Working Papers

FEDERAL RESERVE BANK OF BOSTON™

No. 16-22

Lending to Unhealthy Firms in Japan during the Lost Decade: Distinguishing between Technical and Financial Health

Suparna Chakraborty and Joe Peek

Abstract:
We investigate the misallocation of credit in Japan associated with banks' evergreening loans, distinguishing between two types of firm distress: (perhaps temporary) financial distress and technical distress, which reflects weak operational capabilities, as indicated by low total factor productivity. We show that previous evidence related to firms' financial health is problematic due to the mixing of loan-demand and loan-supply effects. Using a direct measure of operational health, we provide unambiguous, direct evidence of evergreening behavior, as well as confirming evidence based on the relative impacts on subsequent firm viability of loans by bank types with different incentives to evergreen loans.

Keywords: total factor productivity, bank lending, Japan, zombie firms, financial crisis
JEL Classifications: G21, E44, E51

Suparna Chakraborty is an associate professor of economics at the University of San Francisco. Joe Peek is a vice president and economist at the Federal Reserve Bank of Boston and a research associate at the Columbia University Center on Japanese Economy and Business. Their email addresses are, respectively, schakraborty2@usfca.edu, and joe.peek@bos.frb.org.

Our particular thanks to Takeo Hoshi, Mary Amiti, Jozef Konings, Amil Petrin, Mariana Spatareanu, and Kirk White for their many inputs and kindness in sharing their codes and/or data. We also thank William Greene, Anil Kashyap, and David Weinstein for their helpful suggestions. Comments from participants at the NBER Japan Project Workshop and the Stanford Summer Juku, as well as numerous other seminars and conferences are gratefully acknowledged. We also thank Jeremy Wilson, Shivprasad Gunjal, and Sunayan Acharya for excellent research assistance.

This version: December 2016

I. Introduction

The bursting of the stock market and real estate bubbles of the 1980s was a severe shock that dramatically changed the performance of the Japanese economy and the functioning of its banking system. The post-bubble period has been characterized as a prolonged period of economic malaise in Japan, commonly known as the "Lost Decade," although it extended well beyond the conventionally defined 10 years. Being a bank-centered economy, Japan's overall economy is extremely responsive to the behavior of the nation's banks through their effect on the performance of Japanese firms. The conventional wisdom appears to be that Japanese banks were "evergreening" loans (for example, Peek and Rosengren 2005; Caballero, Hoshi, and Kashyap 2008), narrowly defined as extending additional credit to enable unhealthy firms to continue making interest payments on existing loans, but more generally to enable an otherwise-insolvent firm to meet its expenses to avoid default. Among the various explanations provided for such bank behavior are bank responsibilities emanating from historical bank-firm keiretsu or main-bank relationships, government pressure on banks to help avoid firm bankruptcies, and the perverse incentives faced by troubled banks to delay their unhealthy borrowers' bankruptcy, which would, in turn, damage the banks' own balance sheets.[1] Because increasing loans to nonviable firms would contribute to a misallocation of credit, the extent to which evergreening occurred is important, insofar as it could account for much of the depth of the malaise and the protracted length of the Lost Decade.

This study takes a closer look at the evergreening behavior of the Lost Decade. We make three contributions. First, we distinguish between the financial health and technical health of firms to better identify evergreening behavior toward nonviable firms. We use a direct measure of technical health, total factor productivity (TFP), as a proxy for firm viability rather than an indirect measure, such as the subsidized credit measure of Caballero, Hoshi, and Kashyap

[1] A Japanese keiretsu is a grouping of firms based on historical associations, cross-shareholdings, and other linkages. In a keiretsu, each firm maintains its operational independence while retaining very close commercial relationships with other firms in the group. Here, we focus on horizontal keiretsu, which tend to be centered on a major bank and include firms in many industries. Japan is also characterized by a main-bank system, whereby firms have a special relationship with their main bank, and a main bank has special responsibilities to its firms. A firm's main bank typically has the largest volume of loans outstanding to the firm, with cross-shareholdings and interlocking boards being common.

(2008). Second, we distinguish among types of lenders based on the strength of their incentives to undertake evergreening behavior. Third, we consider not only the relative volume of lending by these lender types to healthy versus unhealthy firms, but we investigate differences in the extent to which loans from these alternative sources were prudent based on how the loans were used by technically healthy (viable) and unhealthy (less-viable) firms. That is, were the loans associated with enhanced or inhibited subsequent productivity of the firms?

While the existing literature has, for the most part, interpreted the evidence as providing strong confirmation of evergreening behavior by Japanese banks, this evidence has been produced primarily in the context of firms' financial health, by being based on measures related to a firm's balance sheet and income statement rather than on measures of a firm's underlying technological efficiency (for example, see Peek and Rosengren 2005). However, because in many cases weak balance-sheet and income measures are associated with increased loan demand to address a shortfall in a firm's cash flow or liquidity, the observed increase in bank lending to financially distressed firms may reflect stronger loan demand rather than increased loan supply. Moreover, it is entirely plausible that some firms classified as unhealthy, or even as nonviable zombies, may have been financially distressed but operationally viable. Insofar as increased loans to these relatively productive firms enabled them to invest in new capacity or to restructure in a way that enhanced their efficiency, the additional lending should not necessarily be classified as a misallocation of credit.

