable, it represents the difference in probability with the explanatory variable taking the value of 0 and 1.

Moreover, things were probably different in the 1960 s and before, but that is outside the scope of this paper's investigation.

5.2. FY1993-98: First half of the wave of zombie firms in the lost decade

Table 2–1 displays the summary statistics for this period. Approximately 64% of the sample in financial distress met the criteria for zombie firms by receiving financial assistance during this period. When the distressed sample is compared to the non-distressed sample, these characteristics are similar to those of the 1970 s: smaller in size, heavier debt burden, negative ROA, negative TFP growth by a larger margin, negative sales growth rate by more than 10%, and poor financial buffer, including unrealized gains. Furthermore, the slightly higher firm age and slightly lower Tobin's q indicate that the proportion of growth firms with relatively plentiful investment opportunities among firms in financial distress has decreased since the 1970 s. In terms of firm–bank relationships, the characteristics of the distressed sample are similar to those of the 1970 s in that the share of firms with a MB defined by short-term borrowings and the share of the largest short-term lender are higher, but different in that the share of firms with a MB defined by long-term borrowings, the share of the largest long-term lender, the number of lending banks, and the ratio of short-term debt are higher. Furthermore, the number of lending banks increased in the non-distressed sample while decreasing in the distressed sample. Taken together, for distressed firms, we can see the phenomenon of unwilling concentration of loans on the MB occurring while they had many lending banks and a high level of reliance on short-term borrowings, which was typical of the characteristics identified for troubled firms during the lost decade. In terms of shareholder composition, non-financial domestic corporations have a higher share of the distressed sample, whereas financial institutions and foreign corporations have a lower share. The lower shareholding ratio of financial institutions in the distressed sample is somewhat surprising, but it may reflect the increased presence of newly emerged firms that did not belong to the six major corporate groups in

Table 2–1
Summary statistics (FY1993–1998).

	Non-distressed samples			Distressed samples		
	Obs.	Mean	Std. Dev.	Obs.	Mean	Std. Dev.
Zombie status dummy (dependent variable)	10,973	0	0	431	0.6404	0.4804
Total assets (book value of total assets in natural log)	10,973	17.7494	1.2968	431	17.3687	1.3649
Interest-bearing debt to total assets ratio (ratio of interest-bearing debt to book value of total assets)	10,973	0.2604	0.1801	431	0.4324	0.2292
ROA (EBIT/ book value of total assets)	10,973	0.0427	0.0451	431	-0.0589	0.0879
Tobin's q (in natural log)	10,973	1.0978	0.4598	431	1.0458	0.5309
TFP growth (change in natural log of TFP)	10,973	-0.0212	0.2331	431	-0.0493	0.1100
Sales growth (change in natural log of total sales)	10,973	0.0082	0.1085	431	-0.1044	0.1915
Net worth to total assets ratio (ratio of net worth in current price to book value of total assets)	10,973	0.7476	0.4129	431	0.6958	0.5962
Firm age (in natural log)	10,973	3.8583	0.3787	431	3.8648	0.3500
MB dummy (short term)	10,973	0.5734	0.4946	431	0.6937	0.4615
Share of the largest short-term lender	10,973	0.2702	0.2184	431	0.3608	0.2290
MB dummy (long term)	10,973	0.4897	0.4999	431	0.6195	0.4861
Share of the largest long-term lender	10,973	0.2782	0.2679	431	0.3426	0.2744
Number of lending banks (in natural log)	10,973	1.8844	1.0379	431	2.1637	0.8108
Change in number of lending banks	10,973	0.0678	1.7965	431	-0.2297	1.6846
Short-term to total borrowings ratio (ratio of short-term borrowings to total borrowings outstanding)	10,973	0.4963	0.3611	431	0.5698	0.3053
Financial institutions' ownership	10,973	0.2963	0.1497	431	0.2363	0.1417
Non-financial domestic corporations' ownership	10,973	0.3202	0.1837	431	0.3659	0.1922
Foreign corporations' ownership	10,973	0.0520	0.0756	431	0.0258	0.0647

Note: All explanatory variables are as of the previous period (the end of the previous period, for stock variables).

Table 2–2
Baseline results of weighted probit regression (FY1993–1998, All industries).

Dependent variable: zombie status dummy							
	Coef.	p-value	dp/dx	Coef.	p-value	dp/dx	
Total assets	-0.0118	0.842	-0.0038	-0.1801	0.008	***	-0.0568
Total assets×non-manufacturing dummy				0.4176	0.000	***	0.1316
Interest-bearing debt to total assets ratio	0.8433	0.029	**	0.2739	0.037	**	0.2634
ROA	0.6151	0.362		0.1998	0.4276	0.515	0.1347
Tobin's q	0.1243	0.282		0.0404	0.1351	0.243	0.0425
TFP growth	-0.3872	0.046	**	-0.1257	-0.4098	0.039	**
Sales growth	-0.7336	0.041	**	-0.2382	-0.7601	0.016	**
Net worth to total assets ratio	0.0785	0.494		0.0255	0.0931	0.468	0.0293
Firm age	-0.1030	0.437		-0.0334	-0.0856	0.531	-0.0270
MB dummy (short-term)	-0.1177	0.286		-0.0382	-0.1329	0.233	-0.0419
Share of the largest short-term lender	0.5337	0.033	**	0.1733	0.4500	0.077	*
MB dummy (long-term)	-0.1062	0.324		-0.0345	-0.1135	0.299	-0.0358
Share of the largest long-term lender	0.7532	0.001	***	0.2446	0.7303	0.001	***
Number of lending banks	0.3177	0.004	***	0.1032	0.2870	0.014	**
Change in number of lending banks	-0.0917	0.000	***	-0.0298	-0.0864	0.001	***
Short-term to total borrowings ratio	-0.2117	0.210		-0.0687	-0.2157	0.191	-0.0680
Financial institutions' ownership	0.4840	0.331		0.1572	0.3587	0.483	0.1130
Non-financial domestic corporations' ownership	0.3880	0.208		0.1260	0.4608	0.132	0.1452
Foreign corporations' ownership	0.3750	0.647		0.1218	0.1488	0.855	0.0469
Obs.	11,404			11,404			
Industry dummies	Yes			Yes			
Year dummies	Yes			Yes			

Notes: 1) ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively. 2) The marginal effect (dp/dx) represents the marginal impact that a small change in an explanatory variable has on the probability of becoming a zombie firm, evaluated at the mean value of the explanatory variable. However, when the explanatory variable is a dummy variable, it represents the difference in probability with the explanatory variable taking the value of 0 and 1.

Table 2–3
Results by industry (FY1993–1998).

