ELSEVIER

Unfinished business: Zombie firms among SME in Japan's lost decades

Yasuo Goto[a,b], Scott Wilbur[c,*]

[a] Seijo University, Japan
[b] Research Institute of Economy, Trade and Industry, Japan
[c] École des Hautes Études en Sciences Sociales, France

ARTICLE INFO

ABSTRACT

The "soft budget problem," by which banks loosen their lending stances toward long-term client firms despite worsening business conditions, has been widely discussed in the field of financial studies. In Japan, this problem has attracted attention particularly in connection to so-called "zombie firms," financially weak firms sustained by discounted interest rates and evergreen lending which have become a major research and political interest in recent years. In this article, we focus on zombie firms among small and medium-sized enterprises (SME), a corporate category that has hitherto received less consideration in the discussion about Japan's zombie firms. We find that: (1) many zombie firms exist among SME and that the zombie firm ratio increases as firm size decreases; and (2) some zombie firms eventually emerge from zombie status among SME. In other words, zombie firms are likely problematic from the view of the efficiency of the industries to which they belong. But when one considers that many zombie firms achieve revival, it would seem inappropriate to uniformly promote their elimination. Since ending zombie status seems to directly imply market exit for many SME, it is important to conduct preliminary screening to prevent the creation of zombie firms in the first place.

1. Introduction

Zombie firms—generally defined as insolvent businesses that remain in the marketplace instead of pursuing restructuring or bankruptcy—have been widely discussed as a key factor in Japan's sluggish economic growth in the past two decades, a period commonly known as the "lost decades." First reported by journalists in the late 1990s and early 2000s (Henry, 1997; Chandler, 1999; Landers, 1999; Fackler, 2003), zombie firms were subsequently criticized by economists, who argued that they distorted market competition and hurt healthy firms by depressing profits and discouraging investment, and thereby hindered Japan's macroeconomic revitalization (Hoshi, 2006; Caballero et al., 2008; Hoshi and Kashyap, 2011). Since the global financial crisis, Japan's encounter with zombie firms has become a cautionary lesson for other recessed economies seeking to avoid long-term stagnation, and policymakers in places as varied as the United States, the United Kingdom, the European Commission and China have expressed a strong desire to stop the spread of zombie firms (Summers, 2012; Bank of England, 2012; Stothard, 2013; Zhongguo xinwen wang, 2015).

While the notion of zombie firms has gained international prominence because of Japan's experience, recent questions about conceptualization have reopened the debate about these firms' precise role in Japan's post-bubble economy. Most notably, challengers of the dominant zombie firm argument have asserted that these firms should conceptually include the criteria of profitability and evergreen lending (Fukuda and Nakamura, 2011; Nakamura and Fukuda, 2013), in addition to the criterion of discounted interest payments used in earlier studies (Caballero et al., 2008). Measurement with this revised definition suggests that the ratio of zombie firms in fact declined from the early 2000s, meaning that zombie firms did not persist in significant numbers throughout the 2000s, and thus do not explain Japan's low growth in the latter part of the lost decades.

We are interested in this ongoing debate surrounding zombie firms, not just for its significance to understanding Japan's lost decades, but also for its relevance to other economies concerned about zombie firms' allegedly malefic effects and keen to learn from Japan's experience. However, we believe that the current scholarship on zombie firms in Japan suffers from a key deficiency. Namely, it primarily focuses on stock exchange-listed firms that tend to be large-sized enterprises and overlooks the presence of zombie firms among small and medium-sized enterprises (SME), the corporate category that actually represents the majority of Japanese businesses.

In this article, we examine the presence of zombie firms among SME in Japan during the lost decades. Our contribution is twofold. First, we employ firm-level data from the Ministry of Economy, Trade and Industry's Basic Survey of Japanese Business Structure and Activities

---

* Corresponding author.
  E-mail address: scott.wilbur@ehess.fr (S. Wilbur).

(BSJBSA) to assess the existence of zombie firms among Japanese SME. Our use of this database allows us to make a relatively broad inference about the zombie ratio among SME, which is an improvement over earlier studies that examined the ratio with a limited sample size (Imai, 2016). Second, we explore corporate characteristics of these firms, especially the durability of zombie status, and offer preliminary analysis about these firms' market exit and their employment and sales activity at the time of exit based on our limited data. Our findings about these characteristics add refinement to the debate about zombie firms, since there has hitherto been little attention to important zombie attributes like survival time, with the recent exception of Nakamura (2017). Consequently, they suggest issues for consideration in future research on this topic.

We find that many zombie firms exist among SME during our sample period and that the zombie firm ratio increases as firm size decreases, but also that some zombie SME eventually emerge from zombie status. These results carry considerable generalizability for the broader population of Japanese SME, given their origin in BSJBSA micro-data covering a wide range of firm sizes and behaviors. They also correspond to small firms' widespread utilization of government support policies like credit guarantees and low corporate tax rates which have been a constant presence throughout postwar Japan, and particularly to the period of the Financial Facilitation Act, which eased credit access for many SME between December 2009 and March 2013 (Goto, 2014).

The article is structured in the following way. In the "Literature Review" section, we revisit the debate on zombie firms in Japan and elsewhere to show why SME should be investigated for zombie firms. In the "Data and Method" section, we describe the merits of the quantitative database from which we draw our sample of SME for analysis and outline our article's empirical strategy. In the "Results" section, we quantitatively assess the level of zombies and their corporate characteristics. In the "Conclusion" section, we summarize our findings and discuss their implications for understanding Japan's lost decades and the wider study of zombie firms.

