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# **Corporate Finance Facility and Resource Allocation: Research Trends and Developments during the Spread of COVID-19**

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# Corporate Finance Facility and Resource Allocation: Research Trends and Developments during the Spread of COVID-19\*

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## Abstract

Since the outbreak of COVID-19, governments and central banks in major countries have implemented large-scale corporate finance facilities. While a series of policy actions seemingly have served well to rein in bankruptcies in the short run, more than a few have remarked that the facility measures could hamper business dynamics and distort resource allocation in the medium to long run.

Based on these discussions, this paper provides a literature survey of existing studies on the effects of corporate facility measures of banks and governments on resource allocation in the economy. It mainly focuses on Japan after the collapse of its bubble economy, European countries after the global financial crisis and the sovereign debt crises, China under debt expansion, and developed countries during the spread of COVID-19. We also identify so-called "zombie firms," which survive with banks' and governments' support despite performing poorly without the prospect of recovery, using firms' financial data. We set the criteria of the zombie firms by arranging methodologies proposed by the existing studies. The analysis shows that the number of zombie firms surged after the collapse of the bubble economy in the early 1990s in Japan. It decreased in the early 2000s and remained relatively lower in recent years for both large and small-and-medium enterprises. At least based on the currently available data in fiscal 2020 after the spread of COVID-19, we do not detect a problematic growth in the number of zombie firms as in the 1990s. Still, we need to be cautious about the development of zombie firms because we have data constraints on the recent data.

JEL classification: D22, D24, D30

Keywords: Business dynamics, Resource allocation, Zombie firms, COVID-19

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## 1. Introduction

Following the spread of COVID-19, governments and central banks have implemented massive fiscal spending and monetary easing. One cannot dispute the view that these policy reactions avoided bankruptcies and maintained employment, at least in the short term.<sup>1</sup> Meanwhile, as the effects of COVID-19 have persisted, many studies have pointed out the cost of the policies. In particular, as the corporate financial facilities adopted in developed countries were unprecedentedly extensive, their continuation could potentially harm business dynamics in the medium to the long run and distort resource allocation in the economy. Previous studies argue that such distortion of resource allocation potentially has a risk of ruining sustainable economic growth.<sup>2</sup> Therefore, the risk of ruined resource allocation is regarded as one of the crucial issues in discussion among many international institutions and policy authorities about the economic growth for the period after COVID-19 (see, e.g., IMF (2021), World Bank Group (2020), OECD (2020), and FSB (2021a)<sup>3</sup>). The G20 (2021) argues that paying attention to resource allocation efficiency during the pandemic's recovery period is vital.

Although many studies theoretically analyze the impact of corporate finance facilities by banks, governments, and related entities on the survival of the firms and resource allocation in the economy, it is not easy to evaluate them empirically because it is difficult to identify which firms should not have been rescued with corporate finance facilities from the perspective of appropriate resource allocation. For instance, Caballero *et al.* (2008) focus on the existence of firms that continue in operation under the support despite performing poorly without the prospect of recovery and argue for the importance of inducing such firms to exit the market because their existence would harm business dynamics and distort resource allocation. As Laeven *et al.* (2020) and Gagnon (2021) point out, some studies argue that when policy assessments reference such a theoretical argument, even firms that temporarily postpone losses reflecting the significant damage to economic activity should exit the market. During the spread of COVID-19, quite a few firms, mainly those in the face-to-face services industry, posted losses arising due to public health measures and other factors. Suppose one asks whether all of them should have exited the

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<sup>1</sup> For example, Doniger and Kay (2021) find that the U.S. government's corporate support packages helped small-to-medium-sized enterprises (SMEs) retain jobs. Gourinchas *et al.* (2021) analyze SMEs in 27 countries, including Japan, and argue that the default rates in 2020 would have risen to a 13% level on average in developed countries without the corporate support packages. Actually, the rate remained at the 7% level, similar to previous years, due to the support packages. Yasui (2021) estimates that corporate finance facilities by Japan's government and the Bank of Japan reduced bankruptcies by about 3,000 in 2020.

<sup>2</sup> See Bailey *et al.* (1992) and Foster *et al.* (2001).

<sup>3</sup> The IMF (2021) argues that corporate facility packages without narrowing the scope of target firms have a risk of distorting resource allocation. The World Bank Group (2020), while noting the possible distortion of resource allocation amid the spread of COVID-19, stresses the importance of enhancing business dynamics. The OECD (2020) and the FSB (2021a) argue that it is crucial to consider corporate support packages' targets and duration to minimize the policies' cost.

market as their existence would distort economic resource allocation. In that case, the answer will be apparently "No."<sup>4</sup> Relatedly, the influence of poorly-performed firms on productivity in the macroeconomy is not always apparent, which makes policy assessment difficult.

With awareness of such problems in mind, this paper provides a comprehensive survey of the literature on the influences of corporate finance facilities by banks and governments on the resource allocation of the economy. Then, following the previous studies, we examine several identification strategies to distinguish which firms can be regarded as having been rescued by corporate finance facilities by banks and governments (although they would have difficulty surviving in normal circumstances).

The remainder of this paper is organized as follows. Section 2 provides a survey on the firms that harm the macroeconomy and discusses qualitative definitions of such firms, trends of its discussion, and the influences of those firms on the macroeconomy. Section 3 summarizes quantitative definitions and identification strategies developed in the previous studies and provides empirical analyses of Japan's firms. Finally, Section 4 concludes.

## 2. A survey of existing studies

### 2-1. Qualitative definitions

Many studies argue that huge corporate finance facilities by banks and governments could impede business dynamics and distort resource allocation, potentially affecting the macroeconomy adversely in the medium to long term. Many of these past studies raise the issue of the existence of firms that survive with support from banks or other entities despite performing poorly without no prospect of recovery.<sup>5</sup> These studies find such firms problematic because, in principle, they should close their business. What characterizes these studies is that they consider the existence of financial support in addition to the firm's business performance.<sup>6</sup>

For example, Caballero *et al.* (2008), which pioneered a series of studies, refer to such

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<sup>4</sup> For example, Tokyo Shoko Research (2021a, 2021b) report that 70% of izakaya (Japanese-style bars) and 80% of department stores in Japan claimed losses for fiscal 2020.

<sup>5</sup> Many related studies, including this paper, analyze from the viewpoint of firms receiving support. On the other hand, it would be meaningful to develop an analysis to distinguish the effects of the package by banks and governments from the viewpoint of the support authorities.

<sup>6</sup> Studies that analyze firms with relatively low productivity (e.g., Nakamura *et al.* (2019) and Yagi *et al.* (2022)) broadly examine firms that could potentially affect the macroeconomy adversely. These studies does not consider the existence of financial support. The Bank of Japan (2018) identifies "firms in relatively weak financial condition, whose borrowing interest rate is low relative to its through-the-cycle credit risk." It defines such firms as "firms with low risk-adjusted return for the lender" and referred to them as "low-return borrowers."

firms figuratively as "zombie firms," pointing "their lives are prolonged" by financial support, while it should be difficult for them to remain in business as far as looking at their financial conditions. Many subsequent studies on this subject also use the name. Some studies, albeit small in number, referred to such firms as "low-quality firms," "non-viable firms," or "troubled firms." In this paper, firms that survive with support from banks or other entities despite performing poorly without no prospect of recovery are hereafter referred to as "zombie firms," following the previous studies.

The way to identify zombie firms differs across past studies. Caballero *et al.* (2008) focus on firms allowed to survive with support from banks or other entities (firms for which interest is waived or reduced) despite having no prospect of recovery (Table 1). Fukuda and Nakamura (2011) take notice of firms that are allowed to survive by receiving financial support despite being unable to record sufficient profit to cover their interest payments. Firms that failed to keep repaying debts and survived by receiving financial support are discussed in studies on overseas firms by Adalet McGowan *et al.* (2018), Banerjee and Hofmann (2018), Acharya *et al.* (2020), Grieder and Ortega (2020), and Favara *et al.* (2021). Some of these studies focus on loans to borrowers with almost no prospect of reviving their business that is highly likely to be used for repaying interest or debt without generating new investments (commonly referred to as "forbearance lending"<sup>7</sup>). Schivardi *et al.* (2017, 2020) and Storz *et al.* (2017) looked at firms with solid relationships with banks with low capital adequacy ratios.

## 2-2. Trends in the studies on zombie firms

### (Studies on zombie firms in Japan after the collapse of the bubble economy)

Studies on zombie firms in Japan increased amid discussions about the sluggish economic performance following the collapse of the bubble economy. Hoshi (2000) shows empirical evidence that additional loans that would not have been linked to new investments were provided to real estate firms. Sekine *et al.* (2003) develop an empirical analysis using individual firms' financial data and point out that the Japanese economy was adversely affected by procrastination in resolving the problem of non-performing loans (NPLs) while providing additional loans that keep inefficient companies in the business. Peek and Rosengren (2005) argue that banks provided additional loans to avoid capital loss due to borrowers' bankruptcies.

Caballero *et al.* (2008) analyze listed firms in Japan between 1981 and 2002 and show that the number of zombie firms increased due to banks deferring loss recognition and

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<sup>7</sup> As for forbearance lending, details including its definition are documented in Sekine *et al.* (2003). See also Fukuda *et al.* (2007).

providing additional loans to comply with capital adequacy regulations.<sup>8</sup> The study argues that zombie firms could survive by receiving support from banks or other entities, although they should have had difficulty remaining in business when judged by their financial conditions. The study is regarded as a leading paper on the issues of zombie firms, and subsequent studies on Japanese and overseas firms often refer to the paper.

Fukuda and Nakamura (2011) provide an analysis using data on listed firms in Japan until 2004 and show that zombie firms increased in the 1990s and then decreased in the early 2000s. Studies on unlisted firms, including many SMEs, are also available, albeit few. Imai (2016) analyzes about 2,400 SMEs using data from 1999 to 2008 and shows that zombie firms have increased due to the availability of credit guarantee schemes, a public support mechanism, and additional loan provision by banks. In this way, many studies in Japan attribute the emergence and increase of zombie firms to the financial support provided by banks, mainly due to the vulnerability of bank balance sheets.

#### (Studies on zombie firms in Europe since the late 2000s)

In Europe, after the global financial crisis and European debt crises in the latter half of the 2000s, discussions on zombie firms increased amid concerns over the region's secular stagnation. Many studies, such as Kawai and Morgan (2013), Giannetti and Simonov (2013), and Hoshi and Kashyap (2015), develop their arguments by citing examples from Japan in the 1990s (what is commonly referred to as "Japanification"). Adalet McGowan *et al.* (2018) and Hallak *et al.* (2018) develop an analysis mainly using European data and show that the share of zombie firms has grown since the global financial crisis and European debt crises.

What characterizes the discussions in Europe is that they refer to a low-interest rate environment and the inadequacy of corporate insolvency resolution schemes, in addition to the vulnerability of bank balance sheets, as in Japan, as factors for the emergence and increase of zombie firms.