Dependent variable: zombie status dummy	Manufacturing			Manufacturing			Non-Manufacturing				
	Coef.	p-value	dp/dx	Coef.	p-value	dp/dx	Coef.	p-value	dp/dx		
Total assets	-0.1777	0.020	**	-0.0555	-0.0229	0.784	-0.0058	0.2606	0.003	***	0.0818
Interest-bearing debt to total assets ratio	1.1029	0.024	**	0.3447	1.0137	0.025	**	0.2581	0.8713	0.054	*
ROA	1.2172	0.089	*	0.3804	-10.7029	0.000	***	-2.7248	-1.3744	0.109	-0.4316
Net extraordinary income to total assets ratio					14.2029	0.000	***	3.6158			
Tobin's q	0.1919	0.136		0.0600	0.3111	0.025	**	0.0792	0.1460	0.590	0.0458
TFP growth	-0.9395	0.002	***	-0.2936	-0.4004	0.219		-0.1019	0.0975	0.703	0.0306
Sales growth	-1.0089	0.020	**	-0.3153	0.4383	0.333		0.1116	-0.3360	0.431	-0.1055
Net worth to total assets ratio	0.0277	0.855		0.0087	-0.4599	0.087	*	-0.1171	0.0113	0.964	0.0036
Firm age	-0.1172	0.546		-0.0366	-0.1723	0.399		-0.0439	-0.1778	0.350	-0.0558
MB dummy (short-term)	-0.1928	0.198		-0.0602	-0.2874	0.074	*	-0.0732	0.0209	0.900	0.0066
Share of the largest short-term lender	0.4468	0.165		0.1396	0.5627	0.102		0.1432	0.8230	0.015	**
MB dummy (long-term)	-0.1274	0.382		-0.0398	-0.1199	0.431		-0.0305	0.0491	0.758	0.0154
Share of the largest long-term lender	0.7801	0.006	***	0.2438	0.7973	0.007	***	0.2030	0.5954	0.046	**
Number of lending banks	0.2894	0.038	**	0.0905	0.2583	0.053	*	0.0658	0.1740	0.183	0.0546
Change in number of lending banks	-0.1464	0.001	***	-0.0457	-0.1559	0.000	***	-0.0397	-0.0353	0.305	-0.0111
Short-term to total borrowings ratio	-0.3710	0.131		-0.1159	-0.6187	0.023	**	-0.1575	0.2262	0.346	0.0710
Financial institutions' ownership	1.3063	0.059	*	0.4083	0.9164	0.214		0.2333	-0.4042	0.558	-0.1269
Non-financial domestic corporations' ownership	1.1426	0.006	***	0.3571	1.0380	0.026	**	0.2643	-0.3382	0.455	-0.1062
Foreign corporations' ownership	1.3238	0.154		0.4138	1.1913	0.144		0.3033	-4.1024	0.046	**
Obs.	7638			7638				3766			
Industry dummies	No			No				Yes			
Year dummies	Yes			Yes				Yes			

Notes: 1) ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively. 2) The marginal effect (dp/dx) represents the marginal impact that a small change in an explanatory variable has on the probability of becoming a zombie firm, evaluated at the mean value of the explanatory variable. However, when the explanatory variable is a dummy variable, it represents the difference in probability with the explanatory variable taking the value of 0 and 1.

the construction, real estate, and wholesale and retail industries, which were dubbed the three NPL industries during the lost decade.

In this period, the baseline result of weighted probit regression is shown in Table 2–2. With the addition of three shareholder composition variables: ownership of financial institutions, non-financial domestic corporations, and foreign corporations, the number of characteristic variables used to determine the weight increases to six from this point forward. The coefficient of book value of total assets is negative, but when the non-manufacturing dummy is included, the coefficient of the

cross term is positive and significant, indicating that the TBTF bailout motive was at work in the non-manufacturing sector.³⁰ It has a marginal effect that is more than twice as powerful as the marginal effect on all industries in the 1970 s. After adjusting for the treatment and control

³⁰ After the bubble burst, large troubled loans were concentrated in non-manufacturing industries such as construction, real estate, and wholesale-retail. On the other hand, in the manufacturing sector, as larger listed firms had already shifted to financing from the market, greatly reducing their dependence on banks, the mid-size and smaller firms, where bank dependence was still high, tended to be bailed out.

Table 3–1
Summary statistics (FY1997–2002).

	Non-distressed samples			Distressed samples		
	Obs.	Mean	Std. Dev.	Obs.	Mean	Std. Dev.
Zombie status dummy (dependent variable)	12,158	0	0	803	0.4994	0.5003
Total assets (book value of total asset in natural log)	12,158	17.6976	1.2970	803	17.4309	1.3788
Interest-bearing debt to total assets ratio (ratio of interest-bearing debt to book value of total assets)	12,158	0.2397	0.1944	803	0.3824	0.2285
ROA (EBIT/ book value of total assets)	12,158	0.0323	0.0932	803	-0.0921	0.1778
Tobin's q (in natural log)	12,158	1.0584	0.7217	803	0.9611	0.6841
TFP growth (change in natural log of TFP)	12,158	-0.0485	0.3668	803	-0.0313	0.1592
Sales growth (change in natural log of total sales)	12,158	-0.0001	0.1394	803	-0.1102	0.2095
Net worth to total assets ratio (ratio of net worth in current price to book value of total assets)	12,158	0.6478	0.3312	803	0.6399	0.8916
Firm age (in natural log)	12,158	3.8851	0.4000	803	3.9660	0.3343
Financial institutions' ownership	12,158	0.2627	0.1481	803	0.2220	0.1312
Non-financial domestic corporations' ownership	12,158	0.3063	0.1870	803	0.3230	0.1924
Foreign corporations' ownership	12,158	0.0556	0.0835	803	0.0398	0.0927

Note: All explanatory variables are as of the previous period (the end of the previous period, for stock variables).

groups, the ratio of interest-bearing debt to the book value of total assets remains positive and significant, indicating that the degree of over-indebtedness influenced the likelihood of bailouts. The marginal effect is now more than twice as powerful as it was in the 1970 s. ROA, Tobin's q, net worth ratio, and firm age are not significant, but change-related variables such as TFP growth and sales growth are. Firms with declining sales and productivity are more likely to receive financial assistance, implying an unnatural selection process. This feature was stronger in the manufacturing sector than in the non-manufacturing sector, and it can be interpreted as lending banks regarding declining sales and productivity as a temporary demand shock and deciding to provide support, but in hindsight, it was the structural decline in competitiveness that had already occurred. In terms of firm–bank relationships, the sign for the MB dummy (short-term) becomes negative, although the share of the largest short-term lender remains positive and significant, as it did in the 1970 s. The share of the largest long-term lender, which was not significant in the 1970 s, becomes positive and

significant, and the coefficient of the number of lending banks, which were negative and significant in the 1970 s, becomes positive and significant. In contrast, the change in the number of lending banks is negative and significant. Taken together, the result suggests an unhealthy situation in which the large number of lending banks becomes a bottleneck for renegotiation and increases the likelihood of financial support to postpone the problem, as the traditional MB function is weakened and the phenomenon of unwilling loan concentration on the MB prevails.

Although the results for shareholding ratios are not significant for any category due to a priori adjustment for endogeneity due to selective holdings, some characteristics can be discovered by dividing the sample into manufacturing and non-manufacturing sectors (Table 2–3). First, the coefficient of ROA for the manufacturing industry was positive and significant; hence, it is reported alongside the estimation results with the addition of the net extraordinary income to total assets ratio. Prioritizing the posting of extraordinary incomes, such as the sale of assets with unrealized gains, over the posting of extraordinary losses, such as the disposal of nonperforming assets, is typical problem-procrastinating behavior observed during the lost decade, but the positive significance of the coefficient on the net extraordinary income ratio reflects the fact that such behavior increased the probability of financial support. Receiving financial assistance requires distressed firms to avoid the risk of becoming insolvent, which is thought to be why they generate extraordinary incomes. Looking at their shareholding ratios, the coefficient of financial institutions and that of non-financial domestic corporations were positive and significant. This means that the higher the ratio of friendly shareholders based on long-term business relationships, the greater the possibility to receive financial support. The fact that the coefficient of the ratio of financial institutions shareholding becomes insignificant in the estimation results when the net extraordinary income ratio is included suggests that the link between extraordinary incomes and financial support decisions existed for firms with a higher ratio of financial institution shareholding. However, in the non-manufacturing sector, the shareholding ratios of financial institutions and non-financial domestic corporations are not significant, whereas the shareholding ratio of foreign corporations is negatively significant. This indicates that even after controlling for the endogeneity caused by selective holdings beforehand, foreign investors played a disciplinary role to prevent the inefficient financial support that led to the procrastination of problems. Foreign ownership had no such disciplining effect in the manufacturing sector.