2. Literature review

Zombie firms have long been associated with Japan's lost decades. Initially identified in the late 1990s and early 2000s by journalists who labeled prominent overleveraged firms like Yamaichi Securities and Daiei as "zombies" (Henry, 1997; Wehrfritz and Takayama, 2002), zombie firms became a distinct topic of academic study in the 2000s, when economists noted a wider soft budget problem trend in which insolvent businesses were kept alive by various forms of financial support, instead of being forced to undergo corporate restructuring or liquidation (Katz, 2003). Early studies of Japan's post-bubble economy showed that increased lending to highly indebted firms lowered their profitability (Sekine et al., 2003), and that industries with high concentrations of zombie firms had weak productivity performance (Ahearne and Shinada, 2005), suggesting that zombie firms negatively affected Japan's economic recovery. Studies also demonstrated that Japanese banks' nonperforming loan problems made it more likely for them to give credit to financially-troubled firms, implying that zombie firms received life support in a perverse process of "unnatural selection" that simultaneously reduced the credit available to normal borrowers (Peek and Rosengren, 2005).

Zombie firms' malefic role in Japan's stagnation was most explicitly and influentially asserted by Caballero et al. (2008) (henceforth "CHK"), who measured the prevalence of zombie firms on the Tokyo Stock Exchange between 1981 and 2002 using a clear conceptual criterion of firms that paid discounted interest rates below the hypothetical prime rate. CHK found that nearly one-third of the firms in their sample received this form of financial assistance in late 1990s and early 2000s, which signified strong evidence for their contention that zombie firms caused "congestion" in Japan's marketplace by failing to exit, and

thereby hurt healthy firms and overall economic vitality. CHK tested this hypothesis and discovered that firms identified as zombies both reduced productivity in sectors where their presence was higher and lowered their more profitable competitors' investment and employment growth by impeding the reallocation of capital and human resources. These results led CHK to argue that zombie firms created deflationary pressures in the wider economy, and possibly caused some healthy firms to become zombies as well.

The magnitude of CHK's findings gave the notion of zombie firms much greater weight and shaped the ensuing scholarly and policy debates about Japan's lost decades. Many economists cited CHK's zombie firm argument as a persuasive and at least partial explanation for Japan's long-term stagnation (Griffin and Odaki, 2009; Kobayashi, 2009, 339; Garside, 2012, 90–94), while international organizations like the International Monetary Fund and OECD referenced CHK in calling on Japan to make far-reaching economic policy reforms (Lam and Shin, 2012, 3; Arbatli et al., 2016, 8; OECD, 2015, 23). Moreover, in the aftermath of the global financial crisis, central banks like the Bank of England mentioned CHK in noting that lessons should be drawn from Japan's extension of credit support to weak firms during the lost decades (Bank of England, 2012, 29–31), and leading economic policy voices like former US Treasury Secretary Larry Summers and Liu He, the top economic advisor to Chinese President Xi Jinping, expressed concern about the need to remove zombie firms from their respective economies (Summers, 2012, 72; Zhongguo xinwen wang, 2015). Increased attention by economic policymakers outside Japan suggests that it has become conventional wisdom that zombie firms were a prime reason for Japan's economic malaise after the banking crisis in the 1990s, and a potential threat to other economies trying to recover after the 2008 crisis.

Notwithstanding the widespread influence of CHK's study on the idea of zombie firms, some scholars have questioned the correctness of conceptualizing these troubled firms on the sole basis of discounted interest rates. Most notably, Fukuda and Nakamura (2011) and Nakamura and Fukuda (2013) (henceforth "FN") contended that below-prime rate interest rates are insufficient to indicate zombie firms, because Japan adopted a quantitative easing monetary policy in the 2000s that enabled many firms, including healthy ones, to borrow at very low interest rates, particularly since the policy accelerated competition between banks and put downward pressure on lending rates. To more accurately gauge the presence of zombie firms, FN proposed the addition of two conceptual criteria, profitability and evergreen lending, to CHK's interest rate criterion. Based on this revised definition, FN estimated that the ratio of zombie firms in their sample from the Tokyo Stock Exchange peaked in 2001 at less than 15 percent of firms—a level that was roughly half of CHK's estimate—and that the ratio subsequently declined and remained below 5 percent of firms throughout the 2000s until the global financial crisis.

Since FN offered their revised conceptualization, it has quickly gained traction among economists investigating zombie firms in Japan and elsewhere (Kwon et al., 2015; Imai, 2016; Nie et al., 2016; Tan et al., 2016). This trend suggests that a consensus may be emerging around the relative merits of FN's more strenuous definition, possibly because its additional conceptual criteria help it avoid the Type 1 and Type 2 errors inherent in CHK's definition, and because its estimate of the zombie firm ratio more closely tracks the actual amount of non-performing loans at major Japanese banks.

FN's enhancement to CHK's original conceptualization has reopened the debate about zombie firms' role in Japan's lost decades and proposes that scholars view the effects of zombies on Japan's low growth much more conservatively, especially in the period after 2001. Nonetheless, while we appreciate the creative significance of CHK's landmark argument as well as the enhanced conceptual validity and empirical findings of FN's counterargument, we agree with the observation by Imai (2016) that both these arguments place exclusive emphasis the existence of zombie firms among stock exchange-listed

Table 1
Summary Statistics for Sample Data.

	(unit)	mean	median	s.d.	total numbers of obs.	annual average of firm numbers	sample period
workers	persons	470.03	147.00	1882.79	180294	30049	2009FY -2014FY
capital	million yen	1510.92	90.00	14492.73	180294	30049	
sales	million yen	22392.76	4354.50	152341.40	180294	30049	
ROA	(yen/yen)	0.0404	0.0326	0.1287	180183	30031	

firms which are typically large enterprises, whereas most businesses in Japan (and virtually all other economies) are small and medium-sized enterprises (SME) which do not publicly trade their stock. In Japan's case, SME have traditionally constituted more than 99 percent of the total number of firms in the economy, provide roughly 70 percent of total employment (Economist Intelligence Unit, 2010, 6), and contribute 50 percent of national GDP (Yoshino and Wignaraja, 2015). Therefore, the current debate's inattention to this important corporate category is a significant omission and should be amended to provide fuller understanding of zombies' place in Japan's recent economic history.