First, on the question of bank balance sheet vulnerability, BOE (2011) and Arrowsmith *et al.* (2013) show that banks' forbearance lending practices impaired their soundness and their function to reallocate macroeconomic resources. Storz *et al.* (2017) find a tendency for banks with low capital adequacy ratios to provide more loans to firms with high leverage ratios in peripheral European countries following their debt crises. The analysis suggests that banks with poor soundness resorted to forbearance lending and deferred the disposal of NPLs to avoid a decline in their capital adequacy ratios due to an increase in loan loss reserves. Moreover, the analysis remarks that firms that would have exited the

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<sup>8</sup> The term "zombie firms" was used in economic studies as early as the 1980s. For example, Kane (1989) uses the term in reference to the U.S. firms, as well as in reference to Japanese firms (see Kane (1993)).

market without the support of banks were kept in business.<sup>9</sup> Schivardi *et al.* (2017) show that banks with low capital adequacy ratios provided more loans to problematic borrowers and argue that banks' balance sheet vulnerability might contribute to the increase in zombie firms. Andrews and Petroulakis (2019) also focus on borrowers from banks with low capital adequacy ratios. Specifically, the analysis creates a bank health indicator based on the capital adequacy ratio and NPL ratio, showing that banks with an indicator value lower than average by one standard deviation do more business with zombie firms. Tracey (2021) finds most borrowers provided with forbearance lending to be low-quality firms.

Next, regarding a low-interest rate environment, Banerjee and Hofmann (2018) show that corporate side factors and bank side factors interact with each other in a low-interest rate environment, causing zombie firms to emerge and increase. On the corporate side, the analysis assesses that if interest rates remain low, interest payments will decrease, making it difficult to incentivize companies to reduce debt. The authors also claim that, on the bank side, if interest rates remain low, banks' risk-taking stances will become bolder, and banks will tend to provide loans to borrowers with relatively low credit quality. The study shows that the number of zombie firms in 14 OECD countries rose by 5% points between 1987 and 2016, with 1% point attributable to interest rate declines. Acharya *et al.* (2020) analyze that, in the low-interest rate environment, the risk-taking stance of banks and investors becomes bolder, vitalizing the debt trading markets of relatively high-risk firms (leveraged loans and CLO markets), thus enabling borrowers with low credit quality to raise cash quickly.<sup>10</sup> On the other hand, some argue that there is no clear relation between the emergence of zombie firms and the low interest rates. Bindseil and Schaaf (2020) suggest that low interest rates may have induced innovative firms to pursue innovation and growth, causing uncompetitive firms to exit the market. Obstfeld and Duval (2018), Laeven *et al.* (2020), and Schularick (2021) argue that it is wrong to attribute zombification to monetary policies (i.e., a low-interest rate environment), claiming that the zombie firm ratio in the Euro area varies significantly across countries despite unified policy interest rates in the area.

In addition, some studies argue that an enterprise insolvency resolution scheme affects the emergence and increase of zombie firms. Adalet McGowan *et al.* (2017) claim that zombie firms are kept in business due to a lack of a "market exit inducement mechanism" for companies having difficulty surviving. Using the OECD insolvency regime indicators, Andrews and Petroulakis (2019) analyze that peripheral European countries, such as Spain, were slow to implement insolvency resolution schemes, making companies slow to exit

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<sup>9</sup> Tracey (2021) and Becker and Ivashina (2021) refer to forbearance lending as "zombie lending." Fukuda and Nakamura (2011), Imai (2016), and Goto and Wilbur (2019) refer to banks' actions to defer the disposal of NPLs by means of forbearance lending as "evergreening."

<sup>10</sup> Kankawa *et al.* (2019) focus on developments in the U.S. credit market, such as for leveraged loans and CLOs, in the latter half of the 2010s.

the market.<sup>11</sup> Meanwhile, the analysis shows that Germany has fewer zombie firms because an efficient insolvency resolution scheme has been in place in the country. In this regard, Kinoshita (2014) argues that Germany has a mechanism to induce corporate business dynamics as a legal system and that if a company engages in business while insolvent, it will be subject to criminal proceedings. Nakamura *et al.* (2019) show that in Germany, due to pressure from its legal system, firms with low productivity are not kept in business; capital and labor are redirected to firms with high productivity instead.

#### (Studies on zombie firms in China in the 2010s)

In the 2010s, Chinese state-owned enterprises (SOEs) also became the subject of analyses on zombie firms. These discussions attracted attention, prompted by a rapid expansion of corporate debt following an enormous economic stimulus package (commonly referred to as a 4 trillion yuan investment) by the Chinese authorities following the global financial crisis.<sup>12</sup> Experts attribute the emergence and increase of zombie firms to government support for companies (that for SOEs, in particular).

IMF (2016) raises the issue of risks associated with China's growing corporate debt and suggests the authorities promote restructuring zombie firms. Tan *et al.* (2016) show that government support caused Chinese zombie firms to increase, mainly among SOEs, between 2005 and 2007, adversely affecting the investments and employment of other companies through a distortion of resource allocation. Shen and Chen (2017) analyze Chinese manufacturing industries from 2011 to 2013 and show that many companies with low competitiveness remained in the market as government support was available, noting that SOEs in heavy chemical industries especially held excessive facilities. Renmin University of China National Academy of Development and Strategy (2016) attributes the slow natural selection to (1) the local government's support in the form of subsidies aimed at maintaining employment rates and (2) banks' preferential treatment of large SOEs (commonly referred to as the "too big to fail" argument).

#### (Studies on zombie firms in and outside Japan since the spread of COVID-19)

Since the spread of COVID-19, debates on zombie firms have resurged both in and outside Japan, infections have had protracted effects, and people have become aware of the side effects of government policy actions.

Arranging in line with the factors for the emergence and increase of zombie firms noted in previous studies: (1) vulnerability of bank balance sheets; (2) a low-interest rate

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<sup>11</sup> The OECD insolvency regime indicator scores countries on the length of time it takes to complete a bankruptcy procedure, the framework for debt forgiveness, and the ease of financing after a bankruptcy. It is an indicator created based on the idea that if an environment is in place in which a company exiting from a market can start a new business again, business dynamics would be likely to occur through exit and entry.

<sup>12</sup> Iida *et al.* (2017) summarize the excessive debt of Chinese companies.



environment; (3) inadequate insolvency resolution schemes; and (4) corporate support by governments and other entities. (1) The soundness of bank balance sheets appears to be maintained, at least in developed countries. IMF (2020) shows that credit continued to be made available even after the spread of COVID-19, as banks had ample capital and liquidity before the spread. In this regard, FSB (2021b) argues that the financial regulatory reforms following the global financial crisis successfully kept banks sound before the spread of COVID-19. Meanwhile, (2) the low-interest rate environment and (3) inadequate insolvency resolution schemes in some countries appear to exist still. Demmou *et al.* (2021) note that these factors have potentially increased and preserved zombie firms recently. Currently, studies on this subject spotlight the effects of (4) the unprecedentedly extensive corporate support by governments and other entities.

Among specific studies in Europe and the U.S., Helmersson *et al.* (2021) show that zombie firms were among the beneficiaries of a series of government-corporate support packages.<sup>13</sup> Barnes *et al.* (2021) note that policy responses in the U.K. prolonged the lives of more than half of the firms that would have failed if not for the shock of the spread of COVID-19. Core and De Marco (2021) analyze Italian companies to show that the higher their leverage was, the more government-guaranteed loans they received. Granja *et al.* (2020) and Chetty *et al.* (2020) suggest that the U.S. Paycheck Protection Program (PPP), a loan program for SMEs, could potentially have supported companies other than those truly needing financial support due to plunging sales resulting from the effects of the spread of COVID-19. Gourinchas *et al.* (2021) examine what kinds of companies received corporate support for SMEs in 27 countries. The examination of developed countries found various policies had been poorly targeted, as 90% of the funding was allocated to companies that could remain in business without policy support. Only 5% of the total budget was allocated to firms that could have gone bankrupt if not for the policy support (i.e., companies surviving due to policy support). However, it is argued that, with zombie firms accounting for 10% to 20% of companies that survived because of policy support, it is wrong to think that support packages rescued many zombie firms.

Meanwhile, only a few studies precisely gauge whether zombie firms have increased since the spread of COVID-19. Favara *et al.* (2021) gauge the number of zombie firms in the U.S. and find that, although the number of zombie firms has increased since the spread

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<sup>13</sup> Numerous companies received support in each country. For example, a lending program for SMEs implemented in the U.S. was designed to provide short-term loans to SMEs to prevent business failures and job losses for workers. It was a scheme in which borrowers were allowed to receive debt forgiveness by allocating the loan cash to employee salaries, etc. The first set of loans (provided in 2020) had no income decrease requirement for application, and the second set of loans (provided in 2021) required an income decrease of 25% or more for application. The U.K. implemented a program that enabled SMEs to obtain a government guarantee when receiving a loan. Many companies became eligible for the program as the application requirements were to be a company that existed since before COVID-19 and was not in bankruptcy proceedings.

of COVID-19, the increase has been limited compared to during the Dot-com bubble burst and the global financial crisis. Regarding the situation in Europe, Haynes *et al.* (2021) show that, although zombie firms appear to have increased slightly since the spread of COVID-19 and argue that it is necessary to wait for data to accumulate to conduct a detailed analysis.

In Japan, too, while COVID-19 spread, the government implemented various corporate support packages (Table 2). Morikawa (2021) surveyed about 1,600 companies from August to September 2020 to gauge companies' use of support packages provided by the government (funding support by government-affiliated financial institutions, employment adjustment subsidies, and sustainability benefits, among others) during the spread of COVID-19 and found that about 20% to 50% of companies had used them. The analysis shows that the lower a company's productivity had been before the spread of the disease, the more it used funding support and employment adjustment subsidies by matching companies' productivity (TFP) before the spread with usage records of support packages. Based on its analysis results, the study concludes that if emergency measures were implemented over a long period, it could adversely affect the medium to long-term productivity of the economy as a whole. Hoshi *et al.* (2021) surveyed about 4,000 firms from October to November 2020 concerning their application for and use of various support packages. The analysis shows that zombie firms had actively used multiple support packages, and a "reserve army of zombies" might potentially have been kept in business. The report added that various support packages could give birth to new zombie firms, with their existence prolonging the effects of the shock.

Considering those studies in each country, G30 (2020) and BIS (2021) warn that economic stagnation could be prolonged if zombie firms grow in number due to protracted corporate support packages. FSB (2021c) and Helmersson *et al.* (2021) that, going forward, considering the persisting effects of COVID-19, it would be necessary to implement policies targeting a narrower range of companies, though, in the early stage of the spread of the disease, it had been essential to provide corporate support packages by attaching importance to a sense of urgency. Again, it is unclear whether zombie firms are currently on the rise.