5.3. FY1997–2002: Second half (climax) of the wave of zombie firms in the lost decade

Table 3–1 displays the summary statistics for this period. In this period, the percentage of distressed firms that met the criteria for zombie firms by receiving financial support is around 50%, a decrease from the first half of the lost decade. This is thought to be due to changes in the environment, such as even surviving banks lack the financial strength to postpone problems in a series of bank failures, the advancement of institutional reforms to make arbitrary accounting treatment more difficult, and stricter financial supervision. In comparison to non-distressed firms, distressed firms are smaller in size, have a heavier debt burden, negative ROA, positive but lower Tobin's q, negative sales growth of more than 10%, a poorer financial buffer including unrealized gains on land, and a higher firm age, as in FY1993–98. The only difference between FY1993 and FY1998 is that the TFP growth rate is better than in the non-financial distress sample, albeit it is negative. Given the disparity in sales growth rates, this could be because the distressed sample was forced to downsize much more severely than the non-distressed sample. In terms of shareholder composition, the distressed sample has a higher shareholding ratio of non-financial domestic corporations, whereas the shareholding ratios of financial institutions and foreign corporations are lower.

Table 3–2
Baseline results of weighted probit regression (FY1997–2002, All industries and manufacturing).

Dependent variable: zombie status dummy	All industries			Manufacturing				
	Coef.	p-value	dp/dx	Coef.	p-value	dp/dx		
Total assets	0.0718	0.070	*	0.0226	-0.0585	0.274	-0.0187	
Interest-bearing debt to total assets ratio	0.1397	0.535		0.0439	0.0474	0.828	0.0152	
ROA	0.3978	0.303		0.1250	0.4272	0.394	0.1366	
Tobin's q	-0.0708	0.370		-0.0223	-0.1475	0.229	-0.0472	
TFP growth	0.1300	0.150		0.0409	0.0026	0.985	0.0008	
Sales growth	-0.6976	0.001	***	-0.2193	-0.7825	0.004	***	-0.2502
Net worth to total assets ratio	-0.1978	0.197		-0.0622	-0.8270	0.001	***	-0.2644
Firm age	0.0726	0.499		0.0228	0.1824	0.233	0.0583	
Financial institutions' ownership	0.1242	0.735		0.0390	0.3270	0.516	0.1046	
Non-financial domestic corporations' ownership	0.2540	0.256		0.0798	0.4302	0.154	0.1375	
Foreign corporations' ownership	-0.9158	0.169		-0.2879	0.3219	0.610	0.1029	
Obs.	12,961				8398			
Industry dummies	Yes				No			
Year dummies	Yes				Yes			

Notes: 1) ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively. 2) The marginal effect (dp/dx) represents the marginal impact that a small change in an explanatory variable has on the probability of becoming a zombie firm, evaluated at the mean value of the explanatory variable. However, when the explanatory variable is a dummy variable, it represents the difference in probability with the explanatory variable taking the value of 0 and 1.

Table 3–3
Results of non-manufacturing (FY1997–2002).

Dependent variable: zombie status dummy	All industries			Manufacturing				
	Coef.	p-value	dp/dx	Coef.	p-value	dp/dx		
Total assets	0.1732	0.002	***	0.0485	0.2190	0.000	***	0.0576
Interest-bearing debt to total assets ratio	1.2948	0.000	***	0.3627	1.3584	0.000	***	0.3571
ROA	1.0574	0.042	**	0.2962	-6.5662	0.000	***	-1.7262
Net extraordinary income to total assets ratio					8.1166	0.000	***	2.1338
Tobin's q	-0.0835	0.508		-0.0234	-0.1944	0.393		-0.0511
TFP growth	0.2672	0.059	*	0.0748	0.3224	0.076	*	0.0848
Sales growth	-1.4510	0.000	***	-0.4064	-0.6163	0.170		-0.1620
Net worth to total assets ratio	0.1480	0.060	*	0.0415	-0.0135	0.877		-0.0035
Firm age	-0.3251	0.030	**	-0.0911	-0.3184	0.054	*	-0.0837
Financial institutions' ownership	0.9258	0.093	*	0.2593	0.9676	0.092	*	0.2544
Non-financial domestic corporations' ownership	0.3986	0.233		0.1117	0.4558	0.190		0.1198
Foreign corporations' ownership	-4.5428	0.012	**	-1.2725	-4.0503	0.026	**	-1.0648
Obs.	4563				4563			
Industry dummies	Yes				Yes			
Year dummies	Yes				Yes			

Notes: 1) ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively. 2) The marginal effect (dp/dx) represents the marginal impact that a small change in an explanatory variable has on the probability of becoming a zombie firm, evaluated at the mean value of the explanatory variable. However, when the explanatory variable is a dummy variable, it represents the difference in probability with the explanatory variable taking the value of 0 and 1.

The baseline result of estimating the weighted probit model with the same six-variable sample selection modification as in FY1993–1998 is shown in Table 3–2. Because the results from all industries have many similarities with the results from the manufacturing industry alone, which has a larger number of firms than non-manufacturing, they are presented side by side. Except for the negatively significant coefficient on sales growth, most variables including shareholder composition are not significant, indicating that no corporate factors or characteristics influenced the decision of financial support during this period. Although beyond the scope of this paper's analysis, at the height of the NPL crisis, the state of banks' health and the stance of financial supervision, rather than the characteristics of troubled firms, is believed to have significant impact on the decision to provide financial assistance. In contrast, the estimation results for the non-manufacturing industry show that not only the health of banks and the stance of financial supervision but also various firm-specific factors had a significant impact on the likelihood of financial support (Table 3–3). This is a natural result, of the fact that, although the zombie ratio based on the number of firms in the manufacturing and non-manufacturing sectors was roughly equal during this period, the zombie ratio weighted by outstanding borrowing was overwhelmingly greater in the non-manufacturing sector, indicating its severe impact on the NPL problem. As in the case of the manufacturing sector during FY1993–1998, the coefficient of ROA was positive and significant, so the results are reported alongside the estimation results

with net extraordinary income ratio added to explanatory variables. The positive and significant coefficient on net extraordinary income ratio reflects the fact that putting off problems by realizing unrealized gains increased the likelihood of receiving financial assistance. However, the results for the main variables are essentially unchanged and robust to the inclusion or exclusion of the net extraordinary income ratio. The likelihood of receiving financial assistance is significantly higher for firms larger in size, over-indebted, and have a higher shareholding ratio of financial institutions. The outcome is consistent with the well-known situation at the time, in which banks that lent to troubled firms in three NPL industries were forced to continue supporting them due to the TBTF bailout motive and fear of the fatal impact on their own health if they stopped supporting them. While the marginal effect of firm size is smaller than in FY1993–98, the marginal effect of excess debt is far greater. Furthermore, the shareholding ratio of foreign corporations was negatively significant, confirming that even after controlling for sample selection, it served as a check against inefficient bailouts. This effect was not observed in the manufacturing sector. The fact that the net worth ratio, which was positive and significant before the addition of the net extraordinary income ratio, becomes insignificant after the addition indicates that unrealized gains were associated with the posting of extraordinary incomes.

Table 4–1
Summary statistics (FY2004–2019).