3. Data and method

In our empirical analysis we use the METI Basic Survey of Japanese Business Structure and Activities (BSJBSA). This survey contains data about diversification, globalization, and many other aspects of Japanese firms and is generally used by METI for its own economic policymaking. It covers firms with 50 or more employees and whose paid-up capital or investment are higher than ¥30 million in industries including manufacturing, wholesale and retail trade, and other services. Though the BSJBSA does not include data from microenterprises, a SME category which contains many credit guarantee system users, because the survey encompasses all firms that meet these other size criteria, it addresses a large range of firms and provides a strong advantage in the context of our research.

Our basic empirical strategy consists of (i) identifying zombie firms using BSJBSA micro-data in respective firm-size groups, (ii) investigating the characteristics of these zombie firms, especially their durability in zombie status, and (iii) performing preliminary regression analysis on the relationship among the zombie identifier and other covariates. In step (i), the fundamental task is how to identify zombies. Three measures have been proposed in the literature. First, CHK parsimoniously define zombie firms as companies whose interest payments are lower than the hypothetical risk-free interest payments (Caballero et al., 2008, 1948). Second, FN add two criteria: profitability and evergreen lending. Profitability is important, FN argue, because firms with earnings before interest and taxes (EBIT) that exceed the firms' hypothetical risk-free interest payments are generally healthy, and such firms' good financial standing may in fact explain why their interest payments are lower than what the prime rate would stipulate. Evergreening lending is also relevant, since financially troubled businesses may have their loans rolled-over by their banks when they face difficulties with repayment (Fukuda and Nakamura 2011, 1126–27). Based on these contentions, FN define zombie firms as firms which fulfill the profitability criterion and meet at least one of the financial support criteria of interest payments (the CHK definition) and evergreening. Third, Imai agrees with the FN definition in principle, but uses a longer period to evaluate firm profitability. This modification helps Imai's definition avoid the problems of misidentifying healthy firms as zombie firms if the healthy firms experience temporary profit declines, and misidentifying zombie firms as healthy firms if the zombie firms have temporary profit increases (Imai, 2016, 94). The definitions are expressed as follows:

$$I_{i,t}^* = r_t^{short} * B_{i,t-1}^{short} + \left(\frac{1}{5}\sum_{j=0}^{4} r_{t-j}^{long}\right) * B_{i,t-j}^{long} + \min(r_{t-4}^{cb}, ..., r_t^{cb}) * Bonds_{i,t-1}$$

where $I_{i,t}^*$: minimum required interest, $r_t^{short/long/cb}$: interest rate,
$B_{i,t}^{short/long}$: borrowings from banks,
$Bonds_{i,t-1}$: issued amount of corporate bonds
If $I_{i,t} < I_{i,t}^*$, the firm is regarded as a zombie firm where $I_{i,t}$: actual interest paid (CHK criterion)
If $I_{i,t}^* > EBIT$ and ($B_{i,t} > B_{i,t-1}$ or $I_{i,t} < I_{i,t}^*$), the firm is regarded as a zombie firm where $EBIT$: profit before interest and taxes (FN criterion)
If $\sum_{m=0}^{T}(EBIT_{i,t-m} - I_{i,t-m}^*) < 0$ and ($B_{i,t} > B_{i,t-1}$ or $I_{i,t} < I_{i,t}^*$), the firm is regarded as a zombie firm (Imai criterion)

In the next section we compare the zombie characteristics reported by each of these definitions. Table 1 provides descriptive summary statistics for our sample data.

4. Results

4.1. Identification and comparison of zombie firm ratios by different definitions

Lines in Fig. 1 show the zombie firm ratios according to the respective definitions of CHK, FN and Imai, which are calculated as a percentage of all firms in our sample. The end year of the sample period is fiscal year 2014, but the start year for each definition's estimate is different: 2009 for CHK, 2010 for FN, and 2012 for Imai. Short-term and long-term bank borrowing and corporate bond issuance amounts are used to identify zombie firms, but the BSJBSA only begins covering this data from 2009. In addition, the start year is delayed for the FN definition because it considers differences with the borrowing amount in the previous year, and for the Imai definition which uses multiple year earnings (three years in this article) to identify zombie firms.
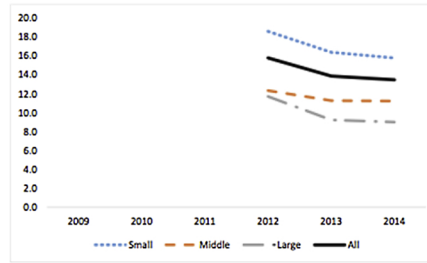
Four points can be observed in the lines in Fig. 1. First, the CHK definition classifies many more firms as zombies than do the other two definitions. Second, the FN and Imai definitions elicit a comparable zombie ratio, though the Imai definition's ratio is slightly lower. These two points are similar to the findings of Imai (2016). Third, while the zombie ratio continues to decrease in both the FN and Imai definitions, the ratio in the CHK definition continues to rise, suggesting that the respective estimates of the CHK definition and the FN and Imai definitions not only have a level gap, but also move in different directions.

