Zombie Lending and Depressed Restructuring in Japan

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Abstract:

In this paper, we propose a bank-based explanation for the decade-long Japanese slowdown. The starting point for our story is the well-known observation that most large Japanese banks would be out of business if regulators forced them to recognize all their loan losses immediately. Because of this, the banks keep many zombie firms alive by ever-greening their loans – rolling over loans that they know will not be collected. Thus, the normal competitive outcome whereby the zombies would shed workers and lose market share is being thwarted. Our model highlights the restructuring implications of the zombie problem. The counterpart of the congestion created by the zombies is a reduction of the profits for potential new and more productive entrants, which discourages their entry. In this context, even solvent banks see no particularly good lending opportunities in Japan. Essentially Japan has reached the situation of having bankrupt banks lend to bankrupt firms, and in this scenario the private sector struggles. We confirm our story's key predictions that zombie-dominated industries exhibit more depressed job creation, lower productivity, and greater excess capacity.

1. Introduction

Japan's economy has stagnated for more than a decade: After averaging 4.1% per year between 1980 and 1990, real GDP growth has averaged just 1.2% per year since then. The performance has been particularly anemic over the last five years, averaging less than 0.7% per year. Will this bad run come to an end? The answer to this question depends on identifying the main obstacles to a healthy recovery.

In all likelihood, there are many inter-related factors dragging down the Japanese economy. Lack of aggregate demand is one of them. However, a series of conventional expansionary macroeconomic policy implemented by the Japanese government and the Bank of Japan, so far has failed to jumpstart the recovery. Thus the problem has deeper roots than just an aggregate demand insufficiency. What are, then, the structural mechanisms behind household and corporate pessimism that continue to stifle consumption and investment?

This paper formalizes and documents a story first proposed by Hoshi (2000) that has been partially elaborated upon by a number of observers of the Japanese economy. It focuses on the role of the banking system in misallocating credit following the large stock and land price declines that began in early 1990s: stock prices lost roughly 80% of their value from the 1989 peak through mid 2003, while commercial land prices have fallen by roughly 60% since their 1992 peak. These shocks impaired collateral values sufficiently that any banking system would have had tremendous problems adjusting. But in Japan the political and regulatory response was to deny the existence of any problems and delay any reforms or restructuring of the banks.[1] Aside from a couple of crisis periods when regulators were forced to recognize a few insolvencies and temporarily nationalize the offending banks, the latter have been surprisingly unconstrained by the regulators.

The one exception to this rule is that banks do have to comply (or appear to comply) with the international rules governing their minimum level of capital (the so-called Basle capital standards). This has meant that when banks want to call in a non-performing loan, they are likely to have to write off existing capital, which in turn pushes them up against the minimum

[1] For instance, in 1997, at least 5 years after the problem of non-performing loans was recognized, the Ministry of Finance was insisting that no public money would be needed to assist the banks and in February 1999 then Vice Minister of Finance Eisuke Sakakibara was quoted as saying that the Japanese banking problems "would be over within a matter of weeks." As late as 2002, the Financial Services Agency claimed that Japanese banks were well capitalized and no *more* public money would be necessary.

capital levels. The fear of falling below the capital standards has led many banks to continue to roll over loans to insolvent borrowers, gambling that somehow these firms will recover or that the government will bail them out.[2] Failing to rollover the loans also would have sparked public criticism that banks were worsening the recession by denying credit to needy corporations. Indeed, the government also encouraged the banks to *increase* their lending to small and medium sized firms to ease the apparent "credit crunch" especially after 1998.[3] The continued roll-over of credit, or "ever-greening," can therefore be seen as a rational response by the banks to these various pressures.

A simple measure of the ever-greening is shown in Figure 1, which reports the percentage of bank customers that are receiving subsidized bank credit. We defer the details of how the firms are identified until the next section, but for now all that matters is that the universe of firms considered here is all publicly traded manufacturing, construction, retail, wholesale (excluding nine general trading companies) and service sector firms. The top panel of the figure shows roughly 30% of these firms are now on life support from the banks. The lower panel, which shows comparable asset weighted figures, suggests that about 15% of assets reside in these firms. As these figures show, these percentages were much lower in the 1980s and early 1990s.

By keeping these unprofitable borrowers (that we call "zombies") alive, the banks are allowing them to distort competition throughout the rest of the economy. The zombies' distortions come in many ways, including depressing market prices for their products, raising market wages by hanging on to the workers whose productivity at the current firms declined and, more generally, congesting the markets where they participate. Effectively the growing government liability that comes from guaranteeing the deposits of banks that support the zombies is serving as a very inefficient program to sustain employment. Thus, the normal competitive outcome whereby the zombies would shed workers and lose market share is being thwarted. More importantly, the low prices and high wages reduce the profits that new and more

[2] The banks also tried to raise capital by issuing more shares and subordinated debt, as Ito and Sasaki (2002) argue. When the banks have raised new capital, however, it has almost all come from either related firms (most notably life insurance companies) that are dependent on the banks for their financing, or the government when banks received capital injections. See Hoshi and Kashyap (2003) for more on this "double-gearing" between banking and life insurance sectors.

[3] Subsequently when the Long-Term Credit Bank was returned to private ownership, a condition for the sale was the new owners would maintain lending to small and medium borrowers. The new owners tightened credit standards and the government pressured them to continue supplying funds, see Tett (2003) for details.

productive entrants can earn, thereby discouraging their entry. In addition, even solvent banks see no particularly good lending opportunities in Japan. Essentially Japan has reached the situation of having bankrupt banks lend to bankrupt firms, and in this scenario the private sector struggles, much as was the case in Russia a decade ago.

In the remainder of the paper we document and formalize this story. In the next section of the paper we describe the construction of our zombie measure. There are a number of potential proxies that could be used to identify zombies. As we explain, however, measurement problems confound most of these alternatives.