Deviating from the past literature, we distinguish between two types of distress: *financial distress* and *technical distress*. A financially distressed firm is identified as one that performs poorly (relative to firms in its industry) on key financial measures, such as the return on assets (ROA). We also consider the "distressed" firm definition of Hoshi, Kashyap, and Scharfstein (1990) and the "zombie" firm classification of Caballero, Hoshi, and Kashyap (2008). A technically distressed firm is one that performs poorly operationally (relative to firms in its industry), measured here by the firm's total factor productivity. An operationally efficient firm could, at the same time, be financially distressed. This financial stress might be temporary or more permanent and could be related to such factors as a shift in the relative prices of inputs, technological innovations, or shifts in the demand for its products. Insofar as the firm faces a temporary liquidity crunch that can be alleviated by additional credit, some of which can be used for such things as restructuring its operations as well as net investment, additional loans could improve subsequent firm performance. Thus, bank lending to financially distressed but economically viable firms may have beneficial effects. On the other hand, additional loans to a firm that is not fundamentally sound could represent a misallocation of credit by allowing the firm to merely cover ongoing financial losses, lessening the pressure on management to either make the structural changes needed to become a viable firm or file for bankruptcy (or try to be acquired) to bring to an end its existence as a nonviable firm.

In this study, we use a panel dataset that matches individual-firm borrowers with individual-bank lenders to investigate the extent of evergreening in Japan during the 1990s. Because we need a measure of technical distress, our sample is limited to manufacturing firms for which TFP can be calculated at the individual-firm level. However, as Caballero, Hoshi, and Kashyap (2008) note, manufacturing is the industry likely to be least affected by the presence of zombie firms, providing a high hurdle for finding evidence of evergreening behavior by banks. Still, our comparisons across manufacturing firms do show substantial variation in both technical and financial health.

A number of possible explanations exist for the differential treatment of firms by lenders. Thus, distinguishing among bank types based on the strength of their incentives to lend to nonviable firms can provide an additional path for isolating evergreening behavior. While government pressure likely provided a general incentive for all banks to evergreen loans, one might reasonably expect the pressure to have been greater on main banks than on secondary banks. Long-term bank-firm relationships represent a second source of incentives for evergreening loans to aid an unhealthy firm, with the incentives being greater for main banks than for secondary banks, and for banks in the same keiretsu as the firm than for banks not in the same keiretsu. A third source of incentives arises from the health of a firm's main bank. Given the large exposure of a main bank to the firm, if the main bank itself is also unhealthy, then the default or bankruptcy of the troubled firm could push the bank's capital ratio below the minimum regulatory requirements. Thus, secondary banks would have the least incentive to evergreen loans, basing their lending behavior primarily on the expected return: a business decision. Healthy main banks would be next, followed by unhealthy main banks, with keiretsu relationships adding another layer of incentives to both healthy and unhealthy main banks.

An additional consideration investigated here is that banks may have been more willing to provide credit to financially distressed firms if the firm's underlying, long-term technical health was strong, in which case the additional lending would not be considered evergreening to prevent firm failure. Thus, the first step is to separate the roles played by financial distress and technical distress in determining which firms received additional bank credit. A second step is to investigate the extent to which, and the mechanism through which, receiving additional loans contributed to an improvement in the recipient firm's operational performance. In particular, we investigate whether the effect of financing was simply an increase in net investment or whether there were any additional channels through which increased credit enhanced subsequent TFP.

Based on balance-sheet and income measures, such as ROA, we find that firms were more likely to obtain increased loans the more financially distressed they were, not only in the Lost Decade of the 1990s, but to a similar extent even during the boom period of the 1980s. This result suggests that previous findings of increased bank lending to firms that were more financially distressed may have been misinterpreted as evidence of widespread evergreening of loans when, in fact, such increased lending may have, in large part, reflected increased loan demand due to larger cash-flow shortfalls by firms as they became more financially distressed. Therefore, to identify clearly the extent to which banks misallocated credit to nonviable firms, it is important to distinguish between financial distress and technical distress. We find that firms that were operationally healthy were more likely to obtain increased loans, especially during the crisis years of the 1990s, when the underlying health of the firms became a more important determinant of bank lending, perhaps because of the increase in firm bankruptcies (Hoshi and Kashyap 2001; Hamao, Mei, and Xu 2007). That is, during the boom period of the 1980s, banks may not have distinguished carefully among listed firms using credit-risk analysis because default risk was minimal, unlike in the post-bubble-period experience of the 1990s, when large firms did fail and default on loans.

We base our analysis of firm financial health on two alternative measures of unhealthy firms that have been used in the literature, both of which are based on a firm's interest expense and use Japanese data: (1) financially distressed firms, based on Hoshi, Kashyap, and Scharfstein (1990), and (2) zombie firms, based on Caballero, Hoshi, and Kashyap (2008). A firm is identified as financially distressed if its operating income is less than its interest payments for two consecutive periods following a period with operating income greater than interest payments. A firm is defined as a zombie if its interest gap (the difference between its actual interest payments and a hypothetical lower bound for interest payments for the highest-quality borrowers for that year) is negative. Zombie firms are taken to be nonviable firms, based on receiving subsidized credit.