The biggest reason for this divergence is that the CHK definition uses the real payment rate, whereas the FN and Imai definitions use revenue. Since both CHK and FN/Imai compare these different indicators with an "ideal payment rate" based on the prime rate, their definitions elicit starkly dissimilar zombie ratios. On the one hand, real payment rates and revenues may be linked. In particular, from the viewpoint of the business cycle, corporate earnings typically worsen during economic recessions, and real payment rates might decrease in response to reductions in policy interest rates. Yet what is decisively different is that in normal bank behavior related to credit risk, firms with low profits should have high interest rates. With the CHK definition, however, zombie firms may not only be weak firms that receive preferential interest rate treatment, but also sound businesses with

(a) FN Definition
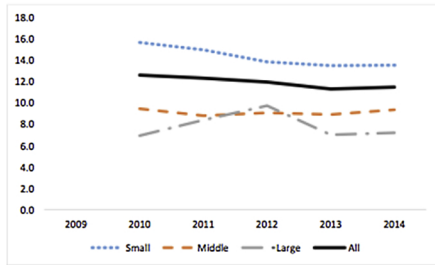
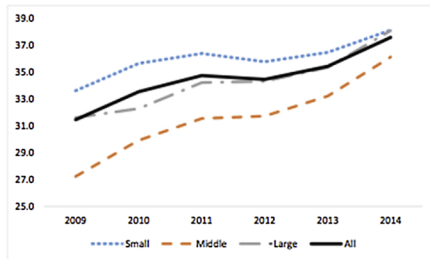(b) Imai Definition

(c) CHK Definition

favorable interest rates based on normal examination criteria. By contrast, the FN and Imai definitions use fundamental corporate earnings, so they more accurately capture underlying corporate strength.

4.2. Characteristics of zombie firms

In this section we investigate the relationship between different corporate attributes and the zombie ratio using the FN definition. First, Fig. 1 shows the zombie ratio by firm size according to capitalization for the respective zombie firm definitions. Small firms have less than ¥100 million in equity capital, medium-sized firms have between ¥100 million and ¥1 billion in equity capital, and large firms have more than ¥1 billion in equity capital. The thick black line in each graph shows the composite zombie ratio for the three size strata. The results reveal that the zombie ratios for the small and medium-size firm categories are uniformly higher than the ratio for large firms. This finding is consistent with Imai (2016) and corroborates the argument that smaller-sized firms have a greater tendency to be zombie firms, a possibility that was not examined in the original CHK study on zombie firms which looked only at large enterprises.

Next, Fig. 2 depicts the situation in Japan's manufacturing and non-manufacturing industries. It shows that the manufacturing industry contains a higher zombie firm ratio than the non-manufacturing industry. This figure is based on the Imai definition, yet the same outcome
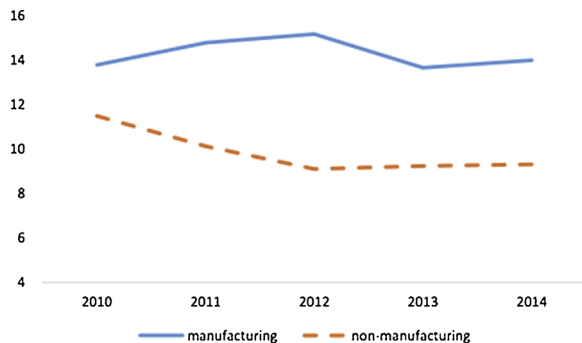
is also observed with the CHK and FN definitions. However, care is needed in interpreting these results, since the BSJBSA widely covers the manufacturing industry but is still in the process of expanding its coverage of the non-manufacturing industry. Additionally, it does not include data for microenterprises, many of which are in the non-manufacturing industry, so there is a high possibility of bias. Therefore, while it is possible to point out that many zombie firms exist in the manufacturing industry, one must be cautious about claiming that the ratio is higher for this industry than for the non-manufacturing industry.

Fig. 2. Zombie Ratios of Manufacturing and Non-Manufacturing Industries.
Note 1: Unit is percentage
Note 2: Based on FN Definition
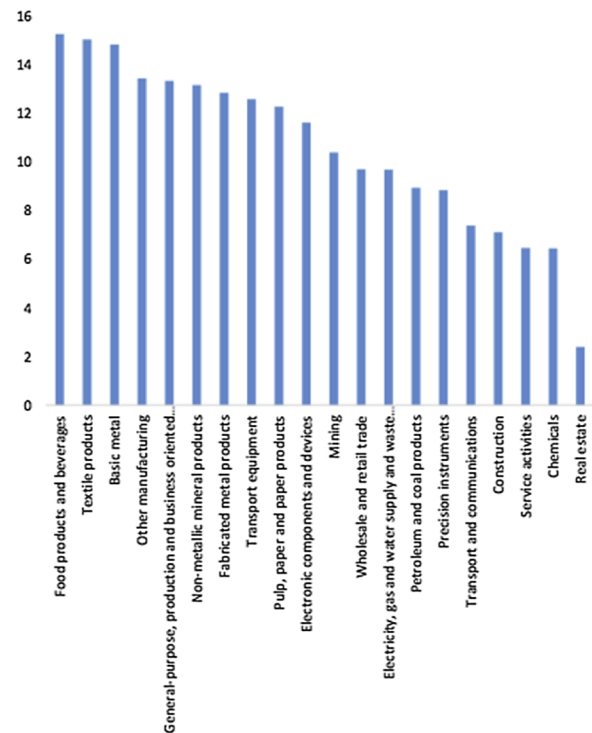Source: Authors

Fig. 3. Zombie Ratios by Industry Sector.
Note 1: Unit is percentage
Note 2: Weighted average for 2010-2014
Source: Authors

Fig. 3 shows the zombie ratio by specific industry sector. It includes 22 sectors based on SNA classification. Manufacturers of material and consumer goods are noticeable as two sectors with high zombie ratios. Results for the non-manufacturing industry require careful evaluation for the reasons stated above.