Having measured the extent of zombies, we then model their effects. The model is standard variant of the type that is studied in the literature on creative destruction. It is designed to contrast the adjustment of an industry to a negative shock with and without the presence of zombies. We model the latter as a constraint on the natural surge in destruction that would arise in the wake of a technological, demand, or credit shock. The main effect of that constraint is that job creation must slow sufficiently to re-equilibrate the economy. This means that during the adjustment the economy is characterized by what Caballero and Hammour (1998, 2000) have called "sclerosis" — the preservation of production units that would not be saved without the banks' subsidies— and the associated "scrambling" — the retention of firms that are less productive than some of those that do not enter due to the congestion caused by the zombies

In the fourth section of the paper we test the simplest implications of the model. In particular, we study the interaction between the percentage of zombies in the economy and the amount of restructuring, both over time and across different sectors. We find that the rise of the zombies has been associated with falling levels of aggregate restructuring, with job creation being especially depressed in the parts of the economy with the most zombies firms. We then explore the impact of zombies on sectoral performance measures. We find that the prevalence of zombies lowers productivity and raises excess capacity.

In the final section of the paper we discuss how our explanation for the Japanese stagnation interacts with other leading explanations, including simple credit crunch hypothesis and standard productivity slowdown stories. We argue that none of these stories can explain the full magnitude and length of the Japanese stagnation without a mechanism to amplify the impacts of the negative shocks. We also describe the policy implications of our explanation for the Japanese sclerosis.

2. Identifying zombies

Our story can be divided into two parts. First, the banks misallocated credit by supporting zombie firms. Second, the existence of zombie firms interfered with the process of creative destruction and stifled growth. Our measure of zombie should not only capture the misallocation of credit but also be useful in testing the effect of zombies on corporate profitability and growth.

There is a growing literature examining the potential misallocation of bank credit in Japan (see Sekine, Kobayashi, and Saita (2003) for a survey). Early studies looked at the profitability of industries that attract more bank loans. For example, in the first paper to directly investigate this issue, Hoshi (2000) found that the bank loans to real estate developers continued to grow in the 1990s, well after the industry's profitability declined following the collapse of land prices, while the bank loans to manufacturers steadily declined. He suggested this may be caused by ever-greening of loans to the real estate industry. Sakuragawa (2002, Chapter 5) shows that the positive relation between the regional land price increase and the importance of real estate loans to the banks headquartered in the region broke down after 1992, when banks became concerned with their capital ratios.

Fukao (2000) calculated the average amount of loans per firm and found it increased in the late 1990s in the industries that had been affected most by the collapse in land prices: construction, real estate, and non-bank financial industries. He interpreted this as evidence that banks were lending more to already heavily indebted firms to prevent their loans from becoming non-performing.

Hosono and Sakuragawa (2003) also examined the loans to the three under-performing sectors: construction, real estate, and non-bank financial institutions. They find the banks with low "market based" capital ratio, which they define as the market value of their shares divided by the sum of the book value of debt and the market value of shares, tend to increase their loans to these three industries.[4] They interpret this finding as showing that banks with weak capital positions roll over non-performing loans to hide the true picture of their health. Sasaki (2000)

[4] Their debt measure includes the subordinated debt that is counted as part of regulatory capital.

also found the banks with more bad loans tend to increase their loans to construction companies, although the result is not statistically significant.

Sekine, Kobayashi and Saita (2003) try to estimate a bank loan supply function using data for individual borrowers. They find that there was a break in the connection between loans received and bank debt to asset ratios. They find that loans grew more at firms with high bank debt to asset ratios starting only after 1993, and that these increases were most pronounced amongst construction and real estate industries. They also find that increase in lending was concentrated in what appears to be the rolling over of short-term loans, rather than the extension of new long-term credits. The Sekine et al. approach encounters all the usual difficulties in separating loan supply from loan demand. In this case, the question is whether one accepts their identifying assumption that a firm's bank debt to asset ratio does not influence firm's demand for bank loans.

Nishimura, Nakajima, and Kiyota (2003) examined entries and exits of Japanese firms between 1994 and 1998 using the METI (Ministry of Economy, Trade, and Industry) data from *Basic Survey of Business Structure and Activity*, and found the average productivity for exiting firms was often higher than the surviving firms, especially in construction, wholesale and retail trade industries. Since many exit decisions are presumably related to availability of working capital, their result indirectly suggests a misallocation of funds.

Peek and Rosengren (2003) conduct arguably the most systematic study to date on the potential misallocation of bank credit. They find that bank credit to poor performing firms often increased between 1993 and 1999. These firms' main banks are more likely to lend to the firms than other banks dealing with these firms when the firm's profitability is declining. This pattern of perverse credit allocation is more likely when the bank's own balance sheet is weak or when the borrower is a keiretsu affiliate. Importantly, non-affiliated banks do not show this pattern.

While identifying zombie firms or industries using data on profitability can be useful in studying the extent of credit misallocation, this approach is less helpful when we also want to investigate the effects of the existence of zombies. Tautologically, this definition will imply that the industries dominated by zombie firms have low profitability, and likely also have low growth.

Instead of looking at the profitability and the quantity of bank loans, we have opted to focus directly on the interest payments made by firms to see if the firms are receiving subsidies. We compare actual interest payments made by firms to a benchmark payment that would be

expected for the firm given its level of borrowing. Aside from the measurement problems discussed below, this proxy is a direct indicator of a credit subsidy. We can then use this indicator to test if the existence of zombies in an industry indeed impairs industry performance, measured by such proxies as productivity growth.

There is previous work supporting the view that interest rates charged for Japanese firms are skewed, especially in recent years. For example, Smith (2003) finds that loan spreads are (on average) lower than in Germany, the U.S. and U.K for the 1990s. Moreover, Japanese lenders charge lower (risk adjusted) spreads than foreign lenders and vary credit terms less than foreign lenders. Schaede (2003) finds that the loan rates for Japanese firms are extremely low (for most firms) or extremely high (for some that need to rely on loan-sharks such as *shōkō loan* lenders) with nothing in the middle. These results suggest that our measure is likely to point to an increase in zombies in recent years.

We proceed by calculating the minimum required interest payment for each firm each year, $R^*_{i,t,}$ as:

$$R^*_{i,t} = rs_{t-1} BS_{i,t-1} + \left(\tfrac{1}{5} \sum_{j=1}^{5} rl_{t-j} \right) \cdot BL_{i,t-1}, \qquad (1)$$

where $BS_{i,t}$ and $BL_{i,t}$ are short-term bank loans (less than one year) and long-term bank loans (more than one year) respectively of firm i at the end of year t, and rs_t and rl_t are the average short-term prime rate and the average long-term prime rate that prevailed in year t. Thus, conservatively, we calculate the minimum payment by multiplying the outstanding bank loans by the prime rate, which is supposed to be the interest rate for the most creditworthy customers.