	Non-distressed samples			Distressed samples		
	Obs.	Mean	Std. Dev.	Obs.	Mean	Std. Dev.
Zombie status dummy (dependent variable)	32,315	0	0	1053	0.3609	0.4805
Total assets (book value of total assets in natural log)	32,315	17.6384	1.4165	1053	16.6175	1.6247
Interest-bearing debt to total assets ratio (ratio of interest-bearing debt to book value of total assets)	32,315	0.1894	0.1784	1053	0.2782	0.2451
ROA (EBIT/book value of total assets)	32,315	0.0466	0.0879	1053	-0.1464	0.3010
Tobin's q (in natural log)	32,315	1.5292	12.9520	1053	1.5671	8.8821
TFP growth (change in natural log of TFP)	32,315	-0.0297	0.3722	1053	-0.0634	0.3543
Sales growth (change in natural log of total sales)	32,315	0.0171	0.3078	1053	-0.1671	0.4648
Net worth to total assets ratio (ratio of net worth in current price to book value of total assets)	32,315	0.6737	0.3223	1053	0.7963	0.7682
Firm age (in natural log)	32,315	3.9223	0.6105	1053	3.7197	0.7400
Financial institutions' ownership	32,315	0.2048	0.1242	1053	0.1251	0.1140
Non-financial domestic corporations' ownership	32,315	0.2716	0.1822	1053	0.2391	0.1964
Foreign corporations' ownership	32,315	0.1086	0.1202	1053	0.0769	0.1264

Note: All explanatory variables are as of the previous period (the end of the previous period, for stock variables).

5.4. FY2004–19: Era of market discipline

Table 4–1 displays the summary statistics for this period. During this period, the percentage of the sample in financial distress that meets the criteria for zombie firms by receiving financial assistance falls from FY1997–2002 to around 36%. In the case of publicly traded companies, this reflects the increasing arm's length nature of firm–bank relations and banks' reduced involvement in financial support and restructuring. Comparing the distressed and non-distressed samples is comparable to that of the 1970 s. That is, the distressed sample has a smaller firm size, a heavier debt burden, a negative ROA, a negative TFP growth rate, and a negative sales growth rate of more than 10%, but the firm age is younger and Tobin's q is slightly higher. The distressed sample also had a larger financial buffer, which included unrealized gains on land. This suggests

that, unlike the lost decade, a certain proportion of firms facing financial distress include growing firms with relatively abundant investment opportunities and financial buffer, implying that the importance for banks to providing financial support to distressed firms has recovered to some extent.³¹ In terms of shareholder composition, not only financial institutions and foreign corporations, but also non-financial domestic corporations' shareholding ratios, were lower in the financial distress sample.

The baseline result of estimating the weighted probit model with the six-variable sample selection modification is shown in Table 4–2. Because the coefficient on book value of total assets is insignificant, we only report the case in which a cross term with a non-manufacturing dummy is included. The coefficient on ROA was positive and significant; thus, it is reported alongside the estimation results and the net extraordinary income ratio. The coefficient on the cross term between firm size and the non-manufacturing dummy is positive and significant, indicating that the TBTF bailout motive was active in the non-manufacturing sector, though the marginal effect is much smaller than previously. Surprisingly, the ratio of interest-bearing debt to book value of total assets is not only positive and significant, but its marginal effect is larger than in the lost decade. The fact that the TFP growth rate is positive and significant whereas the sales growth rate is negative and significant implies that cost cutting was a prerequisite for financial assistance. With respect to the shareholder composition, the finding that financial institution ownership is positively significant may appear surprising. However, given that only firms and banks with compelling relationships continued to hold shares during this period, such selection effects influence the results, when the number of shares held by banks declined overall. To obtain clearer results, we estimated the effect of shareholder composition separately for the manufacturing and non-manufacturing sectors (Table 4–3). In the manufacturing industry, the coefficient of financial institutions, non-financial domestic and foreign corporations are all positive and significant. Non-financial domestic corporations, like financial institutions, are probably affected by the selection effect because of the trend of dissolution of cross-shareholdings among business corporations. The results of foreign corporation ownership are probably influenced by the movement of foreign funds seeking capital gain by temporarily taking over a portion of capital in the expectation of eventual support from banks, as seen in the case of restructuring of distressed firms in the electric machinery and electronic components industries. In the non-manufacturing sector, financial institution ownership is positively significant, whereas non-financial domestic corporation ownership is not significant, and foreign corporation ownership is negatively significant, indicating a three-way split.

Two other points are worth noting for the manufacturing industry: first, the marginal effect of the interest-bearing debt to total assets ratio is significantly higher than for the non-manufacturing sector. This suggests that the manufacturing sector's excess debt problem was more severe during this period compared with the lost decade. The other difference is that the sales growth coefficient is negative and significant, whereas the net worth ratio coefficient is positive and significant. This implies that financial assistance was provided to once-blue-chip companies that, due to the accumulation of past net worth, still had a relative financial buffer even in times of financial distress, but whose recent sales had fallen sharply. However, just as the myth of ever-rising land prices was believed until the lost decade, financial support based on the myth of Japanese manufacturing competitiveness is likely to have resulted in

³¹ However, the average age of the distressed group of firms was 41.3 years, which is significantly lower than FY1997–2002 (52.8 years) but significantly higher than 33.5 years in the 1970 s. Meanwhile, the dispersion of firm age of distressed group has increased, with the average age one standard deviation below the mean being 19.7 years, compared to 23.8 years in the 1970 s. This corresponds to the rapid increase in the number of firms promoted from emerging markets such as TSE Mothers since the 2000 s

Table 4–2
Baseline results of weighted probit regression (FY2004–2019, All industries).

Dependent variable: zombie status dummy							
	Coef.	p-value		dp/dx	Coef.	p-value	dp/dx
Total assets	-0.0262	0.533		-0.0057	-0.0308	0.454	-0.0065
Total assets×non-manufacturing dummy	0.1093	0.040	**	0.0237	0.1243	0.011	0.0263
Interest-bearing debt to total assets ratio	2.4640	0.000	***	0.5351	2.5307	0.000	0.5345
ROA	0.5017	0.000	***	0.1089	-0.4777	0.138	-0.1009
Net extraordinary income to total assets ratio					1.1985	0.002	0.2531
Tobin's q	0.0005	0.732		0.0001	0.0008	0.616	0.0002
TFP growth	0.1315	0.141		0.0286	0.2351	0.015	0.0497
Sales growth	-0.3280	0.000	***	-0.0712	-0.2631	0.005	-0.0556
Net worth to total assets ratio	0.0221	0.813		0.0048	-0.0717	0.391	-0.0151
Firm age	-0.0124	0.819		-0.0027	-0.0324	0.547	-0.0069
Financial institutions' ownership	0.9972	0.017	**	0.2165	1.1081	0.008	0.2340
Non-financial domestic corporations' ownership	0.1799	0.366		0.0391	0.1650	0.413	0.0349
Foreign corporations' ownership	-0.0657	0.856		-0.0143	-0.0327	0.929	-0.0069
Obs.	33,368				33,368		
Industry dummies	Yes				Yes		
Year dummies	Yes				Yes		

Notes: 1) ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively. 2) The marginal effect (dp/dx) represents the marginal impact that a small change in an explanatory variable has on the probability of becoming a zombie firm, evaluated at the mean value of the explanatory variable. However, when the explanatory variable is a dummy variable, it represents the difference in probability with the explanatory variable taking the value of 0 and 1.

Table 4–3
Results by industry (FY2004–19).

Dependent variable: zombie status dummy	Manufacturing			Non-manufacturing		
	Coef.	p-value	dp/dx	Coef.	p-value	dp/dx
Total assets	-0.0576	0.256		0.0797	0.142	0.0154
Interest-bearing debt to total assets ratio	3.6210	0.000	***	2.2276	0.000	0.4303
ROA	-0.3705	0.156		-0.4617	0.039	-0.0892
Net extraordinary income to total assets ratio				1.3945	0.000	0.2694
Tobin's q	0.0019	0.411		0.0006	0.738	0.0001
TFP growth	-0.0567	0.714		0.2442	0.023	0.0472
Sales growth	-0.5502	0.000	***	-0.1351	0.241	-0.0261
Net worth to total assets ratio	0.1989	0.008	***	-0.1886	0.030	-0.0364
Firm age	0.0171	0.825		-0.1080	0.161	-0.0209
Financial institutions' ownership	1.3622	0.012	**	1.4234	0.047	0.2750
Non-financial domestic corporations' ownership	0.5607	0.064	*	0.0075	0.978	0.0014
Foreign corporations' ownership	1.7018	0.001	***	-1.5678	0.014	-0.3028
Obs.	20,208			13,160		
Industry dummies	No			Yes		
Year dummies	Yes			Yes		

Notes: 1) ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively. 2) The marginal effect (dp/dx) represents the marginal impact that a small change in an explanatory variable has on the probability of becoming a zombie firm, evaluated at the mean value of the explanatory variable. However, when the explanatory variable is a dummy variable, it represents the difference in probability with the explanatory variable taking the value of 0 and 1.