Finally, Fig. 4 shows the ratio by firm age. Firm age is defined as the elapsed years since the establishment year. In all definitions including the Imai definition, the zombie ratio increases as firm age increases. We see that there is a positive correlation between zombie formation and age.[1]

4.3. Regression results

Based on the above results, we conduct regression analysis on zombie firms. First, we estimate the probability of a firm's identification as a zombie using a panel logit model, with a dummy dependent variable taking the value of "1" if the firm is a zombie and "0" if it is not. We identify zombie firms using the FN definition. As Fukuda and Nakamura (2011) point out, the CHK definition is problematic due to its inability to capture credit risk, a limitation which is virtually fatal for analysis of SME. Also, the Imai definition would be difficult for us to use given our data's chronological coverage. In particular, when we perform logit regression with a dummy dependent variable for zombie status, having a short sample period would significantly increase the problem of collinearity. For this reason, we elect to use the FN definition rather than the Imai definition because the latter would only allow us to evaluate zombie firms for three years from 2012 until 2014. The definitions of the variables used in our estimations are located in the Appendix A.

Table 2(a) shows the results of the fixed effect model selected by Hausmann's test. As expected, the value of the variable representing the business situation (ROA in this case) is predominantly negative. However, both firm size (log of capital amount) and firm age (elapsed years since establishment year) are not significant. These results are logical because firms' business conditions largely center on profit, a factor which strongly influences the probability of zombie formation. Furthermore, as firms increase in size, firms with higher profits increase, while as firm age increases, profitability tends to decline.[2]

Based on these results, it is clear that the probability of zombie formation is not simply determined by a firm being a SME or having high age, but rather by its business conditions. In other words, there is no reason why zombie formation is only possible among large firms. Instead, the mechanism behind the creation of zombie firms may differ depending on the size of the enterprise. We elaborate this point below.

Initially, academic and policy interest in zombie firms was based on the notion that firms with poor prospects for revival were greatly prolonging their lives. Next, we examine this issue of survival in zombie status. When we look at the parameter of the lagged variable (FN-zombie dummy (-1)) indicating that a firm was identified as a zombie in the previous term, we see that it is significantly negative (Table 2(b)). This means that if a firm has zombie status in one period, its probability of keeping zombie status in the next period decreases. The magnitude of the influence is shown by the marginal effect in the parentheses. If other conditions are the same, the probability that a firm with zombie status in the previous term will be a zombie in the next term decreases by about 13 percent. This result is somewhat surprising, given that zombie firms are commonly portrayed as entities with excessive longevity. It suggests that SME that are identified as zombies do not endure in
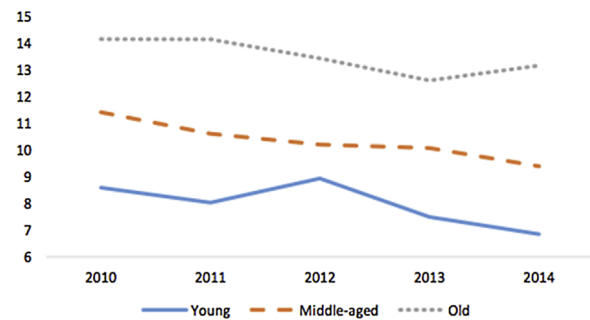

Fig. 4. Zombie Ratios by Firm Age.
Note 1: Unit is percentage
Note 2: Based on FN Definition
Source: Authors

zombie status endlessly and that quite many zombie SME might return to a healthy situation, an outcome which generally corresponds to the finding by Nakamura (2017, 15) that listed zombie firms between 1995 and 2008 stayed as zombies for an average of just over two years, a much shorter period than commonly assumed. At the very least, we cannot confirm the existence of a vicious circle for SME in which becoming a zombie increases the probability of remaining in zombie status. As for the other explanatory variables, the ROA coefficient is significantly positive as in (a) of the same table. For the marginal effects, a 1 percent increase in ROA reduces the probability of becoming a zombie by approximately 6 percent. Firm size and age are not significant, similar to (a).

This article is interested in zombie firms among SME, but not just because traditional research has not analyzed SME. Instead, we consider the possibility that different mechanisms produce zombie firms among large firms and SME. For large firms, zombies may typically happen when firms are "too big to fail." Banks that lend to such large-scale borrowers may be cautious about proceeding with these firms' bankruptcy, since it could likely worsen the banks' own financial condition. However, such a situation does not occur for SME. To the contrary, banks may not face risk even when they continue lending to inefficient SME borrowers because of government financial support measures. Alternatively, when such financial support measures are in place, banks may be asked by the government to maintain and expand lending to SME.

Table 3 shows the results of regression analysis meant to examine differences in trends by firm size between large firms and SME. The results from both groups show that zombie status in the previous term and rise in ROA significantly decrease the probability of zombie formation in the current term, while firm size and firm age are not significant. The marginal effect shows that zombie status in the previous year leads to a reduced possibility of zombie status in the current year by around 15 percent. However, the marginal effect differs somewhat between large firms and SME. In the estimation period, the marginal effect for SME is a slightly larger than that for large firms. This result might imply that it is relatively easier for firms to get out of zombie status when they are in the small and medium size strata, while improvement in business conditions is likely to directly lead to departure from zombie status.

Here we must state several important points from a statistical perspective. In panel logit regressions which use fixed effect models, using a lagged dummy variable as the dependent variable leads to a type of estimation bias known as the incidental parameter problem. Consequently, in this article's analysis, we use a conditional panel logit regression model with fixed effects to obtain consistent estimates (Wooldridge, 2010).

The missing variable problem is also important. Since we use a fixed effect model, many elements may be absorbed as fixed effects. However, we should note that there are some other elements which are

---

[1] While space limitations prevent us from elaborating, preliminary analysis suggests that the average age of zombie firms is about five years higher than that of non-zombies, regardless of definition.

[2] We confirm this tendency through regression where ROA is the dependent variable and firm size and firm age are independent variables, which generates high statistical significance and coefficient signs in the expected direction.