In contrast to the pure evergreening story, banks do appear to distinguish clearly between operationally viable and nonviable firms, with secondary banks and healthy main banks tending to increase loans to technically healthy firms, while unhealthy main banks tend to increase loans to technically unhealthy firms. This latter behavior, along with evidence that bank-firm relationships matter, provides strong evidence that evergreening behavior by unhealthy Japanese main banks did occur.

This evidence is reinforced when we distinguish between subsets of financially healthy and unhealthy firms. Whether measuring firm financial health by financial distress or by "zombiness," higher TFP is associated with increases in both main-bank and secondary-bank loans to financially healthy firms, but not to unhealthy firms, with an additional positive effect if the firm's main bank is healthy, whether or not the recipient firm is financially healthy. In addition, healthy main banks increase loans to financially healthy firms, while unhealthy main banks increase loans to distressed and zombie firms. Moreover, main banks increase loans to distressed and zombie firms that are in the same keiretsu as their main bank, confirming the important role of bank-firm relationships. Interestingly, while lower ROA or working capital is associated with increased loans regardless of whether the firm is financially healthy, increased bank loans are inversely related to the change in both ROA and working capital for financially healthy firms, but not for financially distressed or zombie firms. This finding is consistent with banks' being willing to provide loans to financially healthy firms that experience a (perhaps temporary) decline in liquidity or cash flows.

To further investigate the extent to which credit may have been misallocated, we focus on the contributions of increased credit to subsequent improvements in TFP, distinguishing between technically healthy and technically unhealthy firms, and between financially healthy and financially unhealthy firms. We find that both technically healthy and financially healthy firms make much better use of increased credit than unhealthy firms do, and so do firms with healthy main banks relative to firms with unhealthy main banks. Strikingly, increases in loans from unhealthy main banks to unhealthy firms tend to decrease subsequent TFP, consistent with such loans being misallocated to firms that misuse the increased credit to cover operating expenses rather than to increase net investment or undertake beneficial restructuring of operations. Interestingly, while the mechanism operates through net investment as one might expect, for healthy firms increases in credit appear to operate through one or more additional channels even after controlling for net investment. Such evidence suggests that the misallocation of credit in Japan during the 1990s may not have been as widespread as imagined, although it still points to substantial evergreening of loans by unhealthy banks to unhealthy firms, even taking into account the confounding of loan-demand effects with loan-supply effects in earlier studies.

The remainder of the paper is organized as follows. The next section provides some background for the relevant issues addressed in this study. Section III describes the data used and the method for calculating total factor productivity. Section IV provides details of our empirical specification and estimation strategy. Section V presents the empirical results, and Section VI concludes.

II. Background

While most firms rely on credit to finance their operations, this credit may be obtained directly from credit markets, through commercial paper and bond issuance, through financial intermediaries in the form of loans, or from some combination, at least for firms that are large enough and transparent enough to have direct access to credit markets. Although bond markets began to be deregulated in Japan in the 1980s, Japan remains one of the countries that is typically considered to have a bank-centered, rather than a market-centered, economy. Hence, Japanese firms tend to rely relatively heavily on intermediated credit, with most of that credit being provided by banks. Thus, the way that banks allocate credit to firms and the extent to which that credit is used by the firms to improve or expand their operations are extremely important issues for the performance of the Japanese economy.

One motivation for providing bank credit, especially when firms are under financial stress, was investigated by Hoshi, Kashyap, and Scharfstein (1990) even before the Lost Decade episode. They investigated the role of lender-borrower relationships (main-bank and keiretsu) in Japan in reducing the costs of financial distress. Their measure of financial distress is based on the coverage ratio, the ratio of operating income to interest payments. A firm is financially distressed if it has a coverage ratio greater than one, followed by two years with a coverage ratio less than one, with the date when the firm enters financial distress specified as the second year with operating income less than interest payments. They find that financially distressed firms that have close relationships with their keiretsu group or strong bank ties subsequently perform better, in terms of investing more and selling more, than nongroup firms or firms without strong bank ties. One explanation for this is that such close ties mitigate asymmetric information problems, so lenders can identify which troubled firms remain viable and can renegotiate loans more easily. Thus, this explanation for the availability of bank credit to financially distressed firms is less sinister than more-recent characterizations wherein the support provided by banks to troubled firms may be a result of loyalty or commitment to the troubled firms based on their close bank-firm relationship rather than reflecting the banks' assessment of the prospects or ultimate viability of the firm. In this latter case, bank lending to financially distressed firms based on relationships rather than credit risk analysis would have contributed to the misallocation of credit and the evergreening of loans that many believe characterized Japanese bank behavior during the Lost Decade.

Substantial evidence exists that Japanese banks continued to make additional loans to severely distressed firms following the bursting of the stock market and real estate bubbles at the beginning of the 1990s, even as both the banking sector and the economy were in crisis. For example, Sekine, Kobayashi, and Saita (2003), Peek and Rosengren (2005), Ahearne and Shinada (2005), and Caballero, Hoshi, and Kashyap (2008) all find that bank credit was allocated to relatively (financially) unhealthy firms during this period, suggesting that the banking system misallocated credit. Moreover, this misallocation of bank credit is likely to have contributed to the persistence of the economic malaise experienced by the Japanese economy, insofar as additional bank credit provided to distressed firms reduced the pressure on those firms to restructure their operations and/or poisoned the economic recovery by allowing nonviable firms to live beyond their expiration date.