### 2-3. Effects of zombie firms on the macroeconomy

Many studies note that zombie firms could potentially increase, especially after economies suffer a big shock. Many previous studies conclude that an increase in zombie firms could possibly bring about a distortion of resource allocation, which leads to a decline in macroeconomic productivity and economic growth (e.g., Caballero *et al.* (2008), Adalet McGowan *et al.* (2018), Andrews and Petroulakis (2019), Acharya *et al.* (2020)).

Specifically, many studies presume that if zombie firms exist and continue to possess factors of production such as labor and capital, factors of production needed by viable firms and companies planning to enter the market will fail to be distributed amply to them, distorting the allocation of macroeconomic resources. Such studies argue that if zombie firms exit the market, viable firms can obtain necessary factors of production, which will induce their business dynamics, enlarge high-growth domains, and reinforce new research and development efforts. Many note that zombie firms tend to be less productive and grow more slowly in comparison to non-zombie firms and that their existence itself depresses macroeconomic productivity and economic growth, which pulls down averages in calculations (Adalet McGowan *et al.* (2018), Banerjee and Hofmann (2018), Carreira *et al.* (2021)).

Few studies quantitatively show zombie firms' effects on macroeconomic productivity and economic growth to date. Adalet McGowan *et al.* (2018), noting that the ratio of zombie firms to all European enterprises surged in the wake of the global financial crisis, show that if the balance had been flat compared to the pre-crisis level, it would have had an effect of pushing up capital investment in the region by 2% cumulatively from 2008 to 2013 when the TFP had been depressed by 0.6% points due to a rise in the ratio after the global financial crisis. As mentioned earlier, Banerjee and Hofmann (2018) find that the number of zombie firms in OECD countries rose by 5% points in the last 30 years, analyzing a 1% increase in the number of zombie firms affected lowering the TFP growth rate by 0.3% points or so. However, it must be noted that these studies are based on the premise that if zombie firms exit the market, production factors will be reallocated to viable firms. As stated by Salant and Siegel (2016), it is uncertain whether such reallocation will be carried out smoothly. In this regard, some studies, including Obstfeld and Duval (2018), note that even if zombie firms are eliminated, and a reallocation occurs, the magnitude of the effects on productivity would be limited.<sup>14</sup> As discussed in Section 3, studies used disparate methods to identify zombie firms, so their analysis results should be interpreted with considerable uncertainty (Faria-e-Castro *et al.* (2021)).

Some analyses indicate that zombie firms' existence puts downward pressure on prices. Acharya *et al.* (2020), focusing on 12 European countries, conduct a panel estimation using the inflation rate as a dependent variable and the zombie firm ratio (the ratio of zombie firms to all enterprises) as an explanatory variable, and show that the existence of zombie firms had an effect of lowering the inflation rate in Europe by 0.4% points between 2012 and 2016. Acharya *et al.* (2020) refer to U.S. shale firms in the mid-2010s as an example,

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<sup>14</sup> Obstfeld and Duval (2018), based on the analysis of Adalet McGowan *et al.* (2018) described earlier, show that the zombie firm ratio returning to a pre-global financial crisis level could potentially have an effect of boosting the TFP growth rate by 0.6% points (single-year boost effect). The paper, however, argues that any reallocation that occurs would have only a small effect in terms of boosting the TFP growth rate considering that the TFP growth rate had been continuing to decline by 0.6% points annually following the crisis.

describing a mechanism by which the existence of zombie firms lowers prices. At the time, U.S. shale firms suffered deterioration in profitability and financial conditions as crude oil prices fell in response to increased oil output in Middle East nations and decreased demand from China and other countries. However, some shale companies survived, assisted by banks as they continued to extend loans in a low-interest rate environment. Despite the severe deterioration of their financial conditions, such companies continued production as they had ample working capital due to financial support, which resulted in shale oversupply, further lowering crude oil prices.

### 3. Issues in identifying zombie firms

#### 3-1. Quantitative definitions by previous studies

The preceding section surveys previous studies on zombie firms. Most of the studies claim that, qualitatively, zombie firms increased in each country, including in Japan after the collapse of the bubble economy, in Europe following the global financial crisis and its debt crises, and in China beset with growing debt.

However, those studies differ significantly from a quantitative perspective. This is because they differ from each other in the quantitative definition of a zombie firm, i.e., the requirements for identifying them, whereas, as noted in the preceding section, there is a consensus about the qualitative definition of zombie firms, namely, firms remaining in business with support from banks and other entities despite performing poorly and having no prospect of recovery. For example, no method has yet to be put in place by which to quantitatively distinguish: (1) companies suffering temporary deterioration in business performance (those likely to recover); (2) companies surviving without support despite having relatively low productivity and performing poorly; and (3) companies in the startup stage that are not earning a profit, even though these types of companies should not be included in zombie firms as per the qualitative definition of zombie firms. Summing up previous studies' approaches to identifying zombie firms, the requirements can be broken down into interest rate requirements, solvency requirements, and growth potential requirements (see Table 1).

The interest rate requirement is a method to identify zombie firms from the viewpoint of bank support and was often used in early-stage studies on zombie firms. Caballero *et al.* (2008) regard borrowers paying a loan interest rate below the prime rate as being provided with a bank's reduction or waiver of interest. Fukuda and Nakamura (2011) regard borrowers as receiving financial support if they pay a loan interest rate below the prime rate or have a persistently increasing outstanding balance of loans. However, as noted by Fukuda and Nakamura (2011) and Avouyi-Dovi *et al.* (2016), under these criteria, even a

sound borrower to which preferential loan interest rates are applied due to its high credit quality could potentially be classified as a zombie firm. To prevent this, Fukuda and Nakamura (2011), Acharya *et al.* (2019), and Goto and Wilbur (2019) adopt the solvency requirement outlined below in addition to the interest rate requirement.

The solvency requirement is an identifying method that focuses on a company's business performance. Looking at previous studies that used this requirement, Fukuda and Nakamura (2011) and Kwon *et al.* (2015) select companies earning a profit below minimum interest expense.<sup>15</sup> Adalet McGowan *et al.* (2018), Banerjee and Hofmann (2018), Nurmi *et al.* (2020), ECB (2021), and Favara *et al.* (2021), among others, select companies having an interest coverage ratio (ICR) of less than one as defined by dividing profit by interest expense.<sup>16</sup> In addition, Acharya *et al.* (2020) select companies with a leverage ratio, i.e., debt to equity ratio, lower than the industry median. Andrews and Petroulakis (2019) select companies having a ROA in negative territory. Many studies set the solvency requirement for multiple consecutive years rather than for a single year. This approach intends to select companies surviving with support from banks or other entities despite performing poorly and having no prospect of recovery instead of firms suffering a temporary deterioration in business performance.<sup>17</sup> However, even under a multi-year requirement, a study could potentially select a startup incurring loss upfront in its growth process. Therefore, to avoid this scenario, many studies, including Banerjee and Hofmann (2018), set the growth requirement described below.

The growth potential requirement is a method to identify whether a company will likely grow in the future. Banerjee and Hofmann (2018), Cella (2020), and Hong *et al.* (2021) excluded companies founded less than ten years before from the scope of identification to exclude promising startups from zombie firms. Banerjee and Hofmann (2018), following an idea to rely on market evaluation to ascertain corporate growth potential, tried to exclude companies whose Tobin's Q, i.e., a ratio of the stock market value of a company divided by its capital's replacement price, exceeded the industry median. Helmersson *et al.* (2021) regard companies investing continually as having high growth potential and exclude them from the scope of samples.

When identifying zombie firms consistent with the qualitative definition, we regard it

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<sup>15</sup> Minimum interest expense was computed in accordance with the balance of outstanding borrowings and short-term and long-term prime rates.

<sup>16</sup> Regarding profit items, see Banerjee and Hofmann (2018) and Favara *et al.* (2021) used EBIT (earnings before interest payments and taxes), while Grieder and Ortega (2020) used EBITDA (earnings before interest, taxes, depreciation and amortization).

<sup>17</sup> Some studies do not set a multiple consecutive-year requirement, and thus the number of companies to be select swung in alignment with the economic cycle. Such studies were unable to select companies performing poorly and having no prospect of recovery. Bearing in mind the studies described above, Gagnon (2021) notes that zombie firms tend to emerge in recessions and disappear in economic booms in accordance with macroeconomic conditions.

desirable to meet all three requirements listed earlier over a reasonable period. For example, even if companies are categorized as low in light of the solvency requirement (such as ICR below 1) due to temporary factors, many of them would likely recover shortly, as noted by Gagnon (2021). Even if a company meets the solvency requirement for multiple years, the company could potentially remain in business without support from banks or other entities due to having ample internal reserves. Startups that newly commenced business by using borrowed cash are thought to often be below ones in ICR at the time. Such companies, while performing poorly, cannot definitively be said to have no prospect of recovery. As noted by Adalet McGowan *et al.* (2018), Banerjee and Hofmann (2018), and Grieder and Ortega (2020), solvency and growth potential requirements alone do not capture the existence of corporate support. On the other hand, the interest rate requirement alone runs the risk of picking up companies with sound finances and business performance and enjoying the low interest rates, as described above.

### 3-2. Estimation using methods of previous studies

What happens if we select zombie firms in Japan based on data up to recent years by using the definitions of previous studies? Looking at results for large companies (Figure 1) and SMEs (Figure 2), the number of identified firms varies widely depending on the definitions.<sup>18</sup>

First, computing based on the method of Caballero *et al.* (2008) that uses only the interest rate requirement, the number of identified firms surged significantly for larger companies, particularly in recent years. This finding is probably because sound borrowers with high credit quality and who enjoy preferential loan interest rates are classified as zombie firms in a low-interest rate environment. Next, the method of Fukuda and Nakamura (2011) selects fewer companies than the method described above, as the solvency requirement is used in addition to the interest rate requirement. However, in the absence of the growth potential requirement, even startups likely to grow in the future are potentially picked up. Favara *et al.* (2021) compute the number of zombie firms by adopting the solvency and growth potential requirements. Meanwhile, Fukuda and Nakamura (2011) and Favara *et al.* (2021) both focus on the single-year solvency requirement, so their methods tend to select a growing number of companies in the event of more temporary posting losses due to economic fluctuations. Banerjee and Hofmann (2018) adopt a three consecutive-year solvency requirement and set a growth potential standard; however, they do not include the interest rate requirement and thus can not consider the existence of financial support, as discussed earlier.

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<sup>18</sup> For details of the data used in the analysis, see the Appendix. Details of the calculation methods are different from those of the previous studies. For example, while Caballero *et al.* (2008) and Fukuda and Nakamura (2011) use coupon rates for corporate bonds, we use only interest rates of bank borrowing.

Thus, zombie firms vary following how they are picked up. This suggests that it is not easy to identify zombie firms and that, when doing so, the criteria for picking them up must be considered from various perspectives.