Table 5–1
Summary statistics (FY2004–2013).

	Non-distressed samples			Distressed samples		
	Obs.	Mean	Std. Dev.	Obs.	Mean	Std. Dev.
Zombie status dummy (dependent variable)	20,349	0	0	810	0.3543	0.4786
Total assets (book value of total assets in natural log)	20,349	17.6052	1.3827	810	16.6917	1.5762
Interest-bearing debt to total assets ratio (ratio of interest-bearing debt to book value of total assets)	20,349	0.1949	0.1797	810	0.2794	0.2448
ROA (EBIT/ book value of total assets)	20,349	0.0416	0.0998	810	-0.1549	0.3328
Tobin's q (in natural log)	20,349	1.5159	15.4402	810	1.4117	8.4508
TFP growth (change in natural log of TFP)	20,349	-0.0315	0.3511	810	-0.0675	0.3587
Sales growth (change in natural log of total sales)	20,349	0.0092	0.3193	810	-0.1906	0.4692
Net worth to total assets ratio (ratio of net worth in current price to book value of total assets)	20,349	0.6532	0.3064	810	0.7608	0.7126
Firm age (in natural log)	20,349	3.8977	0.5990	810	3.6900	0.7590
Financial institutions' ownership	20,349	0.2096	0.1270	810	0.1312	0.1152
Non-financial domestic corporations' ownership	20,349	0.2745	0.1850	810	0.2377	0.1924
Foreign corporations' ownership	20,349	0.0957	0.1125	810	0.0716	0.1188

Note: All explanatory variables are as of the previous period (the end of the previous period, for stock variables).

soft budget constraints.³²

5.5. FY2004–13 and FY2007–13: First half of the era of market discipline and the wave of zombie firms after the GFC

The decade from FY2004 to FY2013 is the first half of FY2004–2019 and corresponds to the period before the Abenomics corporate governance reforms and include the period of major external shocks such as the GFC and the Great East Japan Earthquake and the subsequent super strong yen. Table 5–1 displays the summary statistics. The percentage of the sample in financial distress that meets the criteria for zombie firms by receiving financial assistance is around 35%, roughly the same as in FY2004–2019. The difference between the distressed and non-distressed samples is nearly the same as in FY2004–2019, except that the distressed group has lower Tobin's q in this sub-period.

The results of estimating the weighted probit model with the sample selection correction with six variables are shown in Table 5–2. The coefficient on book value of total assets is not significant; therefore, a cross term with the non-manufacturing dummy is added. Moreover, the coefficient on ROA is positive and significant; thus, it is reported along with the estimation results and the extraordinary net income to total assets ratio. However, in contrast to FY2004–2019, the cross-term between firm size and the non-manufacturing dummy is not significant, and the TBTF bailout motive is no longer confirmed.³³ In other ways, the fundamental characteristics are the same as in FY2004–2019, and nothing notable is observed.

Therefore, we will further limit our sample period to FY2007–2013, which marked the peak of the third wave of zombie firms, owing primarily to the major external shocks of the GFC and the Great East Japan Earthquake, and the resulting super-strong yen. Table 5–3 displays the summary statistics. Surprisingly, no significant differences exist in the

³² The mid-2000s onward was an era dominated by market discipline. However, because of the shift to market financing, the role of banks as lender of last resort in the event of market turmoil was rather more important, and even though loan balances declined, the amount of commitment line contracts, for example, was on the rise. Against this backdrop, it is known that the banks' response to the difficulties Japanese firms faced in the aftermath of the GFC was contrasted between the manufacturing and non-manufacturing sectors. Non-manufacturing industries, such as the real estate sector, which was hit hard by the bursting of the land price mini-bubble, saw a large number of black-ink bankruptcies. This is believed to be due to the fact that both the banks themselves and the bank supervisory authorities took a strict stance on bailout loans to the real estate industry after the experience of the lost decade. On the other hand, in the manufacturing sector, there were many cases, particularly in the electric machinery and electronic components industries, where companies did not go bankrupt thanks to financial support despite huge losses. This may have been due to the fact that the banks and bank supervisory authorities, as well as the borrowing companies themselves, shared the stereotypical notion that Japanese manufacturing companies were inherently highly competitive and that poor performance was due to unfortunate external circumstances (the myth of Japanese manufacturing competitiveness). However, in light of the subsequent situation of Japan's electric machinery industry, we cannot deny the possibility that many of the bailout cases were soft budget constraints.

³³ There are three possible reasons why the motive for the TBTF bailout was no longer identified in the post-2004 estimation period. First, the resolution of banks' non-performing loans since the bubble burst has come to an end, and banks' concerns about their own financial crises have shrunk considerably; second, traditional bank-led corporate governance system of Japan, symbolized by the main banks, has completely declined in the course of the lost decade, and banks' concerns about social and political criticism directed at them due to their client's bankruptcy have also shrunk considerably; and third, with introduction of Takenaka Plan in October 2002, the banks' discretionary authority to recognize bad loans has virtually disappeared. The TBTF bailout is essentially a bank-specific phenomenon, and no such incentive exists for widely dispersed shareholders. Therefore, once the incentive no longer existed for banks, TBTF bailouts would no longer be observed.

proportion of the distressed sample that experienced financial distress that meets the criteria for zombie firms by receiving financial support and the difference between the distressed sample and the non-distressed samples from FY2004–2013. However, for Tobin's q, the distressed group is noticeably lower than the non-distressed group.³⁴

The results of estimating a weighted probit model with a six-variable sample selection correction (Table 5–4) show no significant difference between FY2004–2013. However, the fact that the firm age coefficient becomes negative and significant for the first time is noteworthy as a sign of a shift away from the unnatural selection.

5.6. FY2014–19 and FY2017–19: Second half of the era of market discipline (the Abenomics corporate governance reform era)

The period FY2014–2019 is the second half of FY2004–2019 and corresponds to the period following the implementation of the Abenomics corporate governance reforms. It will be interesting to see if the effects of the reforms change the characteristics of firms receiving financial support and the impact of shareholder composition on bailout. Table 6–1 displays the summary statistics. The percentage of the distressed samples that meets the criteria for zombie firms by receiving financial assistance is approximately 38%, which is slightly higher than in FY2004–2013. Most of the items in the comparison between the distressed and non-distressed samples are the same as in FY2004–2013, but Tobin's q is contrary to FY2004–2013, with the q of the distressed group being much higher, exceeding the level of 2. This could be because, as the wave of financial distress in the electric machinery and electronic components industries has gone, more firms promoted from emerging sections of the stock exchange have fallen on hard times during the growth process.