We then compare the estimated minimum interest payment to the actual interest payment of firms and label a firm as a zombie if the actual interest payment is below the minimum payment. Thus, our zombie indicator for firm i in year t is given by:

$$z_{i,t} = \begin{cases} 1 \text{ if } \mathrm{R}_{\mathrm{i,t}} < \mathrm{R}^*_{\mathrm{i,t}} \\ 0 \text{ otherwise} \end{cases},$$

where $R_{i,t}$ is the actual interest payment of firm i for year t.

The usefulness of this approach hinges on whether our estimate of the minimum payment is a plausible lower bound for what firms might pay. For the portion of the interest payments coming from short term bank loans, which accounts for about 40% to 45% of total lending in our sample, this is quite likely because almost no loans are made at rates below the prime rate (once we take into account all the origination and other fees).

Ideally, we would find an equally conservative assumption for handling long-term loans. It is quite likely that interest payment on a new long-term loan would be above the prime rate at the time the loan is originated. Unfortunately, the available data on long-term bank debt gives just the stock outstanding without information on the exact maturity of the loans. So we assume that each firm's long term loans have an average maturity of 2.5 years and with one-fifth having been originated in each year for five years. We make this assumption because the vast majority of long-term bank loans are for five years. This assumption implies that the right interest rate is an equally weighted average of the last five years of the long-term prime rates.[5] Thus, we calculate the minimum required interest payment on the long-term loans by multiplying the outstanding long-term loans of all maturities with the five year average of the long-term prime rates.

A problem arises because the actual interest payment for each firm reported in our database includes more than just the interest payments on bank loans. Most importantly, it includes the coupon payments and other fees relating to corporate bonds and commercial paper. Only since 1998 can we obtain the interest expenses broken down by type of debt (e.g., bank loans or corporate bonds). In general, however, we do know that during the 1990s, roughly 40% of interest paying debt was bonds and about 3% was commercial paper.

Our measure of the required payment ignores the interest payments for commercial paper. Given the limited importance of commercial paper financing and the low interest rates on the commercial paper for the 1990s, this is not likely to cause any serious problems for our analysis.

More significantly, we also ignore the interest payments on corporate bonds. This undoubtedly leads us to understate the required interest expenses for bond-issuing firms and reduces our chance of finding zombies. Therefore, this approach guarantees that any firms that we label as zombies must be getting very favorable interest rates from their banks. Put differently, this strategy will pick out only the most egregious zombies.

[5] In subsequent drafts of the paper we plan to experiment with other long-term rates.

We take this approach with coupon payments because we were not confident, given the time variation in the level of interest rates, that we could reasonably impute estimated coupon payments throughout our full sample. For instance, we experimented with creating a required coupon payment using the assumption that interest payments on bonds would be lower than the prime rate by a constant amount (e.g. 50 basis points or 75 basis points). This assumption naturally produced a much higher fraction of zombies. But we feared that many of these might be misclassified, since the most creditworthy firms would be the ones that were able to primarily rely on bond financing and to issue bonds with low yields.

We see our procedure for handling interest payments on bonds as trading off two tensions. On the one hand, we need to have a minimum payment that is low enough so that the firms we find really are zombies. The procedure that we adopt is extreme in this respect, as we are necessarily going to find a lower bound on the actual number of zombies. Given that we still find lots of subsidized borrowers this does not concern us.

On the other hand, there is a risk that our imputation procedure will underestimate the interest payments for bond-issuing firms so much that we will produced a biased picture of the zombie prevalence. To check this we studied the post-1998 data where the detailed interest payment data exists. Over this period we can subtract out the bond interest payments (and commercial paper interest payments) from the total and compare $R^*_{i,t}$ to the remaining interest payments. Using this modified definition our estimates for the overall level of zombies rises substantially, with the raw percentage and asset weighted percentages hovering around 45% and 40% respectively. However, the increase in the estimates appeared to be across the board; with the relative zombie incidence across sectors (that we discuss next) being unaffected. Thus, it appears that our zombie measure is not systematically biased because of the imputation procedure.

We view the cross-sectional prevalence of zombies as another way to assess the plausibility of our definition. To conduct this assessment, we aggregated the data used in Figure 1 into five industry groups covering manufacturing, construction, real estate, retail and wholesale (other than the nine largest general trading companies), and services – recall that all the firms included here are publicly traded. The zombie index for an industry is constructed by calculating the share of total assets held by the zombie firms.

Figure 2 shows the zombie index for each industry from 1981 to 2002. We draw two main conclusions from Figure 2. First, the individual panels show that the proportion of zombie firms increased in the late 1990s in every industry. Averaging across all industries, the zombie index increased from around 3.73% (1981-1993 average) to 14.28% (1996-2002 average). The second key conclusion is that the zombie problem was more serious for non-manufacturing firms than for manufacturing firms. In manufacturing, the zombie index rose only from 2.66% (1981-1993 average) to 9.89% (1996-2002 average). In the construction industry, however, the index increased from 3.48% (1981-1993 average) to 20.08% (1996-2002 average). Similar large increases occurred for the wholesale and retail, services, and real estate industries.

There are a variety of potential explanations for these cross-sectional differences. For instance, Japanese manufacturing firms face world competition and thus are not easily protected without huge subsidies. One example of this is that many of the Japanese automakers were taken over by foreign firms during the 1990s. In contrast, there is very little foreign competition in the other four industries.

A second important factor was the nature of the shocks hitting the different sectors. For instance, the construction and real estate industries were forced to deal with the huge run-up and subsequent collapse of land prices mentioned earlier. Thus, the adjustment for these industries was likely to be more wrenching than for the other sectors.

But the most important point about the differences shown in Figure 2 is that they confirm the conventional wisdom that bank lending distortions were not equal across sectors and that the problems were less acute in manufacturing – see Sekine et al (2003) for further discussion. Thus, regardless of which explanation one favors as to why this might be the case, we view it as particularly reassuring that our zombie index confirms this conventional view.