### 3-3. Estimation based on a combination of the methods of previous studies

#### (Computation method)

Next, we try to select the Japanese companies that seemingly survive with support from banks or other entities despite performing poorly and having no prospect of recovery. Following the identification strategies in the previous literature described above, we examine their combinations to exploit their advantages. Specifically, we use the three requirements in the previous studies as follows:<sup>19</sup>

*Interest rate requirement:*

Rate of interest paid < Average contracted interest rate on loans (stock base);<sup>20</sup>

or

Current term borrowings > Previous term borrowings.

*Solvency requirement:*

ICR<sup>21</sup> < 1.

*Growth potential requirement:*

Founded at least ten years before.

In the following analysis, we quantitatively define zombie firms as firms meeting the above three requirements for three consecutive years (we call it the "Three Consecutive Year Standard"). As a reference series, we also examine this method that uses the three requirements applied to a single year only ("Single-Year Standard").

Although we set identifying criteria for zombie firms from three perspectives in a way that encompasses previous studies, the strategies have some limitations. The quantitative definition for identifying zombie firms is parsimonious. Therefore, we have to bear in mind that it is impossible to verify exactly whether selected companies are surviving with support from banks or other entities despite performing poorly and having no prospect of recovery unless we analyze each company's financial information in a more detailed manner and carefully analyze banks' lending attitudes. In this section, we do not delve into

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<sup>19</sup> For details of the data used in the analysis, see the Appendix.

<sup>20</sup> In practice, we compute the following on a company-by-company basis: ("balance of short-term borrowings" times "average contracted interest rate on loans (stock, short-term and domestic banks)" plus "balance of long-term borrowings" times "average contracted interest rate on loans (stock, long-term, and domestic banks)") divided by "balance of long-term and short-term borrowings." Since no data are available on the average contracted interest rate on loans in or before fiscal 1992, we estimate them by using the difference between the average contracted interest rate on loans and prime rates for fiscal 1993.

<sup>21</sup> We divide EBIT by interest expense to obtain the ICR.

this point, but state that all companies satisfying specific mechanically-set criteria are "likely" to remain in business with support from banks and other entities.<sup>22</sup> The strategy taken in the following analysis can be regarded as the way to select companies that could potentially be consistent with our qualitative definition. In assessing the number and ratio of zombie firms in the following, it is desirable to spotlight a direction of changes (whether on an uptrend or downtrend), not mainly focusing on the levels of numbers. This is because the number of zombie firms identified changes significantly when the requirements (thresholds) are altered.

#### (Estimation results)

First, we check the situation before the spread of COVID-19. Figure 3 shows the ratio of identified zombie firms by dividing them by the total number of large companies. The share of zombie firms in Japan surged in the early 1990s following the collapse of the bubble economy and then fell as the disposal of NPLs progressed. It has been at a low level since the early 2000s. The reference series under the single-year standard shows that the ratio of zombie firms surged in: i) the first half of the 1990s after the bubble burst, ii) the second half of the 1990s when the Japanese financial crisis erupted, iii) the first half of the 2000s when the Dot-com bubble burst; and iv) the second half of the 2000s when the subprime turmoil and the global financial crisis broke out. Except for the first half of the 1990s, however, the ratio of zombie firms rose only temporarily. The reference series seems to select many firms whose business performance deteriorated only for a short period.

Figure 4 shows the ratio of zombie firms to total SMEs. The three-consecutive-year standard indicates that the share of zombie firms rose from the latter half of the 2000s, when the global financial crisis occurred, to 2011, when the Great East Japan Earthquake occurred. Since then, it has been remaining at the low level seen in the past. The ratio of zombie firms was higher among SMEs than among large companies.<sup>23</sup>

Next, we look at the situation in fiscal 2020 when COVID-19 spread. For the large companies, the zombie firm ratio, while not increasing under the three-consecutive-year

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<sup>22</sup> For example, Uesugi *et al.* (2015), using a questionnaire survey of companies, examine banks' lending stance, by investigating whether any changes were made to the terms of bank loans.

<sup>23</sup> In this regard, it has been noted that the existence of various support packages for SMEs in Japan led to preserving zombie firms. OECD (2015) argues that Japanese SMEs receive substantial government support, which has caused corporate restructuring to progress only slowly, thereby preserving zombie firms. Todo (2011) indicates that protective government policies, such as the Act concerning Temporary Measures to Facilitate Financing for SMEs (brought into force in 2009 and terminated in 2013) might have potentially hindered corporate metabolism. On the other hand, many studies evidently refer to the positive aspects of this law. For example, Yamori (2019) shows the law served to prevent SMEs from going bankrupt and assist them in remaining in business. Uesugi *et al.* (2015), arguing that early efforts are important for SMEs to improve their business, highlight comments that the law had encouraged SMEs and financial institutions to make such efforts.



standard, surged under the single-year standard (Figure 3). To assess how persistent this development is, we count the zombie firms quarterly (Figure 5). The share of zombie firms surged from April to June 2020 and then returned to pre-COVID spread levels (from July-September quarter 2020 to April -June quarter 2021). In general, there is no sign of a surge in the number of firms falling into a state of performing poorly and having no prospect of recovery. For SMEs, just as for large firms, the share of zombie firms did not rise for fiscal 2020 under the three-consecutive-year standard, but it surged for the year under the single-year standard (Figure 4). Because we cannot compute the quarterly series for SMEs due to their quarterly business report availability, we cannot address whether the surge was temporary. In addition, it should be noted that since the spread of COVID-19, profits might have been boosted significantly (resulting in an improvement in ICR), affected by various government benefits, mainly for SMEs. To sum up, we consider that it is too early to judge the effects of the spread of COVID-19 on the rise and fall in the number of zombie firms. Especially for SMEs, we must wait for data to be amassed and monitor how the zombie firm ratio changes.

Figures 6 (large firms) and 7 (SMEs) show the estimation processes of identifying zombie firms (to what extent the number picked up changes due to adding requirements). The zombie firm ratio does not change much for large companies when the growth potential requirement is added after applying the solvency requirement. If the interest rate requirement is added and the existence of financial support is taken into consideration, the number of zombie firms is narrowed down. Next, looking at cases where zombie firms are selected using the interest rate requirement, we find that many companies are chosen at the first stage because the average contracted interest rate on loans is used for identification. Then applying the growth potential and solvency requirements, the number of zombie firms gets narrowed to some extent. While this is also the case with SMEs, the growth potential requirement plays a more prominent role than for large firms. This finding is likely obtained because many startups are small in business size upon their founding and are often classified as SMEs.

Figures 8 (large firms) and 9 (SMEs) show companies meeting each requirement only for a year. The solvency requirement, in particular, has fluctuated following economic cycles. As noted earlier, this results from picking up many companies whose business performance improves owing to economic recovery.

#### (Characteristics of zombie firms)

Next, we closely examine the zombie firm ratio on an industry-by-industry basis. Concerning large companies, Figure 10 shows changes in manufacturing sectors, and Figure 11 shows changes in non-manufacturing sectors. The share of zombie firms (under the three-consecutive-year standard) increased in all industries in the first half of the 1990s

after the collapse of the bubble economy. In recent years, the ratio has been low in all industries. Looking at the situation during fiscal 2020, when COVID-19 spread, under the single-year standard, we find that the ratio surged in the accommodation, eating, and drinking services industries, sectors greatly affected by the pandemic.

The results for SMEs are shown in Figures 12 (manufacturing industries) and 13 (non-manufacturing). The ratios of zombie firms (the three-consecutive-year standard) increased in all industries in 2010. Among non-manufacturing industries, the wholesale and retail, as well as the accommodation, eating, and drinking services industries, had a somewhat high zombie firm ratio. Under the single-year standard, zombie firms increased mainly in the accommodation, eating, and drinking service industries during fiscal 2020 when COVID-19 spread.

Next, we look at how zombie firms remained in the market. Figures 14 (large firms) and 15 (SMEs) show zombie firms by categorizing them into the following three types. The term "remaining classified" firm refers to a company that was successively classified as a zombie firm from the previous fiscal year. The term "newly classified" firm refers to a company that was picked up as a zombie firm for the first time. The term "re-classified" firm refers to a company that was classified again as a zombie firm for the current fiscal year after having been identified as a zombie firm and then becoming a non-zombie (returned to health) for the last fiscal year. This computation suggests that the larger the number of remaining and re-classified firms, the less active corporate business dynamics are. The ratios of those types of firms among large enterprises have been low, while a certain number of remaining classified firms exist among SMEs.

Regarding the relationship between zombie firms and labor productivity, we estimate the labor productivity of large companies on a firm-by-firm basis by using the method of Yagi *et al.* (2022). Figure 16 shows the distribution of labor productivity (from fiscal 2000 to fiscal 2020) for zombie and non-zombie firms under the three consecutive year standard.<sup>24</sup> The figure shows that zombie firms are distributed leftward in labor productivity and are relatively less productive than non-zombie firms.

#### (Robustness check)

Finally, we briefly verify the robustness of each requirement used for selecting zombie firms. Here, we outline the zombie firm ratio obtained in Figures 3 (large firms) and 4 (SMEs) as a base case. While Caballero *et al.* (2008) and Fukuda and Nakamura (2011) use flow base prime rates for the interest rate requirement, we use average contracted interest rates on loans (stock) for the base case of this paper. This is because stock-based

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<sup>24</sup> For the detailed calculation method for individual companies' labor productivity, see Appendix 2 of Yagi *et al.* (2022).

indicators are considered to reflect interest payment circumstances for companies more closely. Still, to verify the robustness of the results, we also conduct estimations using flow-based prime rates.<sup>25</sup>

Borrowing interest rates might vary depending on industry characteristics. For example, for industries in which companies have more loans for long-term investments, loan periods would be longer and interest rates higher. On the other hand, for industries in which companies have more loans for working capital, loan periods would be shorter and interest rates lower. Considering this point, we also estimate the numbers using the median lending interest rate by industry rather than the average contracted lending interest rate for companies in all industries as used for the base case.

Furthermore, in the base case, a company was regarded as a zombie firm upon satisfying all three requirements for three consecutive years. In contrast, previous studies count zombie firms upon satisfying only the solvency requirement for multiple consecutive years. In this section, we also select companies satisfying only the solvency requirement for three consecutive years and meeting other requirements for a single year.

As shown in Figures 17 and 18, the zombie firm ratios are generally higher than in the base case, mainly mirroring changes made to the thresholds of the interest rate requirement. Still, the timings of the ratio rising and declining are almost identical to that of the base case.

#### 4. Conclusion

This paper provides a comprehensive survey of related literature and analyzes the Japanese firms seemingly surviving with support from banks or other entities despite performing poorly and having no prospect of recovery, i.e., zombie firms.