In particular, the conventional view is that banks were more likely to increase loans to the weakest firms, with the effect being even stronger the weaker was the bank's health. Peek and Rosengren (2005) attribute this behavior in large part to the perverse incentives faced by troubled banks to continue allocating credit to many of their weakest borrowers in order to avoid "mutually assured destruction." Because the reported capital ratios of troubled banks were already barely above the regulatory minimums, the banks wanted to avoid reporting further increases in nonperforming loans that would have required them to write off, at least in part, existing loans and add to their loan loss reserves, actions that would have reduced their reported capital ratios. One mechanism that would have enabled troubled borrowers to avoid, or least delay, declaring bankruptcy and hence would have enabled the lending banks to avoid writing off the troubled loans is the evergreening of loans.

Of course, evergreening requires bank regulators to be complicit in allowing such bank behavior, by permitting banks to overstate their capital and understate their problem loans, in part to avoid the high costs that would be associated with widespread bank failures and the massive increase in unemployment that would ensue if many large firms fell into bankruptcy. In fact, using aggregate data, Hosono and Sakuragawa (2003) argue that the discretionary enforcement of minimum capital requirements by bank supervisors was a key determinant of forbearance lending by Japanese banks. In addition, Peek and Rosengren (2005) cite claims that during the crisis, 75 percent of the loans made by the Japanese banks that declared bankruptcy were classified as sound or only in need of monitoring. Moreover, Tett and Ibison (2001) find that almost half of the amount of early injections of public capital into the Japanese banking system was passed on to construction firms, many of which were insolvent due to the sharp declines in real estate prices, suggesting widespread evergreening behavior by banks.

Using data on loans from individual banks to individual firms, Peek and Rosengren (2005) provide direct evidence of evergreening behavior by Japanese banks. They identify firms in financial distress using two measures based on firm balance sheets and income statements, ROA and working capital, as well as a third measure based on the stock market's (relative) perception of firm health. They find that troubled banks with reported capital ratios close to the required minimum value were more likely to increase loans to their weakest borrowers. They also find that banks were more likely to increase loans to a weak firm if the bank was in the same keiretsu as the firm. Moreover, focusing on the debt-to-asset ratio, another measure based on a firm's balance sheet, Sekine, Kobayashi, and Saita (2003) find similar evidence of forbearance lending to nonmanufacturing firms, especially in particularly troubled industries such as real estate and construction, adversely impacting bank profitability. While the extensive misallocation of credit may have prevented widespread bankruptcies of Japanese firms, it also likely impaired the creative destruction that would have contributed to the restructuring of troubled firms and the reallocation of resources to more productive uses necessary for the Japanese economy to have a sustained recovery.

However, a problem with interpreting results that indicate increased bank lending to unhealthy firms as evergreening behavior by banks based on measures of financial distress constructed from a firm's balance sheet and income statement is that the increased lending may primarily reflect increased loan demand by the firms. For example, if a firm suffers a decline in its income (return on assets), the reduced cash flow may increase the need for the firm to borrow funds to be able to continue its operations unimpeded. Similarly, a reduced volume of working capital could signal an increased need for funds to rebuild the firm's liquidity position. To the extent that banks respond to this resulting increase in loan demand by increasing loans to the firm, we would observe a negative correlation between increased loans to the firm and its working capital or ROA, even if banks had not shifted their credit-supply curve. Thus, it is important to control for a firm's health with a measure that is not likely to also be driving the firm's short-term demand for credit.

Caballero, Hoshi, and Kashyap (2008, henceforth CHK) take a different approach for identifying severely distressed firms (otherwise-insolvent borrowers), focusing on the average interest rates paid by firms. The idea is that one way for banks to support such nonviable (zombie) firms is to provide them with subsidized interest rates on their loans. Thus, these authors identify zombie firms as those firms obtaining loans at a subsidized interest rate. The extent of the subsidization is based on the difference between the firm's actual interest payments and a hypothesized lower bound for interest payments based on the interest rate charged to the highest-quality firms. A zombie firm is then identified as a firm with interest payments below this hypothesized lower bound. However, the receipt of subsidized loans is an indirect rather than a direct measure (such as TFP) of a nonviable firm.

After measuring the prevalence of zombie firms, CHK focus on how this forbearance lending to otherwise-insolvent borrowers interfered with the restructuring of troubled firms necessary for the recovery of the Japanese economy. Not only did this forbearance lending allow zombie firms to continue to operate, but their continued operations had an adverse effect across several dimensions, including distorting competition, deterring entry of new competitors, and discouraging non-zombie firms from investing due to their reduced profitability from being forced to compete with zombie firms. CHK's results also highlight the decline in the average TFP of industries that had a higher concentration of zombie firms, both because zombie firms have lower TFP and because they create barriers to entry for newer, more-productive firms. In fact, Ahearne and Shinada (2005) find similar evidence that industries with a concentration of zombie firms tended to have lower productivity growth rates, in part because forbearance lending aided weak firms at the expense of the more-productive firms in those industries, restraining the ability of the more-productive firms to gain market share at the expense of the least-productive firms.

While the evidence does appear to be consistent with Japanese banks' evergreening loans to financially distressed firms, the extent to which credit was being misallocated is not as clear. The existing literature tends not to explore the link between banks' providing additional loans to a firm and the longer-term viability of the firm, based on a measure of operational efficiency, such as firm-level productivity. It is entirely plausible that some firms classified as financially distressed might still be operationally viable, with additional lending to these firms having beneficial effects by enabling these firms to survive a short-term adverse shock or to undertake needed restructuring.