3. A model of the effect of zombie firms on restructuring

To analyze the effect of zombies we study a very simple environment that involves entry and exit decisions of both incumbent firms and potential new firms. As benchmark we start with a normal environment where all decisions are based purely on the operating profits from running a firm. We then contrast that environment to one where incumbent firms (for an unspecified

reason) receive a subsidy that allows them to remain in business despite negative operating profits.

3.1 The Environment

The essential points of interest can be seen in a model where time is discrete (and indexed by t). A (representative) period t starts with a mass m_t of existing production units. The productivity of the incumbents varies over time and the current level of productivity for firm i in year t, y_{it}^o, is:

$$y_{it}^o = A + \in_{it}^o$$

where $\in_{it}^o$ is an idiosyncratic shock that is distributed uniformly on the unit interval. The major predictions from this model do not depend on the persistence of the productivity shocks, so we make the (simplest possible) assumption that they have no persistence.

In addition to the incumbents, there are also a set of potential entrants and we normalize their mass to be ½. The potential entrants each draw a productivity level, y_{it}^n, before deciding whether to enter or not. The productivity for i[th] potential new firm in year t is:

$$y_{it}^n = A + B + \in_{it}^n$$

with $B > 0$ and $\in_{it}^n$ distributed uniformly on the unit interval. The shock $\in_{it}^n$ is again assumed to have no persistence. These assumptions imply that on average the potential new firms will be more productive (and more profitable) than the incumbents (for one period only, then they become incumbents as well). However, we also assume that there is an entry cost, $\kappa > 0$, that they must pay to start up.

Finally, both new and old units must incur a cost $p(N_t)$ in order to produce, where N_t represents the number of production units in operation at time t, i.e., the sum of the existing units that do not exit and new entrants. The cost $p(N)$ is increasing with respect to N and captures any scarce input such as land, labor or capital, or any common output. In reduced form,

$p(N)$ describes the reduction in profits due to congestion or competition. For our purposes, all the predictions we emphasize will hold as long as $p(N)$ is a strictly increasing continuous function of N. For simplicity, we adopt the simplest linear function:

$$p(N_t) = N_t + \mu.$$

where the intercept μ is potential shift variable that captures cost changes and other profit shocks.

3.2 Decisions

This basic model will quickly generate complicated dynamics because the existing firms have paid the entry cost and thus face a different decision problem than the new firms for which the entry cost is not sunk. These dynamics are not essential for our main predictions, so we assume that $B = \kappa$. In this case, the exit decision by incumbents and the entry decision by potential entrants become fully myopic: Since productivity shocks are i.i.d. and there is no advantage from being an insider (the sunk cost of investment is exactly offset by a lower productivity), both types of units look only at current profits to decide whether to operate.

Letting $\overline{y}^o$ and $\overline{y}^n$ denote the reservation productivity of incumbents and potential entrants, respectively, we have:

$$\overline{y}^o - p(N) = 0,$$

$$\overline{y}^n - \kappa - p(N) = 0.$$

In this case it is straightforward to find the mass of exit, D_t, and entry, H_t, respectively:

$$D_t = m_t\left[1 - \int_{p(N_t)-A}^{1} di\right] = m_t(p(N_t) - A), \qquad (2)$$

$$H_t = \frac{1}{2}\int_{p(N_t)-A}^{1} di = \frac{1}{2}(1 - (p(N_t) - A)). \qquad (3)$$

Adding units created to the surviving incumbents yields the total number of units operating at time t :

$$N_t = H_t + m_t - D_t = \left(\frac{1}{2} + m_t\right)\left(1 - \left(p(N_t) - A\right)\right). \qquad (4)$$

3.3 Equilibrium and Steady State

We can now solve for the steady state of the normal version of the economy. The first step is to replace $p(N)$ with $N + \mu$ in (4). The notation is simplified if we define S to be composite shock that is equal to A-μ. Note that a lower S indicates either higher costs (higher μ) or lower average productivity (smaller A). This yields the equilibrium number of units:

$$N_t = \left(\frac{1/2 + m_t}{3/2 + m_t}\right)(1 + S). \qquad (5)$$

Given the total number of operating units, we can solve for equilibrium rates of destruction and creation by substituting (5) into (2) and (3):

$$D_t = m_t\left(\frac{1/2 + m_t - S}{3/2 + m_t}\right) \qquad (6)$$

$$H_t = \frac{1}{2}\left(\frac{1 + S}{3/2 + m_t}\right). \qquad (7)$$

The dynamics of this system are determined by:

$$m_{t+1} = N_t. \qquad (8)$$

In steady state, the mass of incumbents remains constant at $m^{ss} = N^{ss}$, which requires that creation and destruction exactly offset each other or, equivalently, that $m_t = N_t$. Using the

latter condition and (5), yields a quadratic equation for m^{ss}, which has a unique positive solution of:

$$m^{ss} = \frac{S - \frac{1}{2} + \sqrt{\left(\frac{1}{2} - S\right)^2 + 2(1+S)}}{2}$$

One can easily show that the other root is negative. For small values of *S*, we can approximate the above by:

$$m^{ss} \approx \frac{1}{2} + \frac{2}{3}S.$$

In our subsequent analysis we will assume that the economy begins in a steady state and that the initial (pre-shock) value of S, S_0, is 0. Given this normalization, the corresponding steady state will be $m_0 = N_0 = 1/2$ and $H_0 = D_0 = 1/4$.

3.4 A (permanent) Recession

We can now analyze the adjustment of the economy to a profit shock. By construction the model treats aggregate productivity shifts, changes in A, and cost shocks, changes in μ, as equivalent. So what follows does not depend on which of these occurs. We separate the discussion to distinguish between the short- and long-run impact of a decline in S from $S_0 = 0$ to $S_1 < 0$ (lower productivity or higher costs). By the "short-run" we mean for a fixed *m* = m_0 = 1/2. By the "long-run," on the other hand, we mean after *m* has adjusted to its new steady state value $m_1 = 1/2 + (2/3)S_1$.