Table 2

Regression Result by Fixed-Effect Panel Logit Model: Higher ROA and Previous Zombie Status Correlate with Lower Possibility of Current Zombie Status.

dep. var./ FN-zombie dummy	sample period: 2010-2014					
	(a) without zombie dummy			(b) with zombie dummy		
	Coef.	S.E.	p-value	Coef.	S.E.	p-value
roa	−45.1762 (-7.2018)	1.1512	0.0000	−45.8983 (-6.1903)	1.1681	0.0000
FN-zombie dummy(-1)				−0.9399 (-0.1268)	0.0540	0.0000
capital (log)	0.0887 (0.0141)	0.1621	0.5840	0.0793 (0.0107)	0.1652	0.6310
age	−0.0141 (-0.0023)	0.0142	0.3210	−0.0165 (-0.0022)	0.0142	0.2440
year dummies	Yes			Yes		
log likelihood	−3981.9			−3816.8		
p-value, LR chi2	0.000			0.000		
# of obs.	15,256			15,256		
# of groups	4,078			4,078		

Note: BSJBSA data allows estimation for the period 2009-2014. Since the explanatory variable includes a dummy for the previous term, the estimation period here is 2010-2014. The same is true for Table 3.

Table 3

Regression Result by Fixed-Effect Panel Logit Model by Firm Size: SME and Large Firms Respond to Previous Zombie Status.

dep. var./ FN-zombie dummy	sample period: 2010-2014					
	(a) SME			(b) large firms		
	Coef.	S.E.	p-value	Coef.	S.E.	p-value
roa	−45.5654 (-6.9759)	1.2405	0.0000	−48.3788 (-7.8201)	3.5986	0.0000
FN-zombie dummy(-1)	−0.9551 (-0.1462)	0.0573	0.0000	−0.8102 (-0.1310)	0.1698	0.0000
capital (log)	0.1985 (0.0304)	0.2481	0.4240	0.2067 (0.0334)	0.6713	0.7580
age	−0.0189 (-0.0029)	0.0176	0.2840	0.0011 (0.0002)	0.0317	0.9730
year dummies	Yes			Yes		
log likelihood	−3383.7			−409.6		
p-value, LR chi2	0.000			0.000		
# of obs.	13,470			1,752		
# of groups	3,622			452		

Table 4

FE Panel Logit Model for Exit and FN Definition-Zombie: Zombie Firms Are Likely to Exit Especially Among SME.

dep. var./ exit dummy (+1)	sample period: 2009-2013								
	(a) all			(b) SME			(c) large		
	Coef.	S.E.	p-value	Coef.	S.E.	p-value	Coef.	S.E.	p-value
roa	−2.5559 (-0.0156)	0.8262	0.0020	−3.3087 (-0.0228)	1.0212	0.0010	−1.5092 (-0.0482)	1.3587	0.2670
FN-zombie dummy	0.2310 (0.0014)	0.1553	0.1370	0.4824 (0.0033)	0.1780	0.0070	0.1891 (0.0060)	0.4572	0.6790
capital (log)	−0.8587 (-0.0052)	0.3386	0.0110	−4.3776 (-0.0302)	1.0400	0.0000	−0.7896 (-0.0252)	1.2220	0.5180
age	1.3398 (0.0082)	0.0400	0.0000	1.3011 (0.0090)	0.0502	0.0000	0.4392 (0.0140)	0.0765	0.0000
year dummies	Yes			Yes			Yes		
log likelihood	−1289.4			−734.5			−219.7		
p-value, LR chi2	0.000			0.000			0.000		
# of obs.	7,862			4,836			762		
# of groups	2,600			2,350			250		

Note: BSJBSA data allows estimation for the period 2009-2014. Since the dependent variable is as an exit dummy for the next term, the estimation period here is.2009–2013.

Table 5

Logit Model for Profit Decrease by Firm Size: Zombie SME Tend to Exit in Worse Business Condition.

dep. var./ profit-decrease (in 5yrs) dummy	sample period: 2009-2013, sample group: firms which will exit in next year								
	(a) all			(b) SME			(c) large firms		
	Coef.	S.E.	p-value	Coef.	S.E.	p-value	Coef.	S.E.	p-value
roa	−18.8035 (-3.7357)	1.1809	0.0000	−18.9836 (-3.7955)	1.2701	0.0000	−16.9926 (-3.1228)	3.2753	0.0000
FN-zombie dummy	0.3896 (0.0774)	0.1847	0.0350	0.3398 (0.0679)	0.1888	0.0720	1.2929 (0.2376)	1.0990	0.2390
capital (log)	0.0466 (0.0093)	0.0323	0.1500	−0.0112 (-0.0022)	0.0576	0.8460	0.0574 (0.0106)	0.1334	0.6670
age	−0.0079 (-0.0016)	0.0024	0.0010	−0.0081 (-0.0016)	0.0026	0.0020	−0.0075 (-0.0014)	0.0063	0.2330
cons.	0.4964	0.1972	0.0120	0.7689	0.2952	0.0090	0.1465	1.1019	0.8940
year dummies	Yes			Yes			Yes		
log likelihood	−1390.2			−1252.0			−135.6		
p-value, LR chi2	0.000			0.000			0.000		
pseudo R2	0.169			0.165			0.224		
# of obs.	2,415			2,163			252		

not sufficiently controlled. As with other regression analysis, it is also necessary to be aware that endogenous biases can exist. In this article, no causal relationship is explicitly formulated. Nonetheless, even if zombie status is associated with other elements based on just correlation rather than strict causation, the existence of such a relationship may itself carry meaning. In this way, there are various issues with our statistical analysis, so interpretation of our results requires broad understanding.

While the preceding findings are the main part of this article's analysis, we should recognize that the results in Tables 2 and 3 are only for firms that continue their survival in this term. In fact, there is a possibility that firms that were zombies in the previous term have exited this term. However, these firms drop out as a target of regression analysis. Therefore, it should be noted that bias exists in a positive direction when current term zombie status is used as the dependent variable.