The results of estimating the weighted probit model with a sample selection correction using six variables are shown in Table 6–2. Because the coefficient on book value of total assets is not significant, the estimation results include a cross term with a non-manufacturing dummy. The cross-term coefficient between firm size and the non-manufacturing dummy is positive and significant, implying a TBTF bailout motive in the non-manufacturing industry, but the marginal effect is small. The coefficient of interest-bearing debt to total assets ratio is positive and significant and has a large marginal effect. These two points are the same as they were for the entire FY2004–2019. However, none of the other variables, including shareholder compositions, are significant, and except firm size and heavy debt burden, we can conclude that no factor systematically influenced the decision to provide financial assistance. This could be because financial distress has become rare among established firms in the zero-interest-rate environment, and it is primarily emerging firms with high variability that are in distress. The estimates for the manufacturing and non-manufacturing sectors (Table 6–3) are essentially the same. The coefficient of shareholding ratio of foreign corporations in the non-manufacturing sector remains negative and significant. We also tested estimates for the period FY2017–2019, after the revision of the stewardship and corporate governance codes (Table 6–4) and found no differences that could be attributed to changes in corporate governance reform penetration.

The corporate governance reforms in Abenomics are positioned as part of the growth strategy, and are based on the recognition that one of the primary causes of long-term stagnation is the situation in which management responsibility is not questioned as long as the company is financially stable in the prolonged zero-interest-rate environment, even if profitability and growth are far below the international standard and stock prices are stagnant. In the reform, forward-looking discipline through equity governance is required, rather than backward-looking discipline through debt governance. The poor performance of our

³⁴ The level of Tobin's q itself is above 1 in the treatment group and is not particularly low compared to the lost decade or the 1970s

Table 5–2
Baseline results of weighted probit regression (FY2004–2013, All industries).

Dependent variable: zombie status dummy						
	Coef.	p-value	dp/dx	Coef.	p-value	dp/dx
Total assets	0.0330	0.486	0.0069	0.0141	0.767	0.0029
Total assets×non-manufacturing dummy	0.0275	0.656	0.0058	0.0497	0.378	0.0102
Interest-bearing debt to total assets ratio	2.6860	0.000	***	0.5648	0.000	***
ROA	0.4433	0.000	***	0.0932	-0.2390	0.426
Net extraordinary income to total assets ratio				0.9760	0.021	**
Tobin's q	0.0009	0.435	0.0002	0.0011	0.343	0.0002
TFP growth	0.0963	0.299	0.0203	0.2198	0.040	**
Sales growth	-0.3991	0.000	***	-0.0839	-0.3601	0.000
Net worth to total assets ratio	0.2264	0.000	***	0.0476	0.0415	0.671
Firm age	-0.0499	0.432	-0.0105	-0.0613	0.336	-0.0125
Financial institutions' ownership	1.5029	0.001	***	0.3160	1.5024	0.001
Non-financial domestic corporations' ownership	0.0991	0.670	0.0208	0.0557	0.813	0.0114
Foreign corporations' ownership	-0.2827	0.505	-0.0594	-0.1795	0.673	-0.0367
Obs.	21,159			21,159		
Industry dummies	Yes			Yes		
Year dummies	Yes			Yes		

Notes: 1) ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively. 2) The marginal effect (dp/dx) represents the marginal impact that a small change in an explanatory variable has on the probability of becoming a zombie firm, evaluated at the mean value of the explanatory variable. However, when the explanatory variable is a dummy variable, it represents the difference in probability with the explanatory variable taking the value of 0 and 1.

Table 5–3
Summary statistics (FY2007–2013).

	Non-distressed samples			Distressed samples		
	Obs.	Mean	Std. Dev.	Obs.	Mean	Std. Dev.
Zombie status dummy (dependent variable)	14,042	0	0	647	0.3524	0.4781
Total assets (book value of total assets in natural log)	14,042	17.6063	1.4055	647	16.6648	1.6015
Interest-bearing debt to assets ratio (ratio of interest-bearing debt to book value of total assets)	14,042	0.1936	0.1800	647	0.2747	0.2498
ROA (EBIT/ book value of total assets)	14,042	0.0405	0.0757	647	-0.1562	0.3420
Tobin's q (in natural log)	14,042	1.5777	18.1835	647	1.0430	1.0064
TFP growth (change in natural log of TFP)	14,042	-0.0238	0.3417	647	-0.0747	0.3884
Sales growth (change in natural log of total sales)	14,042	-0.0045	0.3277	647	-0.2118	0.4941
Net worth to asset ratio (ratio of net worth in current price to book value of total assets)	14,042	0.6709	0.3016	647	0.7776	0.7337
Firm age (in natural log)	14,042	3.9060	0.6131	647	3.6693	0.7860
Financial institutions' ownership	14,042	0.2010	0.1243	647	0.1271	0.1167
Non-financial domestic corporations' ownership	14,042	0.2748	0.1833	647	0.2295	0.1882
Foreign corporations' ownership	14,042	0.0990	0.1147	647	0.0752	0.1242

Note: All explanatory variables are as of the previous period (the end of the previous period, for stock variables).

Table 5–4
Baseline results of weighted probit regression (FY2007–2013, All industries).

Dependent variable: zombie status dummy						
	Coef.	p-value	dp/dx	Coef.	p-value	dp/dx
Total assets	0.0343	0.522	0.0067	0.0240	0.654	0.0046
Total assets×non-manufacturing dummy	-0.0353	0.577	-0.0069	-0.0319	0.602	-0.0062
Interest-bearing debt to total assets ratio	3.0884	0.000	***	0.6043	0.000	***
ROA	0.9693	0.000	***	0.1897	0.807	0.0115
Net extraordinary income to total assets ratio				1.2967	0.000	***
Tobin's q	-0.1433	0.151	-0.0280	-0.1141	0.188	-0.0221
TFP growth	-0.0661	0.576	-0.0129	0.0436	0.718	0.0084
Sales growth	-0.3983	0.000	***	-0.3619	0.000	***
Net worth to total assets ratio	0.1490	0.131	0.0292	0.0254	0.823	0.0049
Firm age	-0.1163	0.096	*	-0.1317	0.059	*
Financial institutions' ownership	1.1814	0.027	0.2312	1.2462	0.022	**
Non-financial domestic corporations' ownership	0.3299	0.227	0.0646	0.3154	0.254	0.0610
Foreign corporations' ownership	-0.3160	0.529	-0.0618	-0.2844	0.581	-0.0550
Obs.	14,689			14,689		
Industry dummies	Yes			Yes		
Year dummies	Yes			Yes		

Notes: 1) ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively. 2) The marginal effect (dp/dx) represents the marginal impact that a small change in an explanatory variable has on the probability of becoming a zombie firm, evaluated at the mean value of the explanatory variable. However, when the explanatory variable is a dummy variable, it represents the difference in probability with the explanatory variable taking the value of 0 and 1.

Table 6–1
Summary statistics (FY2014–2019).

	Non-distressed samples			Distressed samples		
	Obs.	Mean	Std. Dev.	Obs.	Mean	Std. Dev.
Zombie status dummy (dependent variable)	11,966	0	0	243	0.3827	0.4871
Total assets (book value of total assets in natural log)	11,966	17.6949	1.4706	243	16.3703	1.7578
Interest-bearing debt to total assets ratio (ratio of interest-bearing debt to book value of total assets)	11,966	0.1802	0.1757	243	0.2740	0.2463
ROA (EBIT/ book value of total assets)	11,966	0.0550	0.0615	243	-0.1182	0.1507
Tobin's q (in natural log)	11,966	1.5517	6.9011	243	2.0851	10.1910
TFP growth (change in natural log of TFP)	11,966	-0.0266	0.4055	243	-0.0496	0.3395
Sales growth (change in natural log of total sales)	11,966	0.0306	0.2867	243	-0.0884	0.4416
Net worth to total assets ratio (ratio of net worth in current price to book value of total assets)	11,966	0.7086	0.3448	243	0.9149	0.9216
Firm age (in natural log)	11,966	3.9642	0.6274	243	3.8189	0.6646
Financial institutions' ownership	11,966	0.1967	0.1189	243	0.1049	0.1077
Non-financial domestic corporations' ownership	11,966	0.2666	0.1773	243	0.2440	0.2095
Foreign corporations' ownership	11,966	0.1304	0.1293	243	0.0944	0.1478

Note: All explanatory variables are as of the previous period (the end of the previous period, for stock variables).