It is easy to see from (6) and (7) that in the short-run:

$$\frac{\partial D}{\partial S} = -\frac{1}{4} = -\frac{\partial H}{\partial S}. \qquad (9)$$

That is, when S drops, creation falls and destruction rises, leading to a decline in *N* (see (4)). In other words, in a normal economy, negative profits shocks are met with both increased exit by incumbents and reduced entry of new firms.

Over time, the gap between destruction and creation reduces the number of incumbents (recall from (4) and (8) that $\Delta N=H-D$), which lowers the cost of inputs (*p(N)*) and eventually puts an end to the gap between creation and destruction caused by the negative shock.

Across steady states, we have that:

$$\frac{\partial m}{\partial S} = \frac{\partial N}{\partial S} = \frac{2}{3}.$$

The number of production units falls beyond the initial impact as time goes by and the positive gap between destruction and creation closes gradually. Note that since *N* falls less than one for one with S, the long run reduction in the input cost due to reduced competition is not enough to offset the direct effect of a lower S on creation. That is, creation falls in the long run. And since creation and destruction are equal in the long run, the initial surge in destruction is temporary and ultimately destruction also ends up falling below its pre-shock level.[6]

3.5 Zombies

Suppose now that "banks" choose to protect incumbents from the initial surge in destruction brought about by the decline in S. There are a variety of ways that this might be accomplished. We assume that the banks do this by providing just enough resources to the additional units that would have been scrapped so that they can remain in operation. With this assumption, a firm that does receive a subsidy is indifferent to exiting and operating, and thus entry and exit decisions remain myopic.

The maximum short run effect would be on impact, when the normal economy would show a spike in destruction (see 5). Under the zombie-subsidy assumption, we have that:

[6] This long run level effect is undone when creation and destruction are measured as ratios over *N*, as is often done in empirical work. However, the qualitative aspects of the short run results are preserved since in the data the flows are divided by initial employment, or a weighted average of initial and final employment.

$$D^z_{0+} = D_0 = \frac{1}{4}.$$

The post-shock destruction remains the same as the pre-shock level. The lack of adjustment on the destruction margin means that now creation must do all the adjustment:

$$N^z_{0+} = H^z_{0+} + m_0 - 1/4 = H^z_{0+} + 1/4. \qquad (10)$$

Replacing this expression into (3), we can solve out for *H*:

$$H^z_{0+} = \frac{1}{4} + \frac{S}{3},$$

This can be compared to the impact change in creation that occurs in the absence of zombies. Doing so, we see:

$$\frac{\partial H^z_{0+}}{\partial S} = \frac{1}{3} > \frac{1}{4} = \frac{\partial H_{0+}}{\partial S}.$$

That is, a decline in S has a much larger negative effect on creation in the presence of zombies. This result is a robust feature of this type of model. In particular, the same qualitative prediction would hold even if we had not suppressed the dynamics and had allowed persistence in the productivity shocks and a gap between entry costs and the productivity advantage of new firms. Intuitively, this is the case because the adverse shock causes the labor market to clear with fewer people employed. If destruction is suppressed, then the labor market clearing can only occur if job creation drops precipitously.

As Caballero and Hammour (1998, 2000) emphasize, both this "sclerosis" — the preservation of production units that would not be saved without the banks' subsidies— and the associated "scrambling" — the retention of firms that are less productive than some of those that do not enter due to the congestion caused by the zombies – are robust implications of models of creative destruction when there are contracting frictions.

Compared with a normally functioning economy, we have shown the existence of zombies softens a negative shock's impact on destruction and exacerbates its impact on creation. What is the net effect on the number of firms? It is straightforward to show:

$$\frac{\partial N_{0+}^{z}}{\partial S} = \frac{1}{3} < \frac{1}{2} = \frac{\partial N_{0+}}{\partial S}.$$

That is, in response to a negative shock, *N* falls by less if there are zombies. In other words, in the presence of zombies the reduced destruction is not fully matched by a drop in creation. This is another intuitive and robust result. Loosely speaking, this occurs because the reduction in job creation means that the marginal firm that is entering despite the zombies has high productivity. This high productivity allows the marginal entrant to operate despite the higher cost induced by (comparatively) larger *N*.

A final important prediction of the model is the existence of a gap in profitability (net of entry costs) between the marginal entrant and the marginal incumbent when there are zombies.[7] At impact, the destruction does not change, so that all the firms with idiosyncratic productivity shocks above the old threshold (1/2) remain in the industry. On the other hand, new entrants have to clear a higher threshold to compensate for the negative shock in S (which is only partially offset by the lower congestion following the negative shock). As a result, the profitability of the marginal entrant is inefficiently higher than that of the marginal incumbent. The difference is given by:

$$\left[\left(\frac{1}{2} + \frac{S_1}{3}\right) - S_1\right] - \frac{1}{2} = -\frac{2}{3}S_1 > 0.$$

In summary, the model makes two robust predictions. The first is that the presence of zombies distorts the normal creation and destruction patterns to force larger creation adjustments following shocks to costs, productivity or profits. Second, this distortion depresses productivity

[7] Note that a wedge like this one also arises when there is a credit constraint on potential entrants but not on incumbents. Instead, in our model depressed entry results from the congestion due to zombies, and the gap is due to the subsidy to incumbents. Clearly, however, if the two mechanisms coexist they would reinforce each other, as congestion would reduce the collateral value of potential entrants.

by preserving inefficient units at the expense of more productive potential entrants. Accordingly, productivity will be lower and excess capacity will be higher when there are zombies.

4. Empirical investigation

We use these two robust predictions of the model to guide our search for evidence that the zombie problem has affected Japan's economic performance significantly. In this draft we focus mostly on the cross-industry differences. In future revisions we will also use firm-level data to characterize how the behavior of the non-zombie firms has been altered by the presence of zombie competitors.

Because our zombie indices exist from 1981 onwards, we start by calculating the average zombie index for each industry from then until 1993 and compare that to the average for the late 1990s (1996-2002). We use the differences in these two averages to correct for possible biases in the level of zombie index and any industry-specific effects. In what follows, it makes little difference as to how we define the pre-zombie period. In particular, the results we show would be very similar if we took the normal (non-zombie) period to be 1981 to 1990, or 1990 to 1993. Our evidence consists of relating creation, destruction, productivity and capacity data to this change in the zombie index, in order to see if these measures are more distorted in the industries where zombie prevalence has increased the most. Our preliminary findings suggest that this is clearly the case.