In addition to distinguishing between financially and technically distressed firms in order to better understand the extent to which credit was misallocated in Japan during the Lost Decade, it is also useful to take the further step of determining the characteristics of those firms that used the additional loans to improve their operational efficiency and to determine whether the effectiveness of the use of the loans is associated with the loans' source; for example, whether the loans were from healthy main banks, unhealthy main banks, or secondary banks. Amiti and Weinstein (forthcoming), for example, find that bank loan-supply shocks have substantial effects on firm investment.

In sum, to the extent that viable firms use additional loans in a productive manner, while nonviable firms use the additional funding merely to cover current expenses in an effort to delay bankruptcy, conclusions about the extent to which credit was misallocated in Japan require distinguishing between financially distressed, but technically viable, firms and nonviable firms. Similarly, loans from unhealthy main banks are much more likely to be associated with evergreening behavior, and thus less likely to be used to increase operational efficiency, while healthy main banks have less incentive to make such loans, although they may still make unproductive loans based on historical bank-firm relationships. On the other hand, secondary banks, having weaker historical relationships with the firms, are more likely to make loans to firms solely as a business decision based on analysis of the credit risk.

III. Data

Our empirical analysis relies on a number of data sources. The two main sources are the Development Bank of Japan (DBJ) and the Nikkei NEEDS Bank Loan Database (NEEDS). The DBJ provides detailed, annual, balance-sheet and income-statement information (consolidated as well as unconsolidated), as well as information on the firms' outputs and inputs. We use the unconsolidated data for our analysis. We restrict our sample to manufacturing firms for which total factor productivity is well defined. NEEDS contains loans outstanding to individual firms from individual lenders, including loans from banks, government institutions, and other financial institutions. This database is merged with the DBJ data using the unique Tokyo Stock Exchange (TSE) code, restricting our sample to publicly listed firms with a TSE code. These firms are reclassified from the DBJ industries to match the industry classifications provided in the Japanese Industrial Productivity (JIP) database, compiled by the Research Institute of Economy, Trade and Industry and Hitotsubashi University, in order to use the industry-specific price deflators from the EUKLEMS Growth and Productivity database to transform the nominal DBJ values into real terms.

A further complication is that fiscal years of Japanese firms are spread throughout the calendar year. While more than 90 percent of the firms in our sample have a March fiscal year-end, the remaining firms have fiscal years that end in other months. To form our annual observation database for the regression analysis, we must allocate each firm observation into one of the regression years. Because so few Japanese firms end their fiscal years in the summer, we formed our regression-year observations by splitting the firms between June and July fiscal year-ends. For example, regression-year 1994 contains the firm observations with fiscal years ending from July 1994 through June 1995. Because some firms changed their fiscal year-end during our sample period, we include only those fiscal-year observations that contain a full 12 months, to avoid data distortions associated with such changes.

Because of the strong bank-firm relationships in Japan that influence the availability of loans to firms, we identify a main bank for each firm. Using information in the NEEDS database, we designate the bank with the largest volume of loans outstanding to the firm in each fiscal year as the main bank. Because the identity of the main bank can potentially shift from year to year as loans mature and new loans are originated, we then smooth the main-bank series for each firm by requiring that a firm's main bank change only when another bank exceeds the volume of loans outstanding to the firm by the current main bank by at least 10 percent.

Because credit availability may depend on bank health, we control for main-bank health using the bank's market-to-book ratio, based on market values from the Nikkei Financial

Database. We do not rely on bank balance-sheet information, such as capital ratios or nonperforming-loan ratios, because of the widespread (and well-known) forbearance practiced by bank regulators during this period that allowed banks to substantially overstate their capital and understate their problem loans. Finally, to control for group affiliations, we use horizontal keiretsu groupings from the Industrial Groupings of Japan.

We restrict our sample period to regression years 1984 to 1989, prior to the bursting of the stock market and real estate bubbles, referred to as the boom years, and the post-bubble years from 1993 to 2000. We end our sample period in 2000 because of the major consolidation of the banking sector, and we omit the transition period from 1990 through 1992, immediately following the bursting of the bubbles.[2]

We omit observations with missing values and eliminate observations with extreme values (outliers) for any of our variables. Extreme values are defined as values that are more than four standard deviations away from the mean value of that variable for firms in the same industry and for the same year. Outlier observations are identified in this way rather than for the overall sample to avoid disproportionately omitting observations in specific industries that tend to perform much better or worse than firms in other industries and to avoid disproportionately omitting observations in specific years tied to the business cycle when economic performance is particularly good or bad. Our final sample includes 9,953 observations from 1,008 manufacturing firms, spanning 27 manufacturing industries.

Measurement of TFP

Total factor productivity plays a key role in our analysis. Therefore, it is important to use state-of-the-art techniques for computing firm-level TFP. We assume that every industry operates according to a Cobb-Douglas production function using capital, labor, and materials as its inputs. TFP is then measured as the residual of output adjusting for the share of capital, labor, and material inputs.