Table 6–2
Baseline results of weighted probit regression (FY2014–2019, All industries).

Dependent variable: zombie status dummy	Coef.	p-value	dp/dx
Total assets	-0.0864	0.351	-0.0183
Total assets×non-manufacturing dummy	0.1811	0.089 *	0.0385
Interest-bearing debt to total assets ratio	2.6297	0.000 ***	0.5583
ROA	0.3077	0.600	0.0653
Tobin's q	-0.0329	0.517	-0.0070
TFP growth	0.2242	0.240	0.0476
Sales growth	0.0506	0.819	0.0107
Net worth to total assets ratio	-0.1298	0.194	-0.0276
Firm age	0.0266	0.816	0.0056
Financial institutions' ownership	0.4308	0.663	0.0914
Non-financial domestic corporations' ownership	0.5093	0.210	0.1081
Foreign corporations' ownership	0.0453	0.948	0.0096
Obs.	12,209		
Industry dummies	Yes		
Year dummies	Yes		

Notes: 1) ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively. 2) The marginal effect (dp/dx) represents the marginal impact that a small change in an explanatory variable has on the probability of becoming a zombie firm, evaluated at the mean value of the explanatory variable. However, when the explanatory variable is a dummy variable, it represents the difference in probability with the explanatory variable taking the value of 0 and 1.

Table 6–3
Results by industry (FY2014–2019).

Dependent variable: zombie status dummy	Manufacturing			Non-manufacturing		
	Coef.	p-value	dp/dx	Coef.	p-value	dp/dx
Total assets	-0.0560	0.575	-0.0131	0.1261	0.256	0.0199
Interest-bearing debt to total assets ratio	2.5994	0.000 ***	0.6091	3.6945	0.000 ***	0.5842
ROA	-0.0998	0.902	-0.0234	0.5707	0.400	0.0902
Tobin's q	-0.1328	0.360	-0.0311	-0.0091	0.150	-0.0014
TFP growth	-0.2942	0.128	-0.0689	0.3319	0.095 *	0.0525
Sales growth	-0.2521	0.423	-0.0591	0.2286	0.354	0.0362
Net worth to total assets ratio	0.1935	0.123	0.0453	-0.3522	0.001 ***	-0.0557
Firm age	0.1082	0.559	0.0254	-0.1266	0.380	-0.0200
Financial institutions' ownership	0.5643	0.651	0.1322	-0.0694	0.971	-0.0110
Non-financial domestic corporations' ownership	0.5424	0.387	0.1271	0.2950	0.631	0.0466
Foreign corporations' ownership	0.7352	0.360	0.1723	-1.9222	0.089 *	-0.3040
Obs.	7,301			4,908		
Industry dummies	No			Yes		
Year dummies	Yes			Yes		

Notes: 1) ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively. 2) The marginal effect (dp/dx) represents the marginal impact that a small change in an explanatory variable has on the probability of becoming a zombie firm, evaluated at the mean value of the explanatory variable. However, when the explanatory variable is a dummy variable, it represents the difference in probability with the explanatory variable taking the value of 0 and 1.

empirical model after 2014 demonstrates the limitations of the traditional backward-looking definition and identification of zombie firms based on debt governance. The development of a new framework and empirical analysis based on the framework for considering the zombie firm problem in a zero-interest-rate environment and a situation where equity governance is left for future work is left for our future work.

6. Conclusion

This study uses a unified framework to examine quantitatively and qualitatively long-term changes in “zombie firms” in Japan over a half-century spanning the early 1970 s to the end of 2010 s. The concept of “zombie firms” includes possible efficient bailouts. We use regression analysis to show how banks and shareholders have been involved in corporate bailouts and uncover the reality of Japanese firm governance to disprove commonly held beliefs.

The primary contribution of this paper is to visualize the dynamics of zombie firms for the first time from a very long-term perspective. We discover three major waves of zombie firm ratios over the course of 50 years. The wave is small during the MB period, and the bailout of financially distressed companies was a minor burden on the banks' health, allowing for bold intervention. The wave of the lost decade is the largest and longest, but the problem of zombie firms in the manufacturing sector was just as serious in terms of the number of firms

Table 6–4
Baseline results of weighted probit regression (FY2017–2019, All industries).

Dependent variable: zombie status dummy							
	Coef.	p-value		dp/dx	Coef.	p-value	dp/dx
Total assets	0.1090	0.367		0.0227	0.1132	0.334	0.0196
Interest-bearing debt to total assets ratio	3.2211	0.000	***	0.6705	4.1085	0.000	*** 0.7103
ROA	1.4200	0.090	*	0.2956	-5.2633	0.001	*** -0.9100
Net extraordinary income to total assets ratio					8.0859	0.000	*** 1.3980
Tobins' q	-0.0060	0.919		-0.0013	-0.1421	0.370	-0.0246
TFP growth	-0.0682	0.683		-0.0142	0.1591	0.438	0.0275
Sales growth	0.0528	0.845		0.0110	0.4023	0.099	* 0.0695
Net worth to total assets ratio	0.3461	0.007	***	0.0720	0.2776	0.039	** 0.0480
Firm age	0.2014	0.227		0.0419	0.1272	0.449	0.0220
Financial institutions' ownership	1.3618	0.318		0.2835	2.0090	0.153	0.3473
Non-financial domestic corporations' ownership	-0.0340	0.956		-0.0071	0.1580	0.826	0.0273
Foreign corporations' ownership	-2.2175	0.106		-0.4616	-1.9087	0.195	-0.3300
Obs.	6,086				6,086		
Industry dummies	Yes				Yes		
Year dummies	Yes				Yes		

Notes 1) ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively. 2) The marginal effect (dp/dx) represents the marginal impact that a small change in an explanatory variable has on the probability of becoming a zombie firm, evaluated at the mean value of the explanatory variable. However, when the explanatory variable is a dummy variable, it represents the difference in probability with the explanatory variable taking the value of 0 and 1.

as it was in the non-manufacturing sector. The wave following the GFC is also as high as the lost decade in the manufacturing sector. The problem of zombie firms during this period has been underestimated because of the strong monetary easing measures introduced in response to the external shocks and the reduced concentration of risk in the banking sector.

Another contribution is to use an elaborated empirical framework and detailed data to overturn the stereotypical view of Japanese corporate bailouts and zombie firms that has been held for the past 50 years. To determine what types of companies become zombie firms, we estimate a weighted probit regression model that controlled for sample selection bias between distressed and non-distressed firms. The findings show that the presence of an MB with a certain loan share in the 1970 s increases the likelihood of bailouts, but no evidence shows the superiority of bailed-out firms (zombie firms) over non-bailed-out firms in hindsight. Corporate groups and long-term credit banks play a limited role. By generalizing beautiful anecdotes of corporate bailouts, the role of MB monitoring, corporate groups is significantly exaggerated over the actual situation, both quantitatively and qualitatively. Concerning the lost decade, we demonstrate that pathological phenomena such as problem procrastination and unwilling concentration of loan to the MB are more typical of the manufacturing sector, and that disciplining by foreign investors is only effective in the non-manufacturing sector. Takenaka Plan, which required banks to dispose of NPLs to end the wave of the lost decade creates new type of zombie firms in the manufacturing sector after the GFC. It takes the form of priority bailouts for over-indebted firms that have lost competitiveness and suffer declining sales but still had a financial buffer from previous accumulation.