Analysis on the specific issue of market exit could lead to new knowledge about zombie firms. However, the BSJBSA does not collect information on firms' market exit itself. In the following, we offer preliminary analysis within the scope of BSJBSA, recognizing that full-fledged analysis on exit should be performed with data that explicitly captures this event. We regard firms which do not report their data thereafter as having exited. It should be noted that this identification strategy possibly includes firms that simply quit answering the survey in later years.

Table 4(a) presents the results of a regression which makes exit the dependent variable (represented as dummy variable which takes "1" if a firm exits). The table suggests that if a firm becomes a zombie, the probability of exit significantly increases.

As expected, as the size of firm (log of capital amount) becomes larger, the probability of exit decreases. This is not surprising considering that smaller firms have higher credit risk. However, the parameter is not so large. Regression by segmented size groups shows us quite another aspect. We divide firms into two size groups, SME and large firms. Tables 4(b) and 4(c) show that becoming a zombie significantly increases the probability of exit in SME, while the parameter is not significant in large firms.

We also compare the business situations of zombies and non-zombies around the timing of exit. Table 5 shows the results of logistic regression in which the dependent variable is a dummy with the value "1" if the profit of the firm decreases within the five-year period before the firm's market exit. We can see that the probability of lower profit increases if the firm is a zombie among SME, while there is not such tendency among large firms. However, we stress that Tables 4 and 5 are based on preliminary analysis with limited data. Future research in this

direction would be important, especially if similar analysis could be performed after additional BSJBSA data has accumulated or with other long-term data to check these results.

5. Conclusion

In this article, we analyze the situation of zombie firms among Japanese SME with data from the BSJBSA. Our analysis covers a much larger sample of SME than previous studies, and addresses multiple characteristics of zombie SME, including firm size, firm age, and durability of zombie status. We also offer preliminary analysis about market exit and corporate activity at the time of exit.

Our findings reveal that though there remains some discrepancy over the zombie firm ratio based on different definitional criteria, Japanese SME contained a non-negligible amount of zombie firms during the lost decades. This finding suggests that zombies existed to a significant degree in the past, and at a comparably higher level than large-sized zombie firms estimated in other studies (Nakamura, 2017). In other words, our analysis implies that CHK's original study may have been intuitively correct about zombie firms' presence in the post-bubble Japanese economy, but that its focus on listed firms was misplaced. To the extent that zombie firms existed in the lost decades, especially in the 2000s, they were a greater problem among SME.

Our article makes an additional contribution by elucidating corporate characteristics of zombie SME. On the durability of zombie status, our statistical results suggest that zombie SME may often escape from zombie status through recovery or exit, rather than perpetually remaining zombies. In a preliminary way, we also investigate other aspects of zombie firms and find tentative evidence that the probability of exit is higher for zombies that are SME, and that exiting zombies' economic performance is worse than that of exiting non-zombies. Certainly, firms' exit, economic performance and zombie status are endogenous, but identifying zombies might offer an effective signal in the view of finance and economic policy.

Taken together, our findings carry two general implications for the study of zombie firms going forward. First, it is important that research on zombie firms considers SME as well as large firms. Recent studies on Europe and South Korea have extended the debate on zombie firms beyond Japan and include some SME in their analyses (Acharya et al., 2017; McGowan et al., 2017). Data restrictions may complicate comprehensive analysis, but as this article shows, SME are a significant corporate class where the possible presence of zombies should not be underappreciated.

Second, comparisons between different corporate categories might indirectly expose the presence of alternative mechanisms behind the

generation of zombie firms. While the nature of BSJBSA data prevents this article from testing the proposition that Japan's SME policies such as the credit guarantee system supported zombie firms among Japanese SME, the finding of a high zombie ratio among small firms during the 2000s suggests that these zombies were underpinned by factors that did not similarly affect large firms. Future work should specifically examine the situation of firms using SME support policies to determine whether such measures have been responsible for generating zombie SME. This could be a key lesson from Japan for scholars and policymakers concerned with zombie firms.

Zombie SME are likely problematic from the view of the efficiency of the industries to which they belong. But when one considers that many zombie firms seem to achieve revival as our findings suggest, it would appear inappropriate to uniformly promote their elimination. Rather than trying to end zombie status through the market exit of many SME, it may be more important to have preliminary screening that prevents the creation of zombie firms in the first place.

Appendix A. Explanation of Dependent and Independent Variables

Variable	Definition
roa	Return on assets (ROA), i.e. current profit over total assets
FN-zombie dummy	Dummy variable showing zombie status (zombie = 1, non-zombie = 0)
capital(log)	Natural logarithm of capital amount (million yen)
age	Years since firm establishment
exit dummy	Dummy variable which assigns "1" to the relevant year if there is no response after that year
profit decrease (in 5 years)	Dummy variable which takes the value "1" when current profit is decreasing as compared to 5 years ago

References

Acharya, Viral V., Eisert, Tim, Eufinger, Christian, Hirsch, Christian W., 2017. Whatever it takes: the real effects of unconventional monetary policy. SAFE Working Paper 152, 1–67.

Ahearne, Alan, Shinada, Naoki, 2005. Zombie firms and economic stagnation in Japan. Int. Econ. Econ. Policy 2 (4), 363–381.

Arbatli, Elif, et al., 2016. Reflating Japan: time to get unconventional? IMF Working Paper 16 (157), 1–45.

Bank of England, 2012. Financial Stability Report.

Caballero, Ricardo J., Hoshi, Takeo, Kashyap, Anil K., 2008. Zombie lending and depressed restructuring in Japan. Am. Econ. Rev. 98 (5), 1943–1977.

Chandler, Clay., 1999. In Japan, a reversal on reform?: premier draws fire for 'Go slow' stance on economy. Washington Post 29 (October), E1.