The production function is of the standard form:

$$Y_{i,j,t} = A_{i,j,t}\left(K_{i,j,t}^{\beta_j^k}\right)\left(L_{i,j,t}^{\beta_j^l}\right)\left(M_{i,j,t}^{\beta_j^m}\right), \tag{1}$$

[2] Our results are robust to omitting only 1990 through 1991 as the transition years.

where $Y_{i,j,t}$, representing the output of firm *i* belonging to industry *j* at time *t*, is a function of the firm's capital stock, $K_{i,j,t}$, labor, $L_{i,j,t}$, and material inputs, $M_{i,j,t}$. β_j^k , $\beta_{j,}^l$and β_j^m are the industry-specific parameters of the production function and denote the shares of capital, labor, and materials in output. These parameters are constant across time for each industry, but differ across industries. The $A_{i,j,t}$ terms measure total factor productivity, often referred to as the Solow residual.

Expressing equation (1) in logarithms yields a linear relationship between output and inputs:

$$\log(Y_{i,j,t}) = \log(A_{i,j,t}) + \beta_j^k \log(K_{i,j,t}) + \beta_j^l \log(L_{i,j,t}) + \beta_j^m \log(M_{i,j,t}). \quad (2)$$

Given the linear equation above and using regression analysis to estimate the coefficients on inputs, the logarithm of TFP is calculated as the residual of output after accounting for the shares of capital, labor, and material inputs:

$$\log(A_{i,j,t}) = \log(Y_{i,j,t}) - \hat{\beta}_j^k \log(K_{i,j,t}) - \hat{\beta}_j^l \log(L_{i,j,t}) - \hat{\beta}_j^m \log(M_{i,j,t}), \quad (3)$$

where $\hat{\beta}_j^k$, $\hat{\beta}_j^l$, and $\hat{\beta}_j^m$ are estimated using regression techniques. The measurement of the production function parameters is not trivial because standard ordinary least squares (OLS) techniques yield biased estimates owing to possible correlation between inputs and predicted shocks to TFP (for a full discussion, see Marschak and Andrews 1974, Olley and Pakes (OP) 1996, and Levinsohn and Petrin (LP) 2003). Two commonly accepted solutions to the simultaneity bias plaguing OLS techniques have been provided by Olley and Pakes (1996) and Levinsohn and Petrin (2003), who suggest using investment (OP) or material inputs (LP) as proxies for predictable productivity shocks. While the simultaneity bias is resolved in the canonical OP or LP estimator, they both still suffer from some collinearity problems (see Ackerberg, Caves, and Frazer (ACF) 2006 for a discussion). In this study, we use the modification of the LP technique suggested by Wooldridge (2009), popularly referred to as the Wooldridge-Levinsohn-Petrin method (WLP, see Petrin, White, and Reiter 2011), which allows for better measurement of TFP by further correcting the collinearity issues of the LP method.

Because the calculation of firm-level TFP relies on estimating production functions at the industry level, we combine smaller industries with similar products and require that an industry have at least 10 firms on average during our sample period to ensure that there are enough observations per industry to conduct the WLP procedure. The production functions, in logarithmic form, are estimated over the period 1980 through 2003 for a set of 27 manufacturing industries included in our final sample.

The Wooldridge (2009) correction can be applied to the LP technique both for the "output" approach, where TFP is the residual of output after adjusting for the shares of capital, labor, and materials, and the "value-added" approach, where we first define value-added as output adjusted for the cost of material inputs and then define TFP as the residual share of value-added after adjusting for the shares of capital and labor. While both approaches have been applied in the literature (for example, Javorcik (2004) and Javorcik and Spatareanu (2011) use the output approach, and Petrin, White, and Rieter (2011) use the value-added approach), we follow the suggestions of ACF (2006) and Petrin, White, and Reiter (2011), applying the WLP method to the 27 industry-specific, value-added, production functions, where equation (2) is modified to the value-added (VA) form:

$$\log(VA_{i,j,t}) = \log(A_{i,j,t}) + \beta_j^k \log\left(K_{i,j,t}\right) + \beta_j^l \log\left(L_{i,j,t}\right), \qquad (4)$$

where value-added is defined as output minus intermediate inputs, and output is measured as a firm's gross sales adjusted for the change in finished goods, half-finished goods, and work in progress. Intermediate inputs are measured as material costs adjusted for changes in raw materials.[3] The capital stock is measured as the firm's tangible fixed assets. Value-added, capital-stock, and intermediate-inputs data are in nominal terms (the unit of measurement is 10,000 yen), which are then converted to real terms (1995 base year), using industry-specific price deflators obtained from the EUKLEMS Growth and Productivity database.

The remaining variable, labor, is measured as man-hours (employment multiplied by the average number of hours worked per employee). We take the average of employment at the end of periods *t* and (*t*-1) as the measure of a firm's employees during period *t*. One drawback, not unique to our study, is the paucity of coverage for the average number of hours worked by

[3] A more-precise estimation of intermediate inputs would also adjust material costs by including electric, water, gas, and power expenses in addition to raw materials. However, for many of the firms in our sample, these variables are missing. Consequently, we choose not to include utilities in our calculation of intermediate inputs.

employees at the firm level. The literature has largely handled this issue by ignoring hours and instead measuring labor input more simply as the number of employees (see, for example, Amiti and Konings (2007), Javorcik (2004), and Javorcik and Spatareanu (2011)). Instead, we choose to include the industry-specific averages of hours worked by employees as our measure of hours and multiply average hours by the firm-specific employment data to obtain an approximate measure of labor hours. Second, and more importantly, while average industry-specific hours are the same across all firms belonging to a given industry (thus, not capturing any firm-level heterogeneity that might exist in the number of hours worked per employee), they do vary over time. This variation might have a non-trivial effect on the measurement of the parameters of the production function.