Our most direct evidence on this point is in Figure 3, which plots the rate of job creation and destruction against the change in the zombie index. We use the job flow measures constructed by Genda et al. (2002) as proxies for the concepts of entry and exit in our model. The series used for our analysis include not only the job creation (destruction) at the establishments that were included in the survey in both at the beginning and at the end of the year, but also the estimated job creation (destruction) by new entrants (and the firms that exited). To control for the industry specific effects in job creation/destruction, we look at the difference between the average job creation (destruction) rate for 1996-2000 period and the average for 1991-1993 period. We are restricted to using the 1991—93 data as a control because figures of Genda et al. start only in 1991 and we stop in 2000 because that is the last year they cover.

The top of Figure 3 shows that the job destruction rate in the late 1990s increased from that in the early 1990s in every industry, as we would expect to see following an unfavorable shock to the economy.[8] More importantly, the graph shows that the increase was smaller in the industries where more zombies appeared. Thus, as we expected, the presence of zombies slows down job destruction.

The second panel of Figure 3 shows that the presence of zombies depresses job creation. Creation declined more in the industries that experienced sharper zombie growth. In manufacturing, which suffered the least from the zombie problem, job creation hardly changed from the early 1990s to the late 1990s. In sharp contrast, job creation exhibits extensive declines in non-manufacturing sectors, particularly in the construction sector.

Of course not all sectors were equally affected by the Japanese crash in asset markets and the slowdown that followed it. For example, construction, having benefited disproportionately from the boom years, probably also was hit by the largest recessionary shock during the 1990s. A large shock naturally raises job destruction and depresses job creation further. Despite this source of (for us, unobserved) heterogeneity, the general patterns we expected from job flows hold. One way of controlling for the size of the shock is by checking whether in more zombie-affected sectors, the *relative* adjustment through job creation is larger. In this metric, it is quite clear from Figure 3 that job creation has borne a much larger share of the adjustment in construction than in manufacturing.

Our evidence on productivity distortions caused by the interest rate subsidies is given in Figure 4. In the model, zombies are the low productivity units that would exit the market in the absence of help from the banks. Directly by continuing to operate, and indirectly be deterring entry of more productive firms, they bring down the average productivity of the industry. Figure 4, which plots the average growth of the total factor productivity (TFP) from 1996 to 1998 against the change in the zombie index, shows that the data are consistent with the model's

[8] Our simple model assumes that the job destruction rate stays the same even after a negative shock in a zombie industry. It is straightforward to relax this by assuming, for example, 90% of zombies are rescued by banks. None of the major results would change. The job destruction would go up after a negative shock but not as much as it would under the normal environment.

implication.[9] The TFP growth was low and negative for the industries that suffer most from zombies. This contrasts to a small but positive TFP growth in the manufacturing industry.

Finally, our model also implies that the number of units in the industry declines less after a negative shock if zombies exist. The data supporting this implication are shown in Figure 5, which depicts the changes in employment growth by industry against the change in the zombie index. The data for the employment growth come from *Tankan Survey*. The *Tankan* is a survey of corporations conducted by the Bank of Japan every quarter.[10] With the exception of construction, which as we said above was probably affected by a larger shock, the figure shows that indeed employment grows more (controlling for pre-shock growth) during the slowdown in zombie-affected industries.

We read this preliminary evidence as consistently showing that zombies are distorting industry patterns of job creation and destruction, productivity and capacity in the ways suggested by the model. While there certainly further empirical work to be done, we view this as a encouraging sign that our analysis is on the right track. We conclude by describing some further tests that would strengthen the analysis and sketching the policy implications of our view of the Japanese depression.

5. Final Remarks

Even at this early stage of our empirical work, there are a few conclusions that we can already draw. The first is that the mechanism we have highlighted compounds the problems caused by a traditional credit crunch. Recall that the reduced form profit shock that we analyze in the model subsumes a simple credit crunch. Thus, if a pure contraction in credit availability was all that was going on, the economy would be expected to behave like the normal benchmark case we analyze. It follows that the evidence we presented to support the zombie model, also shows that a pure credit crunch explanation for the recent experience is insufficient.[11]

[9] The data for TFP growth sere taken from Kimura (2002), Table 1. Kimura considers several modifications to the standard measure of TFP, but we use the TFP figures calculated under the standard assumptions of constant returns to scale, etc.

[10] The *Tankan* measure of employment growth captures employment growth only at existing firms and cannot capture the employment changes that accompany the entry or exit of firms.

[11] There are also other implications that we have not tested so far that could be further used to distinguish these two models. For instance, the zombie model explains why the firms that do enter or expand need not have high values of Tobin's Q – essentially because the zombie congestion costs lower their profitability. In contrast, a standard credit

This in turn implies that some of the policy advice that might be given for a standard credit constrained economy may not be as relevant for Japan. One key distinction is that the zombies are creating an on-going distortion that lowers job creation and industry productivity. A straightforward extension of the model makes long-run productivity growth endogenous and in this case the present value of the costs due to the suppression of restructuring generated by continuing forbearance that permits the zombies to exist, is probably much higher than just the present value of the subsidies that are keeping the zombies alive.

Properly recognizing the large costs of status quo arrangement is important, since this is the benchmark that should be used in considering alternative policies. In particular, the costs of recapitalizing the banks sufficiently so that they no longer have an incentive to evergreen may be quite expensive. But the costs of this one-time adjustment are still likely to be much lower than continued forbearance. Put differently, delaying the day of reckoning means forgoing all the benefits that would accrue in the interim from returning to normally functioning economy. These forgone benefits could be large enough to justify a very generous transition policy package to the displaced workers that would be released if the zombies were shuttered.

Drawing any further conclusions requires us to enrich the model to explicitly consider the banks and their incentives. Our preliminary work on this extension adds banks with potentially binding capital-adequacy constraints to the model developed in section 3. When the capital constraints are not binding, the model behaves as in the standard (normal) case, while when the constraint is binding the banks have an incentive to evergreen.[12] More importantly, when the capital-adequacy constraints are binding the enriched model exhibits hysteresis: if the shock S that caused the initial contraction disappears, the economy recovers only slowly, as the congestion effect is only gradually undone. This is in sharp contrast with the zombie-less economy, where the recovery begins immediately when the recessionary shock vanishes.