Our empirical model's explanatory power has declined since the mid-2000 s, particularly after FY2014, when the Abenomics corporate governance reforms were implemented, thus confirming the limitations of traditional backward-looking zombie firm analysis based on debt governance assumptions. In Japan and the major countries affected by the GFC, the zombie firm problem are shifting from a combined problem of low productivity/low growth and excessive debt to a problem of low productivity/low growth alone. In order to accurately grasp what types of firms are the main obstacles to economic metabolism, future studies must consider a stock market perspective, such as that used in some foreign studies of zombie firms.

Acknowledgements

We would like to thank Takeo Hoshi, the two anonymous reviewers, and the editor for their careful reading of my manuscript and many

insightful comments that helped to significantly improve the paper.

References

- Adalet McGowan, M., Andrews, D., Millot, V., 2018. The walking dead? Zombie firms and productivity performance in OECD countries. *Econ. Policy* 33 (96), 685–736. <https://doi.org/10.1093/epolic/eiy012>.
- Aoki, M., Jackson, G., Miyajima, H. (Eds.), 2007. *Corporate Governance in Japan: Institutional Change And Organizational Diversity*. Oxford University Press.
- Aoki, M., Patrick, H., Sheard, P., 1994. The Japanese main bank system: an introductory overview. In: Aoki, M., Patrick, H. (Eds.), *The Japanese main Bank System: Its Relevance for Developing and Transforming Economies*. Oxford University Press, pp. 1–50. <https://doi.org/10.1093/0198288999.003.0001>.
- Aoki, M., Saxonhouse, G.R. (Eds.), 2000. *Finance, Governance, and Competitiveness in Japan*. Oxford University Press.
- Banerjee, R., Hofmann, B., 2022. Corporate zombies: anatomy and life cycle. *Econ. Policy* 37 (112), 757–803. <https://doi.org/10.1093/epolic/eiac027>.
- Caballero, R.J., Hoshi, T., Kashyap, A.K., 2008. Zombie lending and depressed restructuring in Japan. *Am. Econ. Rev.* 98 (5), 1943–1977. <https://doi.org/10.1257/aer.98.5.1943>.
- Fukuda, S., Nakamura, J., 2011. Why did 'zombie' firms recover in Japan? *World Econ.* 34 (7), 1124–1137. <https://doi.org/10.1111/j.1467-9701.2011.01368.x>.
- Fukuda, S., Okumura, K., 2021. The aging society, savings rates, and regional flow of funds in Japan. *Article 101165 J. Jpn. Int. Econ.* 62. <https://doi.org/10.1016/j.jjie.2021.101165>.
- Goto, Y., Wilbur, S., 2019. Unfinished business: zombie firms among SMEs in Japan's lost decades. *Jpn. World Econ.* 49, 105–112. <https://doi.org/10.1016/j.japwor.2018.09.007>.
- Hanazaki, M., Horiuchi, A., 2000. Is Japan's financial system efficient? *Oxf. Rev. Econ. Polic.* 16 (2), 61–73. <https://doi.org/10.1093/oxrep/16.2.61>.
- Hanazaki, M., Horiuchi, A., 2001. A vacuum of governance in Japanese bank management. In: Osano, H., Tachibanaki, T. (Eds.), *Banking, Capital Markets and Corporate Governance*. Palgrave Macmillan, pp. 133–180. <https://doi.org/10.1057/9780230288140>.
- Honda, T., Hosono, K., Miyakawa, D., Ono, A., Uesugi, I., 2023. Determinants and effects of the use of COVID-19 business support programs in Japan. *Article 101239 J. Jpn. Int. Econ.* 67. <https://doi.org/10.1016/j.jjie.2022.101239>.
- Hoshi, T., 2006. Economics of the living dead. *Jpn. Econ. Rev.* 57 (1), 30–49. <https://doi.org/10.1111/j.1468-5876.2006.00354.x>.
- Hoshi, T., Kashyap, A.K., 2004. *Corporate Financing and Governance in Japan: The Road to the Future*, revised ed. MIT press.
- Hoshi, T., Kashyap, A.K., Scharfstein, D., 1990. The role of banks in reducing the costs of financial distress in Japan. *J. Financ. Econ.* 27 (1), 67–88. [https://doi.org/10.1016/0304-405X\(90\)90021-Q](https://doi.org/10.1016/0304-405X(90)90021-Q).
- Hoshi, T., Kawaguchi, D., Ueda, K., 2023. Zombies, again? The COVID-19 business support programs in Japan. *Article 106421 J. Bank. Financ.* 147. <https://doi.org/10.1016/j.jbankfin.2022.106421>.
- Hoshi, T., Koibuchi, S., Schaede, U., 2018. The decline in bank-led corporate restructuring in Japan: 1981–2010. *J. Jpn. Int. Econ.* 47, 81–90. <https://doi.org/10.1016/j.jjie.2017.11.004>.
- Imai, K., 2016. A panel study of zombie SMEs in Japan: identification, borrowing and investment behavior. *J. Jpn. Int. Econ.* 39, 91–107. <https://doi.org/10.1016/j.jjie.2015.12.001>.
- Miyajima, H., Kuroki, F., 2007. The unwinding of cross-shareholding in Japan: Causes, effects, and implications. In: Aoki, M., Jackson, G., Miyajima, H. (Eds.), *Corporate Governance in Japan: Institutional Change and Organizational Diversity*. Oxford

- University Press, pp. 79–124. <https://doi.org/10.1093/acprof:oso/9780199284511.001.0001>.
- Nakamura, J., 2017. Japanese firms during the lost two decades: The recovery of zombie firms and entrenchment of reputable firms. Springer, <https://doi.org/10.1007/978-4-431-55918-4>.
- Nakamura, J., Fukuda, S., 2013. What happened to ‘zombie’ firms in Japan? Reexamination for the lost two decades. *Glob. J. Econ.* 2 (2), 1–18. <https://doi.org/10.1142/S2251361213500079>.
- Packer, F., 1994. The role of long-term credit banks within the main bank system. In: Aoki, M., Patrick, H. (Eds.), *The Japanese main bank system: Its relevancy for developing and transforming economies*. Oxford University Press, pp. 142–187. <https://doi.org/10.1093/0198288999.001.0001>.
- Peek, J., Rosengren, E.S., 2005. Unnatural selection: Perverse incentives and the misallocation of credit in Japan. *Am. Econ. Rev.* 95 (4), 1144–1166. <https://doi.org/10.1257/0002828054825691>.
- Sheard, P., 1989. The main bank system and corporate monitoring and control in Japan. *J. Econ. Behav. Organ* 11, 399–422. [https://doi.org/10.1016/0167-2681\(89\)90037-1](https://doi.org/10.1016/0167-2681(89)90037-1).
- Sheard, P., 1994. Main banks and the governance of financial distress. In: Aoki, M., Patrick, H. (Eds.), *The Japanese Main Bank System: Its Relevance for Developing and Transforming Economies*. Oxford University Press, pp. 188–230. <https://doi.org/10.1093/0198288999.001.0001>.
- Shioji, E., 2019. Quantitative ‘flooding’ and bank lending: Evidence from 18 years of near-zero interest rate. *J. Jpn. Int. Econ.* 52, 107–120. <https://doi.org/10.1016/j.jjie.2019.01.003>.
- Tomeczek, A.F., 2022. The evolution of Japanese keiretsu networks: A review and text network analysis of their perceptions in economics. *Article 101132 Jpn. World Econ.* 62. <https://doi.org/10.1016/j.japwor.2022.101132>.
- Uchino, T., Uesugi, I., 2022. The effects of a megabank merger on firm-Bank relationships and loan availability. *Article 101189 J. Jpn. Int. Econ.* 63. <https://doi.org/10.1016/j.jjie.2021.101189>.
- Weinstein, D.E., Yafeh, Y., 1998. On the costs of a bank-centered financial system: evidence from the changing main bank relations in Japan. *J. Financ* 53 (2), 635–672. <https://doi.org/10.1111/0022-1082.254893>.