Applying the WLP (Wooldridge 2009) technique to equation (4), we estimate the parameters $\hat{\beta}_j^k$ and $\hat{\beta}_j^l$ of the value-added production process, which are then used to calculate the shares of capital and labor in value-added. Once we obtain the estimated shares, we subtract the shares of capital and labor from value-added to obtain our estimate of the log of TFP that is used in our analysis as a proxy for the technical health of a firm.[4]

IV. Specification

Evergreening refers to the loan-supply behavior of banks based on the health of the borrowers, as well as possibly the health of the lenders. Consequently, measures of both firm health and bank health are required. In addition, the estimation faces the standard problem of controlling for shifts in a firm's demand for credit.

We conduct our investigation in two steps. The first concerns the determinants of a firm's obtaining additional loans, concentrating on both firm and bank characteristics, while controlling for the general macroeconomic environment. The focus is on the distinction between firm financial health and firm technical health as factors determining the magnitude of any increase in loans obtained by a firm. We focus on a firm's obtaining an increase in loans outstanding compared with the prior year because to do so a firm must request additional loans and be granted additional loans by its potential lender(s). On the other hand, ambiguity

[4] Interested readers can obtain the estimated parameters from the authors.

surrounds situations when loans outstanding to a firm are unchanged or decline from the prior year's amount. If loans are unchanged, it could be because the firm did not request additional loans or because, even though the firm did request additional loans, potential lenders denied the request(s). If loans outstanding to the firm decline, it could be because of the amortization of outstanding loans, because loans matured and the firm did not request replacement loans, because lenders refused to roll over existing loans, or even because lenders forgave existing loans. These alternative explanations for why loans outstanding either were unchanged or declined have quite different implications for loan supply and/or demand.

The second step investigates the extent to which additional loans were used by the firms to improve their TFP, emphasizing differences in firm characteristics and the source of the additional loans. This analysis can shed some light on the nature of any misallocation of credit during the 1990s. In particular, it may be that loans from unhealthy main banks may not increase subsequent TFP or may even be associated with a decline in TFP if the funds are used in unproductive ways, such as simply covering the current expenses of a failing firm. On the other hand, loans from secondary banks, to the extent that these banks make loans primarily based on a firm's prospects rather than on historical relationships, might be expected to be used to enhance subsequent TFP.

The baseline random-effects Tobit specification for firm *i* in industry *j* for the first step is:

$$\frac{Loan_{i,j,t}-Loan_{i,j,t-1}}{Asset_{i,j,t-1}} = b_0 + b_1 FIRM_{i,j,t-1} + b_2 BANK_{i,j,t-1} + b_3 AFFILIATION_{i,j,t-1} + b_4(INDUSTRY_j * YEAR_t) + b_5\delta_i + v_{i,j,t}, \quad (5)$$

where $\frac{Loan_{i,j,t}-Loan_{i,j,t-1}}{Asset_{i,j,t-1}} = \frac{Loan_{i,j,t}-Loan_{i,j,t-1}}{Asset_{i,j,t-1}}$ $if\ Loan_{i,j,t}-Loan_{i,j,t-1} > 0$,

and zero otherwise.

Note that a Tobit specification is used because the dependent variable is left-censored at zero. This specification of the dependent variable takes into account the ambiguous signal provided by either no change or a decline in loans outstanding to a firm. The equation can be thought of as trying to identify the determinants of the magnitude of the increase in loans to the firm, given that the firm does experience an increase in loans.

FIRM is a vector of firm characteristics, measured at time (*t*-1), that includes Log of TFP, our measure of technical health. It also includes Average ROA, constructed as the average of periods (*t*-1) and (*t*-2) values of the firm's return on assets, a common measure of financial health. The average value rather than just the annual value is used because ROA can fluctuate substantially from one year to the next. The vector also includes Sales Growth, the percentage change in total real sales, as a measure of firm health. Unfortunately, both of these measures of firm health also can be determinants of a firm's demand for credit. For example, low ROA might signal that a firm's cash flow alone is insufficient to cover its current expenses, and high sales growth might signal the need for additional credit to fund an expansion of productive capacity. The vector also includes Average Working Capital, the average of the firm's working capital for periods (*t*-1) and (*t*-2) as a control for the demand for credit, with a low value signaling a need for additional funding. Working capital is based on the standard definition of current assets minus current liabilities, scaled by total assets. The vector also includes Change in ROA and Change in Working Capital (each calculated as the change between period (*t*-1) and the average of periods (*t*-2) and (*t*-3)) to capture what might be a temporary change in a firm's financial health. In particular, a decline in either ROA or working capital might signal deterioration in the firm's financial health.

Additional control variables contained in ***FIRM*** include Current Bonds/Assets, Loans/Assets, Tangible Asset Share, and Log of Assets. Current Bonds/Assets as of period (*t*-1) captures potential demand for additional loans in period *t*, insofar as current bonds measure the volume of a firm's bonds maturing within one year. If a firm is unable to issue new bonds to replace the maturing bonds, for example due to deterioration in its health, or if it chooses to replace all or part of the maturing bonds with bank loans, loan demand will increase. Loans as a percentage of total assets controls for the exposure of banks to the firm. Tangible Asset Share is the ratio of tangible assets to total assets and reflects the extent to which a firm has assets that can serve as potential collateral for loans. The Log of Assets is the logarithm of total real assets of the firm and serves as a control for firm size.