The next revision of this paper will include an analysis of this extended model and a more complete analysis of firm-level data. The additional empirical work will allow us to further pinpoint the congestion effects of the zombies by showing how their presence has altered the behavior of non-zombie firms.

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crunch model would predict that these firms should be earning rents by virtue of being able to operate against reduced competition.

[12] Hosono and Sakuragawa (2003) and Sakuragawa (2002, Chapter 5) also develop models that suggests the capital ratio regulation increases the incentive for banks to evergreen. However, they do not model the link between ever-greening and economic growth.

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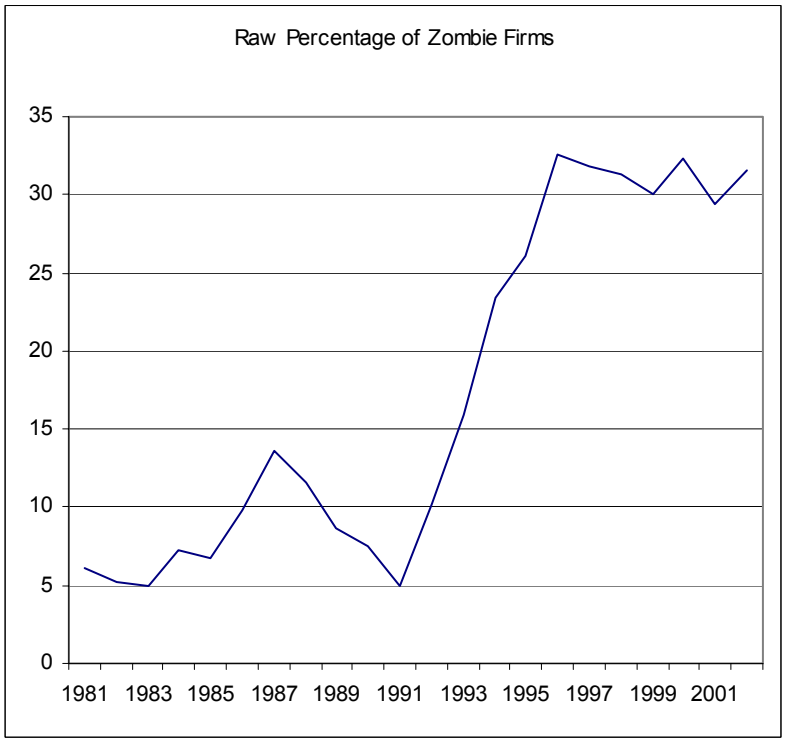
Figure 1: Prevalence of Firms Receiving Subsidized Loans in Japan



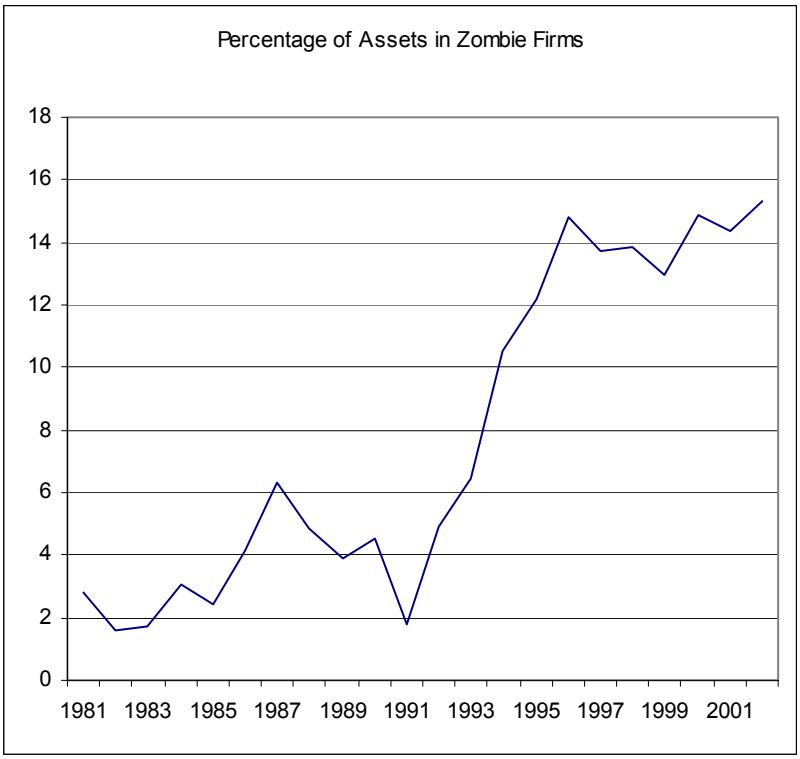
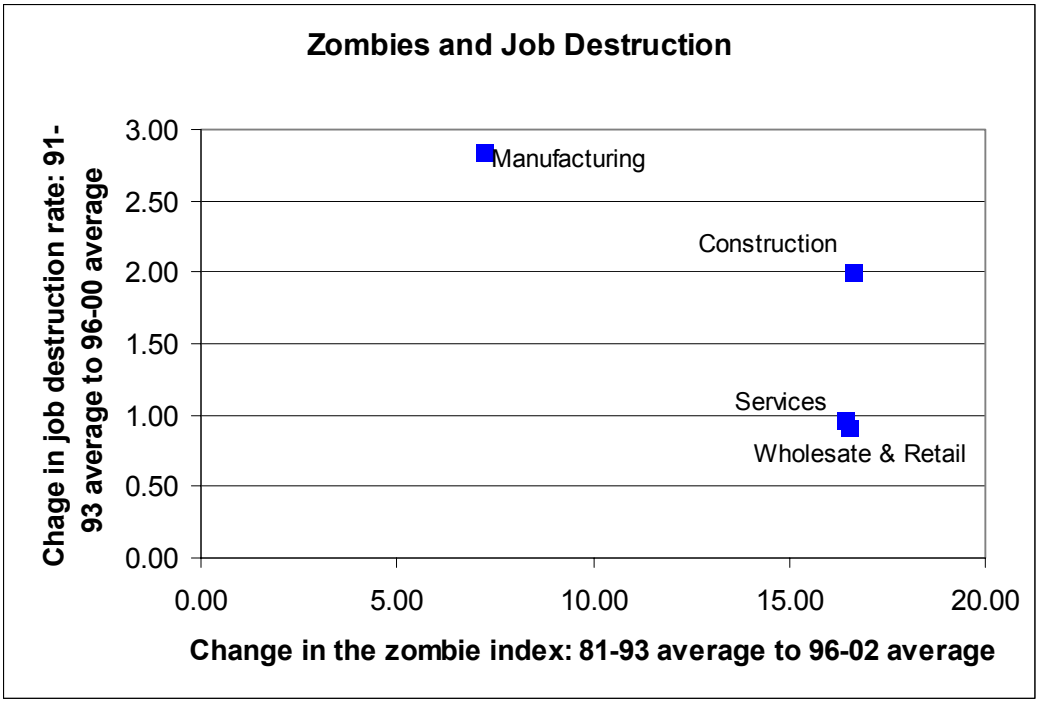