Economist Intelligence Unit, 2010. SMEs in Japan. A New Growth Driver? The Economist.

Fackler, Martin., 2003. Japan targets bad bank debt: effort to help lenders take over corporate borrowers. Wall Street J. 14 (April), C9.

Fukuda, Shinichi, Nakamura, Junichi, 2011. Why did 'Zombie' firms recover in Japan? World Econ. 34 (7), 1124–1137.

Garside, W.R., 2012. Japan's Great Stagnation: Forging Ahead, Falling Behind. Edward Elgar Publishing, Inc., Northampton.

Goto, Yasuo., 2014. Chusho Kigyo No Makuro Pafomansu: Nihon Keizai E No Kiyodo O Kaimei Suru [SME Macro-performance: Clarifying the Contribution to Japan's Economy]. Nihon Keizai Shimbun Shuppansha, Tokyo.

Griffin, Naomi N., Odaki, Kazuhiko, 2009. Reallocation and productivity growth in Japan: revisiting the lost decade of the 1990s. J. Product. Anal. 31 (2), 125–136.

Henry, David., 1997. Japan Forced to Clear Out Deadwood. USA Today November 25: B3.

Hoshi, Takeo., 2006. Economics of the living dead. Jpn. Econ. Rev. 57 (1), 30–49.

Hoshi, Takeo, Kashyap, Anil K., 2011. Why Did Japan Stop Growing? National Institute for Research Advancement., Tokyo.

Imai, Kentaro., 2016. A panel study of zombie SMEs in Japan: identification, borrowing and investment behavior. J. Int. Econ. 39, 91–107.

Katz, Richard., 2003. Japanese Phoenix: The Long Road to Economic Revival. M.E. Sharpe, Armonk.

Kobayashi, Keiichiro., 2009. Financial crisis management: lessons from Japan's failure. In: Felton, Andrew, Reinhart, Carmen M. (Eds.), The First Global Financial Crisis of the 21st Century: Part II: June-December, 2008. Centre for Economic Policy Research, pp. 337–341.

Kwon, Hyeog Ug, Narita, Futoshi, Narita, Machiko, 2015. Resource reallocation and zombie lending in Japan in the 1990s. Rev. Econ. Dyn. 18 (4), 709–732.

Lam, Raphael W., Shin, Jongsoon, 2012. What role can financial policies play in revitalizing SMEs in Japan? IMF Working Paper 12 (291), 1–23.

Landers, Peter., 1999. Tokyo still needs plan to clean up bad loans stifling firms' growth. Asian Wall Street J. 23 (August), 1.

McGowan, M.üge Adalet, Andrews, Dan, Millot, Valentine, 2017. The walking dead? Zombie firms and productivity performance in OECD countries. OECD Econ. Department Working Papers 1372, 1–45.

Nakamura, Junichi., 2017. Japanese Firms During the Lost Two Decades: The Recovery of Zombie Firms and the Entrenchment of Reputable Firms. Springer, Tokyo.

Nakamura, Junichi, Fukuda, Shinichi, 2013. What happened to 'Zombie' firms in Japan? Reexamination for the lost two decades. Glob. J. Econ. 2 (2), 1–18.

Nie, Huihua, Jiang, Ting, Zhang, Yuxiao, Fang, Mingyue, 2016. Zhongguo Jiangshi Qiye Yanjiu Baogao: Xianzhuang, Yuanyin He Duice [China's Zombie Firms Research Report: Current Situation, Causes and Countermeasures]. Renmin University National Academy of Development and Strategy Anti-Corruption and New Political Economy Research Center, Beijing.

OECD, 2015. Economic Surveys: Japan: Overview. OECD (August 3, 2016). www.oecd.org/eco/surveys/Japan-2015-overview.pdf.

Peek, Joe, Rosengren, Eric S., 2005. Unnatural selection: perverse incentives and the misallocation of credit in Japan. Am. Econ. Rev. 95 (4), 1144–1166.

Sekine, Toshitaka, Kobayashi, Keiichiro, Saita, Yumi, 2003. Forbearance lending: the case of Japanese firms. Monetary Econ. Stud. 21 (2), 69–92.

Stothard, Michael., 2013. Companies: The Rise of the Zombie. Financial Times (April 22, 2016). http://www.ft.com/intl/cms/s/0/7c93d87a-58f1-11e2-99e6-00144feab49a.html#axzz46YJNJc11.

Summers, Lawrence H., 2012. U.S. economic prospects: secular stagnation, hysteresis, and the zero lower bound. Bus. Econ. 49 (2), 65–73.

Tan, Yuyan, Huang, Yiping, Woo, Wing Thye, 2016. Zombie firms and the crowding-out of private investment in China. Asian Econ. Pap. 15 (3), 32–55.

Wehrfritz, George, Takayama, Hideko, 2002. King of the Zombies. Newsweek 21 (January), 40.

Wooldridge, Jeffrey M., 2010. Econometric Analysis of Cross Section and Panel Data, 2nd ed. MIT Press, Cambridge.

Yoshino, Naoyuki, Wignaraja, Ganeshan, 2015. SMEs internationalization and finance in Asia. Presented at the IMF-JICA Conference: Frontier and Developing Asia: Supporting Rapid and Inclusive Growth February 18.. https://www.imf.org/external/np/seminars/eng/2015/jica2015/pdf/1-B1.pdf (October 2, 2017).

Zhongguo xinwen wang. 2015. "Fagaiwei: Jiakuai taotai jiangshi qiye youxiao huajie guosheng channeng [National Development and Reform Commission: Speed Up the Elimination of Zombie Firms to Effectively Resolve Excess Capacity]." Zhongguo xinwen wang. http://www.chinanews.com/cj/2015/10-12/7564476.shtml (January 28, 2017).