Previous studies identify zombie firms using quantitative criteria such as interest rate, solvency, and growth potential requirements. In this paper, we identify zombie firms by setting the criteria based on a combination of the advantages in the identification strategies used by previous studies. We find that the ratio of zombie firms to all companies surged in the 1990s and has remained at low levels since the 2000s. Even after the spread of COVID-19, the share of zombie firms did not rise as far as the fiscal 2020 numbers show. However, given the data constraints on this point, we must closely monitor the firms' future developments. When considering the post-COVID-19 growth potential of the Japanese economy, we must closely watch to see if zombie firms increase and distort

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<sup>25</sup> Following previous studies, we use current year values for short-term prime rates and average value for the past five years for long-term prime rates.

macroeconomic resource allocation in the country.

Finally, we reiterate the points noted regarding this paper's identification of zombie firms. First, while this paper examines the survey of previous studies and tries to combine their strengths to the extent possible when picking up zombie firms, it still uses limited financial data to distinguish companies surviving due to various support packages. We would like to stress that not all companies classified as zombie firms in this study are unlikely to have a recovery in business performance. Even a company that continues to perform poorly and is highly unlikely to be revived, judging from its simple financial data, could have a good chance of recovery from the perspective of banks having qualitative data. Rethinking the meaning of the term "zombie" is defined by many dictionaries as a corpse that has been reanimated by means of a supernatural power such as magic. Nakamura and Fukuda (2008) point out that "if construed literally as defined by such dictionaries, the term zombie firm means a dead company with no prospect of being revived." Other studies also defined a zombie firm qualitatively as a company that performs poorly and has no prospect of recovery, as noted earlier. Given this, there should essentially be no company that has recovered in performance, changing from a zombie state to a non-zombie state before becoming a zombie again. However, as noted by Fukuda and Kasuya (2009) and Banerjee and Hofmann (2020), such companies were selected by many previous studies. Even the methods in this paper also choose such companies, although much more limited compared to past studies (re-classified firms in Figures 14 and 15). As this suggests the difficulty in identifying zombie firms, the estimation results of this paper should be interpreted with some latitude. Moreover, past studies have not amply verified whether zombie firms adversely affected resource allocation and productivity, as seen from a macroeconomic perspective, so this point must be researched further.

Second, the number of zombie firms changes if the selection criteria (threshold) are altered. In light of this, it is desirable to spotlight their directions (whether on an uptrend or downtrend) rather than focusing on their levels in assessing the numbers and ratios of zombie firms.

Third, when there is a significant shock, such as the spread of COVID-19, and support packages from governments and other entities are implemented, the identification requirements (financial figures) for zombie firms will be affected by such packages. Therefore, to see the effects of a shock on the number of zombie firms, it is necessary not only to look at the number of zombie firms immediately after a large event but also to analyze it over a somewhat more extended period.

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## Appendix: Detailed data on the analysis of zombie firms in Japan

### < Large companies >

- Data Sources: Development Bank of Japan "Industrial Financial Data," NIKKEI NEEDS-Financial QUEST
- Samples: Approx. 2,300 companies listed on the First and Second Sections of the Tokyo Stock Exchange
- Period: From fiscal 1980 to fiscal 2020

### < SMEs >

- Data Source: Credit Risk Database (CRD)<sup>26</sup>
- Samples: Approx. 1 million companies described above
- Period: From fiscal 2002 to fiscal 2020<sup>27</sup>

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<sup>26</sup> CRD contains financial data of member financial institutions of the CRD Association as well as SME business partners of credit guarantee associations. Analyses conducted by using CRD include those by Ikeuchi *et al.* (2020) and Iida (2021), both of which examined the productivity of SMEs.

<sup>27</sup> It should be noted that the sample size of SMEs for fiscal 2020 stood at approx. 400,000 because no financial information was gathered from many of the SMEs. The sampling periods for SMEs are shorter in comparison to those for large companies due to data constraints.

Table 1. Literature overview

Literature	Focus	Qualitative definition of "zombie firms"	Quantitative definition of "zombie firms"		
			Interest-rate requirement	Solvency requirement	Growth-potential requirement
Caballero et al. (2008)	Listed firms (Japan) 1981–2002	Firms receiving subsidized credits while being insolvent without them	The actual interest payment is below the minimum interest expense	—	—
Fukuda and Nakamura (2011)	Listed firms (Japan) 1995–2004	Firms receiving financial support while being unable to cover the interest payment	"Actual interest payment is below minimum interest expense," or "Outstanding balance of loans increase and leverage is over half" and "EBIT is below minimum interest expense"	—	—
Giannetti and Simonov (2013)	Listed firms (Japan) 1998–2004	Low-quality firms receiving subsidized credits	The actual interest payment is below the minimum interest expense	—	—
Kwon et al. (2015)	Firms of all sizes (Japan) 1981–2000	Firms receiving financial support while having solvency problems	The actual interest payment is below minimum interest expense, or the outstanding balance of loans increase	EBIT is below the minimum interest expense	—
Imai (2016)	SMEs (Japan) 1999–2008	Firms that should exit a market but continue to operate through bank supports such as interest rate exemption and additional credits	The actual interest payment is below minimum interest expense, or the outstanding balance of loans increase	3-year average EBIT is below minimum interest expense	—
Tan et al. (2016)	Large firms (China) 2005–2007	Insolvent firms that still stay in operation supported by extended bank credits and national financing facility	The actual interest payment is below the minimum interest expense	EBIT is below the minimum interest expense	—
Adalet McGowan et al. (2017)	Firms of all sizes (9 countries, mainly Europe) 2003–2013	Over-ten-years-old firms that have persistent problems meeting their interest payments and that receive financial support	—	ICR has been below 1 for 3 consecutive years	Over 10 years old
Schivardi et al. (2017)	Firms of all sizes (Italy) 2004–2013	Non-viable firms that depend on bank loans	—	Leverage is above the sample median, etc.	—

Table 1. Literature overview (cont.)

Literature	Focus	Qualitative definition of "zombie firms"	Quantitative definition of "zombie firms"		
			Interest-rate requirement	Solvency requirement	Growth-potential requirement
Shen and Chen (2017)	Manufacturing firms (China) 2011–2013	Firms that would go bankrupt due to low profitability but continue to operate with support from governments or banks	—	The actual profit has been negative for 3 consecutive years	—
Storz et al. (2017)	SMEs (7 European countries) 2010–2014	Non-viable firms that connect to banks in distress	—	ROA has been negative for 2 consecutive years, and EBITDA over the financial debt has been below 5% for 2 consecutive years	Net investments have been negative for 2 consecutive years
Adalet McGowan et al. (2018)	Firms of all sizes (9 countries, mainly Europe) 2003–2013	Over-ten-years-old firms that have persistent problems meeting their interest payments and that receive financial support	—	ICR has been below 1 for 3 consecutive years	Over 10 years old
Banerjee and Hofmann (2018)	Large firms (14 OECD advanced countries) 1987–2016 <sup>(Note)</sup>	Firms that are apparently unable to cover debt servicing costs from current profits but continue to operate because of additional credits	—	ICR has been below 1 for 3 consecutive years	Over 10 years old and Tobin's q below the industry-median
(b) Broad definition	As above	As above	—	ICR has been below 1 for 3 consecutive years	Over 10 years old
Hallak et al. (2018)	Firms of all-sizes (19 European countries) 2010–2013	Firms that are apparently unable to cover debt servicing costs from current profits, yet continue to operate	—	ICR has been below 1 for 3 consecutive years	—
(b)	As above	As above	—	ICR has been below 1 for 3 consecutive years	Over 10 years old
(c)	As above	As above	—	ICR has been below 1 for 5 consecutive years	Over 10 years old
Obstfeld and Duval (2018)	—	Firms with persistently low profitability or even losses	—	—	—
Acharya et al. (2019)	Firms of all sizes (5 European countries) 2009–2014	Low-quality firms receiving subsidized credits	Interest rate is below that of industry peers	3- year average rating is BB or lower	—

Note: Including Japanese firms.



Table 1. Literature overview (cont.)

Literature	Focus	Qualitative definition of "zombie firms"	Quantitative definition of "zombie firms"		
			Interest-rate requirement	Solvency requirement	Growth-potential requirement
Andrews and Petroulakis (2019) (a)	Firms of all sizes (11 European countries) 2001–2014	Firms that should exit in a competitive market	—	ICR has been below 1 for 3 consecutive years	—
(b)	As above	As above	—	"Negative ROA or negative investment" for 3 consecutive years" and "EBIT over financial debt is below 20% for 3 consecutive years"	
Goto and Wilbur (2019)	Firms of all sizes (Japan) 2009–2014	Firms continue to operate through bank supports such as interest rate exemption and additional credits	The actual interest payment is below minimum interest expense, or the outstanding balance of loans increase	3-year average EBIT is below minimum interest expense	—
Acharya et al. (2020)	Firms of all sizes (12 European countries) 2009–2016	Low-quality firms receiving subsidized credits	Interest rate is below that of AAA-rated industry peers	ICR is below the industry median, and leverage is above industry-median	—
Banerjee and Hofmann (2020)	Listed firms (14 OECD advanced countries) 1980–2017 <sup>(Note)</sup>	Firms that have low stock market valuation but remain in the market rather than exiting through takeover or bankruptcy	—	ICR has been below 1 for 2 consecutive years	Tobin's q is below the industry median for 2 consecutive years
Cella (2020)	Firms of all sizes (Sweden) 2002–2016	Firms that are persistently unable to cover interest payments from current profits and that should exit a market	—	ICR has been below 1 for 3 consecutive years	Over 10 years old
Grieder and Ortega (2020) (a)	Listed firms (Canada) 1980–2018	Firms that are unable to cover interest payments from current profits but continue to operate because of additional credits	—	ICR has been below 1 for 3 consecutive years	IPO date is more than 10 years ago
(b)	As above	As above	—	ICR has been below 1 for 3 consecutive years	IPO date is more than 10 years ago, and PBR is below industry-median

Note: Including Japanese firms.

Table 1. Literature overview (cont.)

Literature	Focus	Qualitative definition of “zombie firms”	Quantitative definition of “zombie firms”		
			Interest-rate requirement	Solvency requirement	Growth-potential requirement
G30 (2020)	—	Firms that are unable to cover debt servicing costs from current profits and that depend on creditors for their continued existence	—	—	—
Laeven et al. (2020)	—	Non-viable firms kept alive by public support programs and bank lending action	—	—	—
Nurmi et al. (2020)	Firms of all sizes (Finland) 1999–2017	—	—	ICR has been below 1 for 3 consecutive years	—
Schivardi et al. (2020)	Firms of all sizes (Italy) 2020	Weak firms receiving bank loans	—	Altman z score is below the worst 3 rating out of 10 possible scores	—
Carreira et al. (2021)	SMEs (Portugal) 2004–2017	Mature firms that are persistently unable to repay their debt due to a lack of profitability	—	ROA is below Euribor 12-month for 3 consecutive years, and leverage is above industry-median	Over 5 years old
ECB (2021)	Firms of all sizes (6 European countries) 2000–2018	Poorly performing firms	—	ICR has been below 1 for 3 consecutive years	—
Favara et al. (2021)	Listed firms (The U.S.) 2000–2020	Firms that are unable to generate enough profits to cover debt servicing costs and that need to borrow to stay alive	—	ICR is below 1, and leverage is above the sample median	Negative real sales growth for 3 consecutive years
Gourinchas et al. (2021)	SMEs (27 countries) 2020 <sup>(Note)</sup>	Firms that can survive only with continued financial support	—	—	—

Note: Including Japanese firms.