Figure 2: Incidence of Zombies Across Industries

Figure 3. Zombie firms and job flows



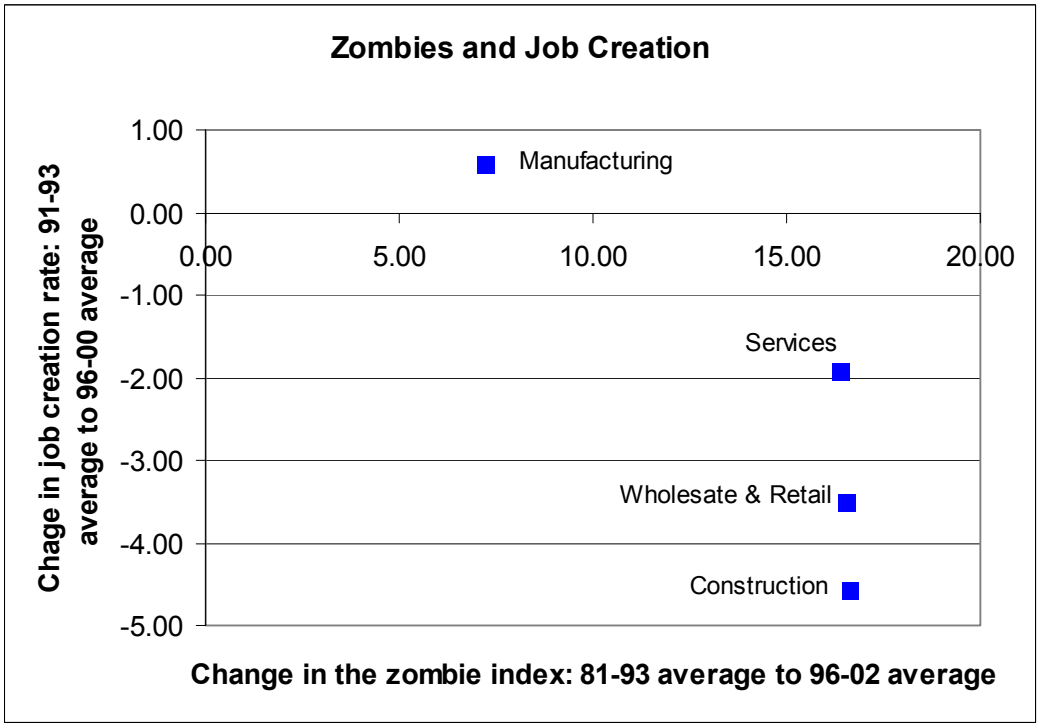


Figure 4. Zombies and productivity growth

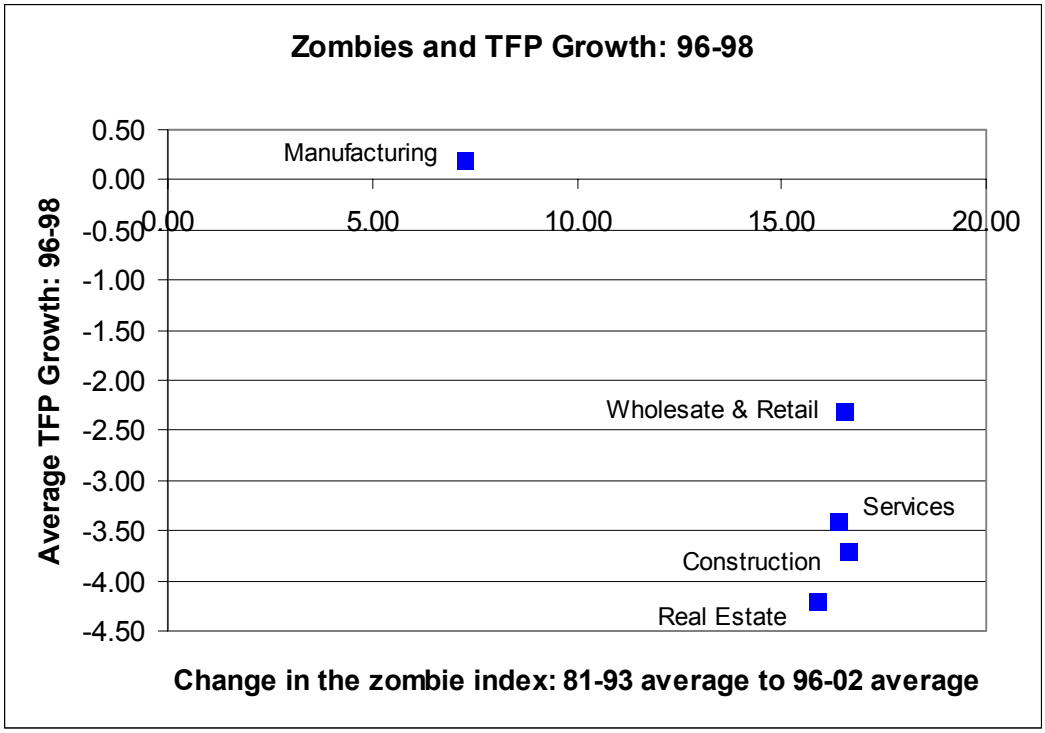


Figure 5. Zombies and over-capacity