Table 1. Literature overview (cont.)

Literature	Focus	Qualitative definition of "zombie firms"	Quantitative definition of "zombie firms"		
			Interest-rate requirement	Solvency requirement	Growth-potential requirement
Gagnon (2021)	—	Firms that continue to operate receiving unreasonable subsidized credits	—	—	—
Haynes et al. (2021)	Listed firms (28 European countries) 2020	Mature firms that are persistently unable to repay their debt and are not expected to be strong performers in the future	—	ICR has been below 1 for 3 consecutive years	—
Helmersson et al. (2021)	Firms of all sizes (Euro area) 2004–2019	Non-viable and unprofitable but still operating firms	—	Negative ROA for 2 consecutive years and EBITDA over financial debt is below 5% for 2 consecutive years	Negative net investment for 2 consecutive years
Hong et al. (2021)	Firms of all sizes (Japan) 2004–2015	Unproductive and insolvent firms	—	ICR has been below 1 for 3 consecutive years	Over 10 years old
Schularick (2021)	Listed firms (14 OECD advanced countries) 1980–2017 <sup>(Note1)</sup>	Firms that are unable to cover interest payments from current profits and that have a low stock market valuation	—	ICR has been below 1 for 3 consecutive years	Over 10 years old, and Tobin's q is below industry-median
Tracey (2021)	Firms of all sizes (17 European countries) 2011–2014	—	—	3-year average ICR is below the sample median	—
Becker and Ivashina (2021) <sup>(Note2)</sup>	Firms of all sizes (14 European countries and the U.S.) 2004–2020	Less productive firms receiving interest rate exemption and additional credits	Interest rate is below that of "AA" rated firms	—	—

Note1: Including Japanese firms.

Note2: Analysis of "zombie lending".

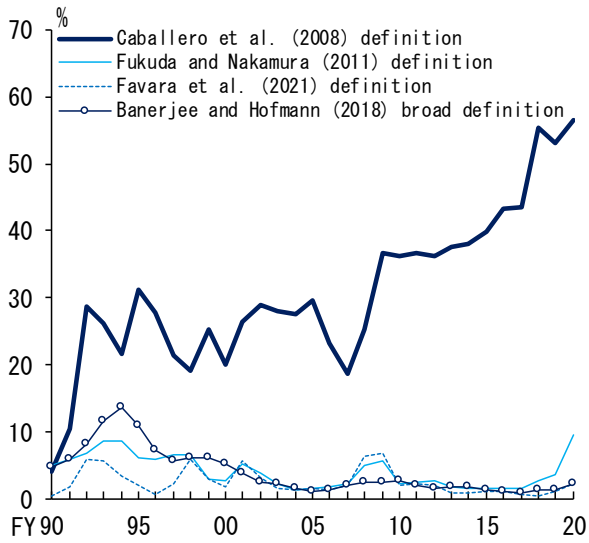
Table 2. Major corporate finance facilities in Japan

Title	Measures	Support period	Eligible firms	
			Main sales and profit requirements	Others
Employment Adjustment Subsidy (Special Measures)	Leave allowance	Since April 2020	Declined in sales by 5%	—
Subsidy Program for Sustaining Businesses (Special Benefits)	Up to ¥ 15,000 per person/day, etc. SMEs: ¥ 2 million Sole proprietors: ¥ 1 million	From May 2020 to February 2021	Declined in sales by 50%	Willingness to continue business
Rent Support Funds	Up to ¥ 6 million (up to ¥ 3 million for sole proprietors)	From July 2020 to February 2021	Declined in sales by 50%	Capital less than ¥ 1 billion
Grace of Corporate Tax Payment	Grace of corporate tax payment for up to 1 year	From May 2020 to February 2021	Declined in sales by 20%	—
Fixed Assets Tax Reduction	Half or full reduction of fixed assets tax (Tokyo)	From May 2020 to February 2021	Declined in sales by 30%	Capital less than ¥ 100 million
Financing Support (Government-Affiliated Financial Institutions)	Concessional loan (up to 3 years)	Since May 2020	Sole proprietors: no requirement SMEs: Declined in sales by 20%	—
Safety-Net Guarantee Program (SMEs)	Raising financing guarantee (from 80% to 100%)	Since March 2020	Declined in sales by 15%	—

Note: As of November 2021.

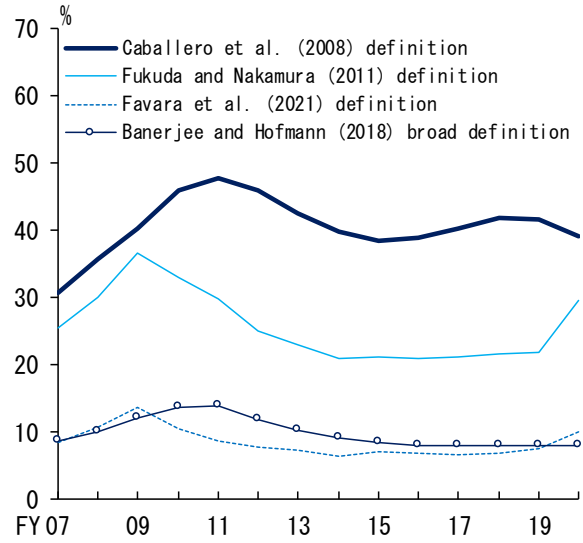
Sources: MHLW, METI, National Tax Agency, Small and Medium Business Administration, Tokyo Metropolitan Government

Figure 1. Share of zombie firms classified by selected previous studies: Listed firms



Note: See Table 1 and the main text for the detail.

Figure 2. Share of zombie firms classified by selected previous studies: SMEs



Note: See Table 1 and the main text for the detail.

Figure 3. Share of zombie firms: Listed firms

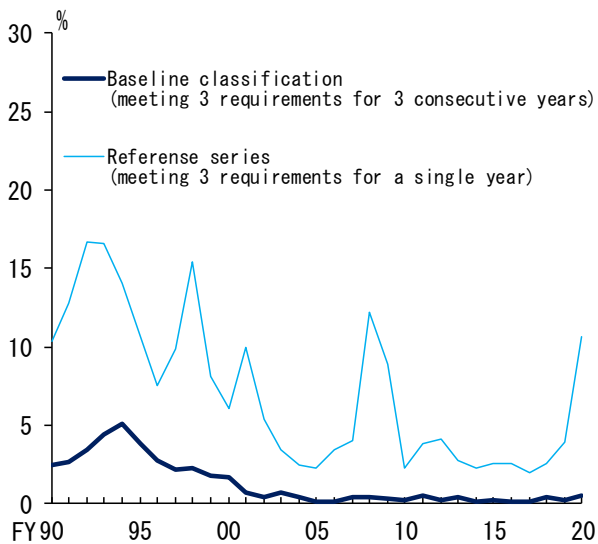


Figure 4. Share of zombie firms: SMEs

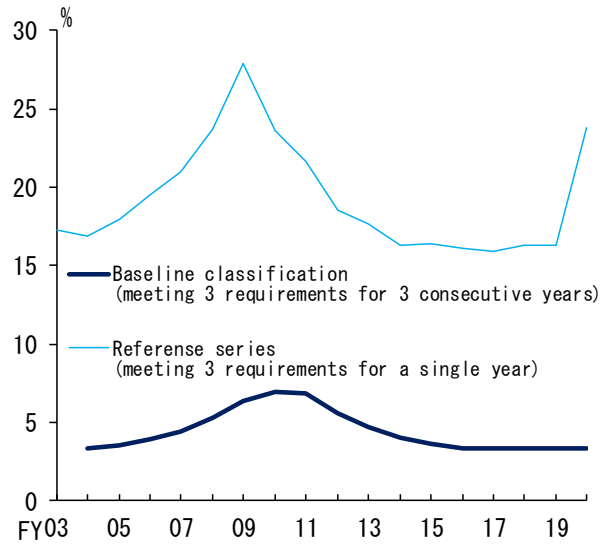


Figure 5. Share of firms meeting 3 requirements based on the quarterly financial report: Listed firms

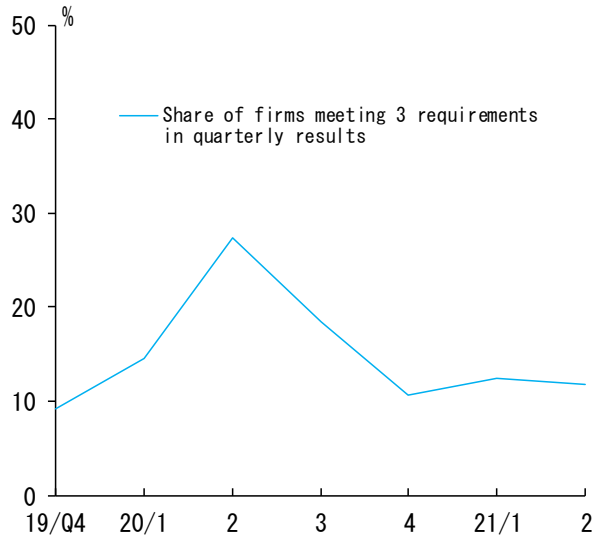
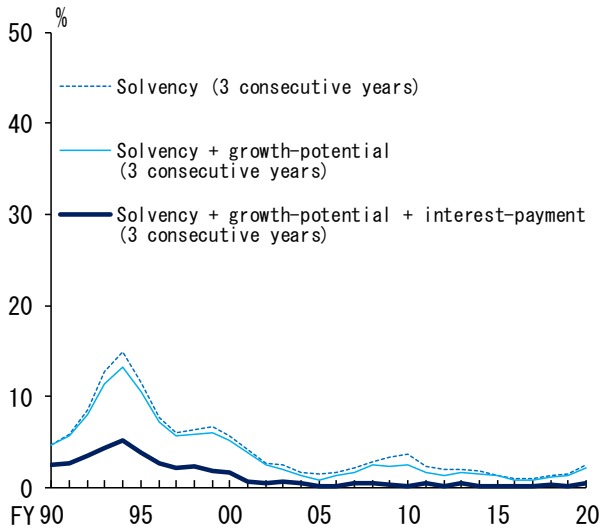


Figure 6. Classification processes of zombie firms: Listed firms

*Starting from the solvency requirement*



*Starting from the interest-payment requirement*

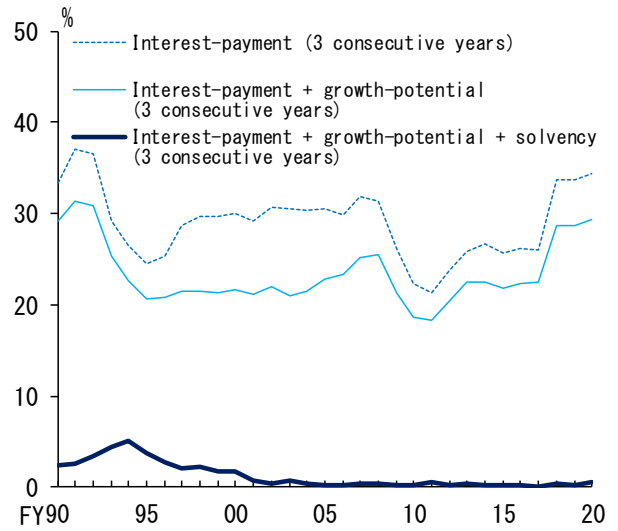


Figure 7. Classification processes of zombie firms: SMEs

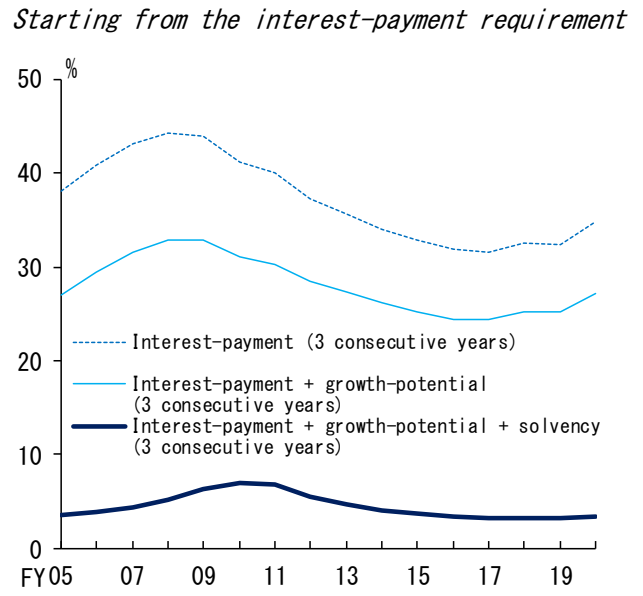
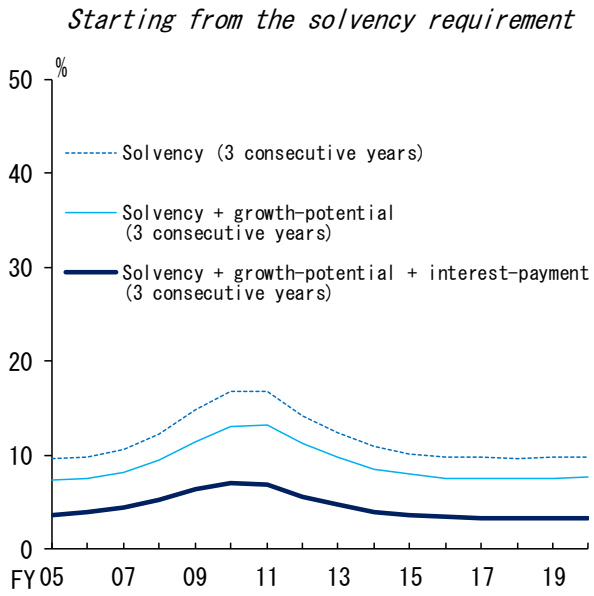


Figure 8. Share of firms meeting each requirement for a single year: Listed firms

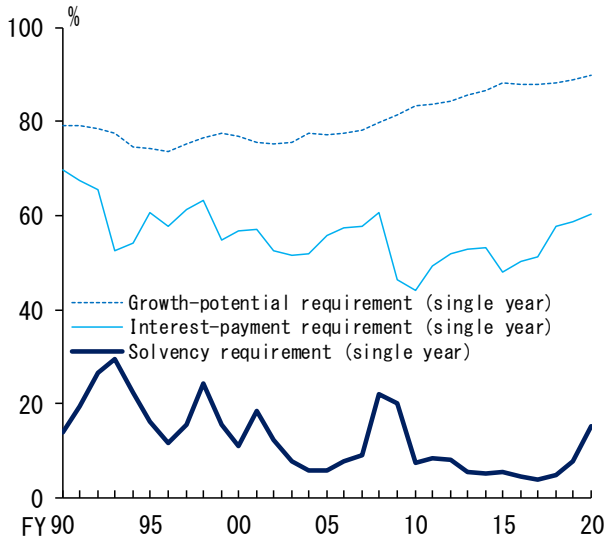


Figure 9. Share of firms meeting each requirement for a single year: SMEs

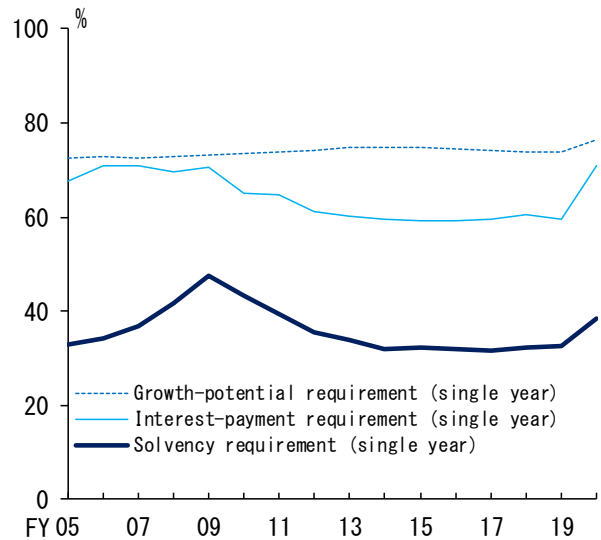


Figure 10. Share of zombie firms by industry: Listed firms, manufacturing  
*Manufacturing total*      *General-purpose, production, and business-oriented machinery*      *Transport equipment*

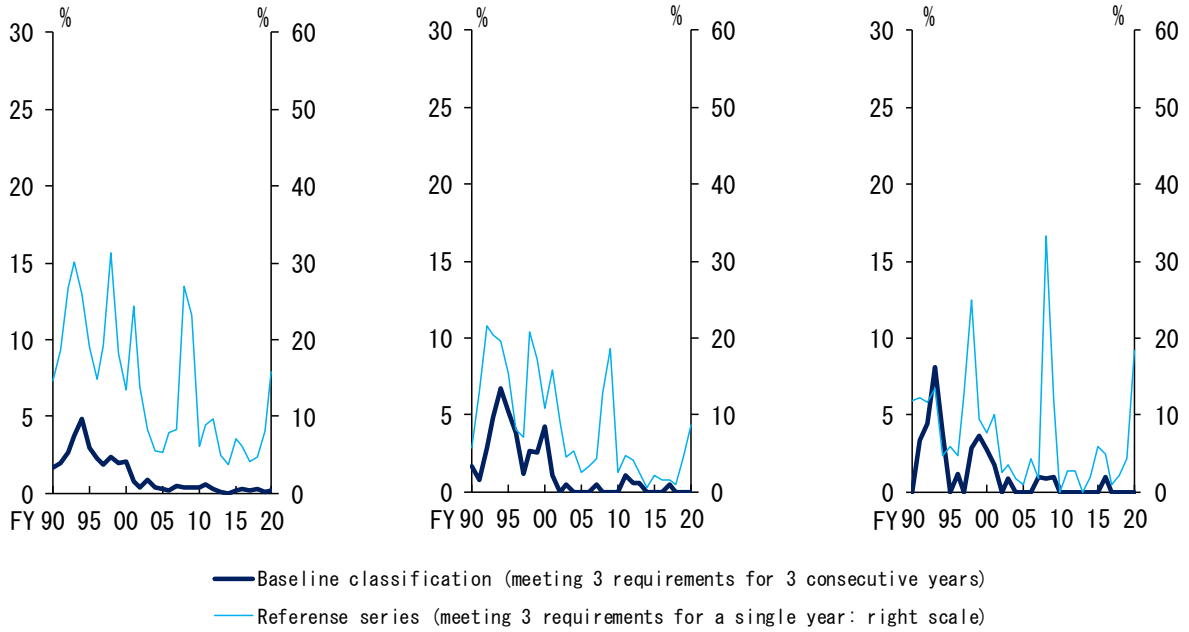


Figure 11. Share of zombie firms by industry: Listed firms, non-manufacturing  
*Non-manufacturing total*      *Wholesale and retail*      *Real estate*      *Accommodations, eating, and drinking services*

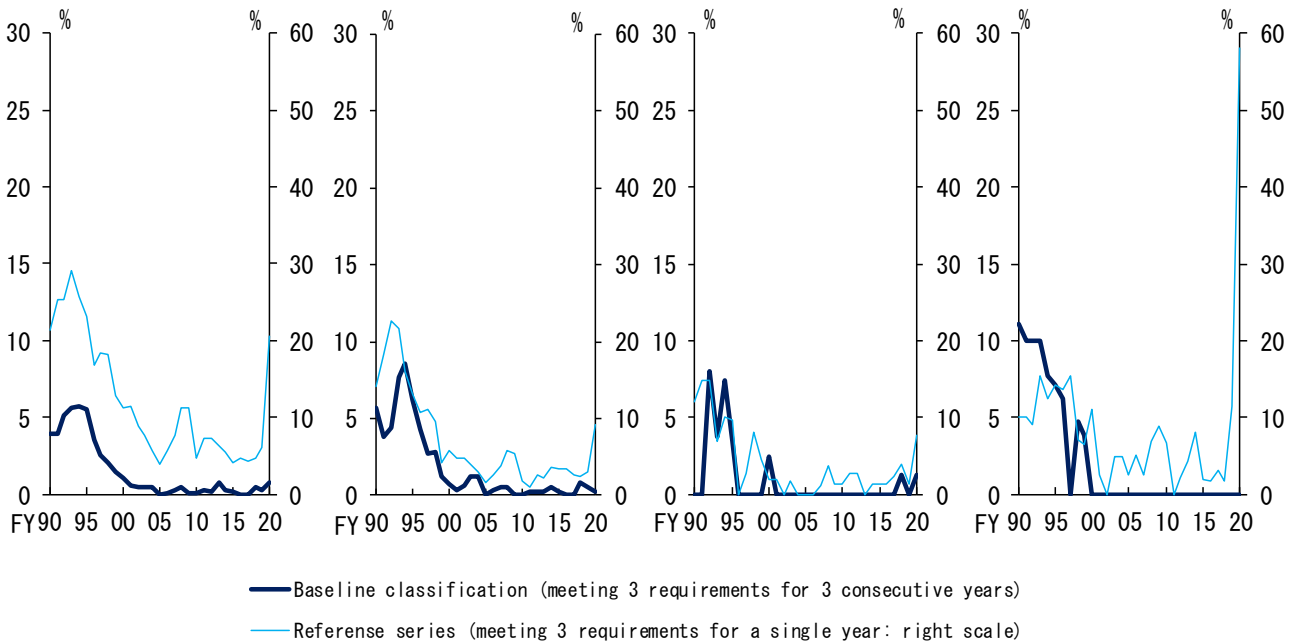




Figure 12. Share of zombie firms by industry: SMEs, manufacturing  
*Manufacturing total*      *General-purpose, production, and business-oriented machinery*      *Transport equipment*

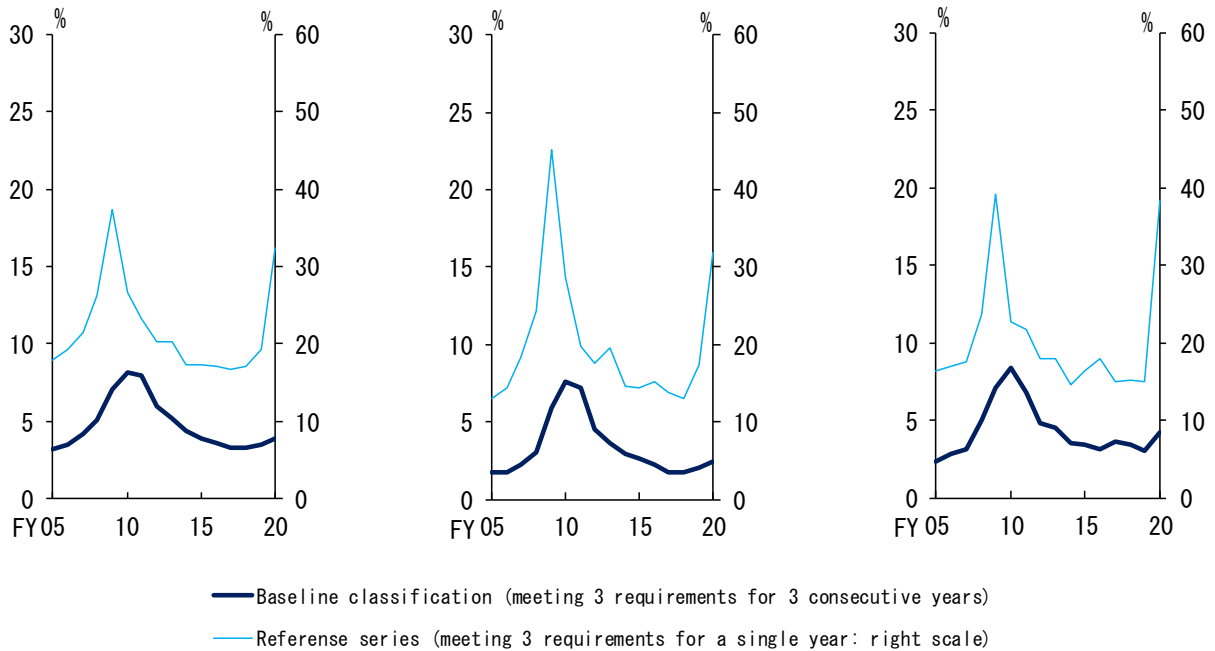


Figure 13. Share of zombie firms by industry: SMEs, non-manufacturing  
*Non-manufacturing total*      *Wholesale and retail*      *Real estate*      *Accommodations, eating, and drinking services*

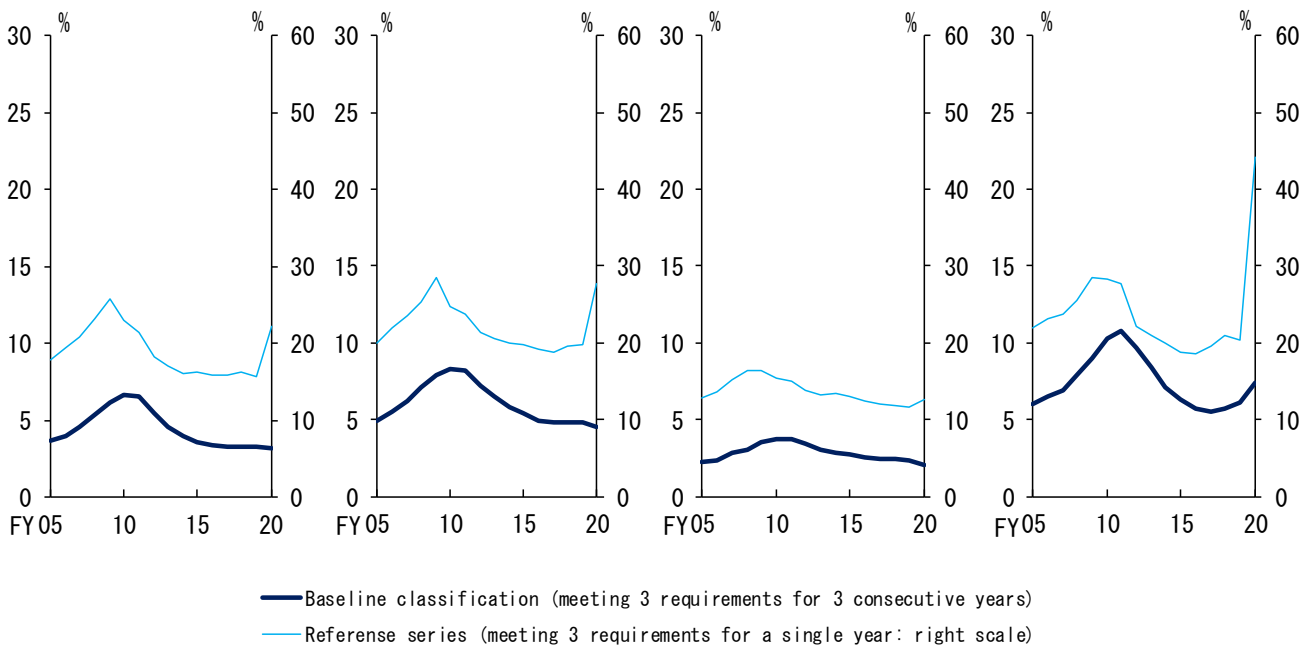


Figure 14. Persistency of zombie firms: Listed firms

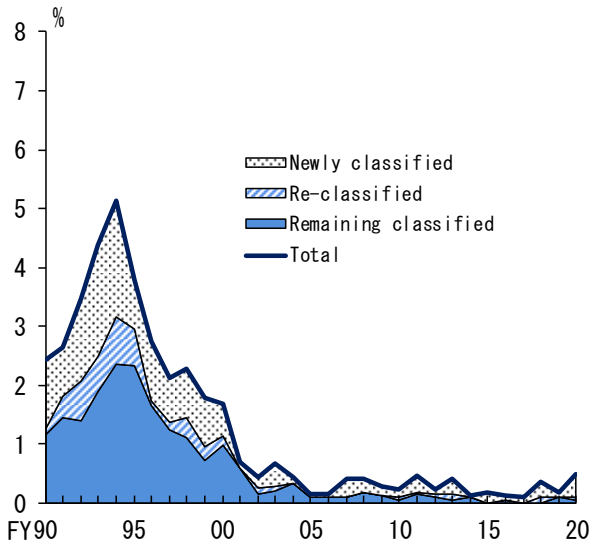


Figure 15. Persistency of zombie firms: SMEs

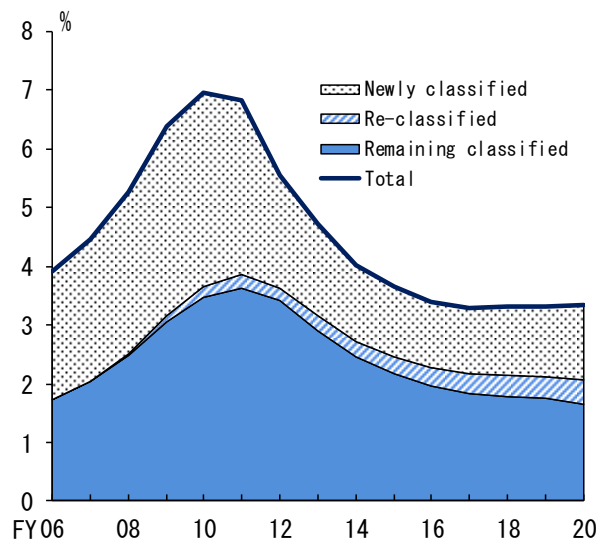


Figure 16. Labor productivity of zombie firms: Listed firms

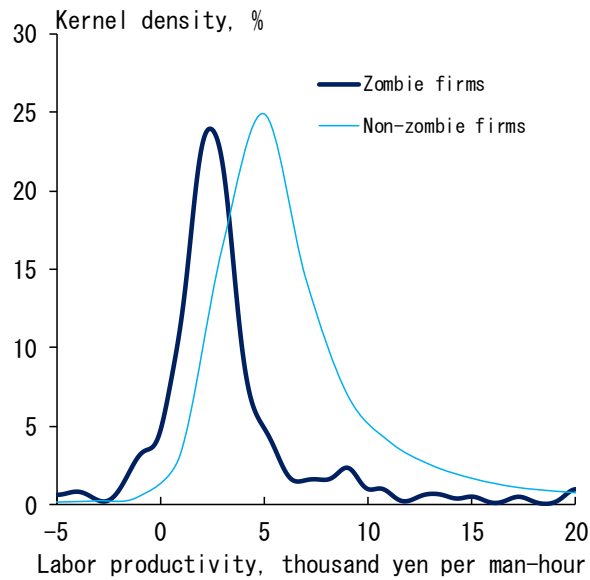


Figure 17. Robustness check:  
Listed firms

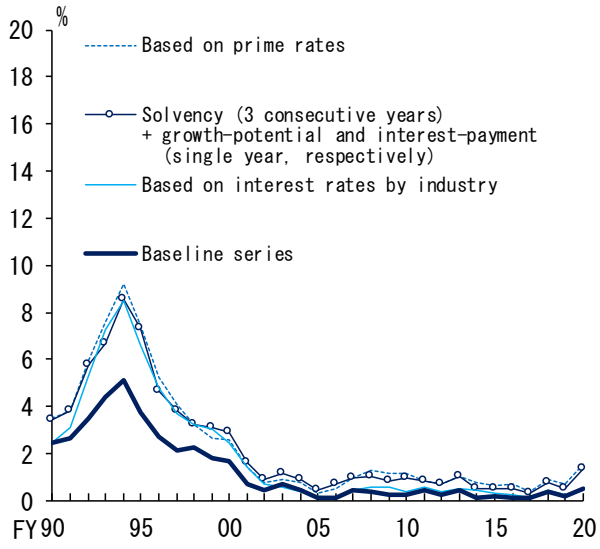


Figure 18. Robustness check:  
SMEs