BANK includes two indicator variables for the health of a firm's main bank. For each year, each bank that serves as a main bank is classified into one of three groups (healthy, medium-health or unhealthy) based on the bank's market-to-book ratio at the end of its prior fiscal year. Because main banks serve widely varying numbers of firms, the three groupings of main banks are based on serving approximately one-third of the firms rather than accounting for one-third of the main banks. We include (1,0) dummy variables for healthy and unhealthy main banks, with a value of one if the firm's main bank is in the group, and zero otherwise. The estimated effects are the differential effects measured relative to that of the omitted group, medium-health main banks. Because evergreening behavior has been shown to be more prevalent among unhealthy banks, these main-bank health classification variables should help to capture the link between bank health and the granting of increased loans to a troubled firm.

AFFILIATION contains a single variable, Same Keiretsu. This variable is a (1,0) dummy variable that has a value of one if a firm and its main bank belong to the same horizontal keiretsu, and zero otherwise. The presumption is that if a troubled firm is in the same keiretsu as its main bank, the bank's relationship with the firm provides a stronger incentive for the bank to support a troubled firm by evergreening its loans to the firm.

We also include a set of (1,0) dummy variables formed from the interaction of the set of industry dummy variables with the set of year dummy variables, *INDUSTRY*YEAR*. These variables control for macroeconomic effects over time and systematic differences across industries. Interacting the industry and year dummy variables allows the timing and magnitudes of business cycles to differ across industries. Finally, the Tobit model controls for firm-specific random effects, δ_i. In addition, to better isolate the nature of differences in effects, we estimate regressions on subsets of observations based on firm health indicators, as well as separating the lending behavior of the main banks and secondary banks. Standard errors for the Tobit specification are calculated using the observed information matrix based on asymptotic maximum likelihood theory.

The equation specification for the second step of the analysis concerning the effect of obtaining additional loans, as well as the effect of other firm and bank characteristics, on subsequent TFP is:

$$TFP\ Growth_{i,j,t} = c_0 + c_1 CREDIT_{i,j,t-1} + c_2 BANK_{i,j,t-1} + c_3 FIRM_{i,j,t-1} + c_4 (INDUSTRY_j * YEAR_t) + c_5 \delta_i + w_{i,j,t}. \quad (6)$$

The dependent variable is measured as Log of TFP in period *t* minus Log of TFP in period (*t*-1). *CREDIT* includes Increase in Bonds/Assets, Increase in Main-Bank Loans/Assets, and Increase in Secondary-Bank Loans/Assets. The measure of bonds outstanding used to calculate the increase in bonds includes commercial paper as well as straight bonds, convertible bonds, and bonds with attached warrants. The increase in bonds and the increase in loans are censored as before so that if the change is negative, our measure takes on a value of zero. *BANK* includes Healthy Main Bank and Unhealthy Main Bank dummy variables. In addition, we include the two bank health dummy variables interacted with both Increase in Main Bank Loans and Increase in Secondary Bank Loans. The set of *FIRM* explanatory variables includes Log of Assets, Average Working Capital, Tangible Asset Share, and Loans/Assets. All explanatory variables are entered as lagged values. In addition, for the increases in bonds, main-bank loans, secondary-bank loans, and main-bank health measures, alone and interacted, a second lagged value is included to allow for "time to build," insofar as the additional credit provided to the firm is used for investment, which may have an effect that takes some time to fully affect TFP. The regression includes INDUSTRY*YEAR and firm fixed effects, and the standard errors are robust and clustered at the firm level.

We further investigate the mechanism through which additional credit to a firm impacts the firm's subsequent change in TFP. A natural path is through the credit funding net investment, which in turn contributes to improved TFP. We thus estimate regressions with the firm's net investment, calculated as the change in net fixed assets between periods *t* and (*t*-1), scaled by lagged (beginning-of-period) net fixed assets as the dependent variable, and the increases in bonds, main-bank loans, and secondary-bank loans, as well as the main-bank-health dummy variables and the firm characteristics as explanatory variables. Here, because funding of the investment would occur in the same fiscal year as the investment itself, we use contemporaneous values for the increase in credit measures, picking up correlations rather than a causal relationship, and we split the sample by firm technical health and main-bank health. We then re-estimate equation (6) with the addition of the first and second lagged values of net investment to investigate whether the various credit variables have any effect on the change in TFP beyond the channel operating through net investment. The regressions are estimated on subsamples based on firm health and main bank health to better isolate the nature of any differences in responses.

Table 1 provides suggestive evidence about the nature of evergreening behavior by Japanese banks. Firm observations are divided into three cohorts based on firm health. The three columns indicate the percentage of the total observations in the row accounted for by firm observations in each of the three firm-health cohorts. Panel A is based on firm financial health (Average ROA), and Panel B is based on firm technical health (TFP). The top part of each panel is based on increases in total loans, the middle part is for increases in main-bank loans, and the lower part is for increases in secondary-bank loans. The panels contain rows for all firms, followed by the results when the observations are disaggregated into cohorts of firms with healthy main banks, medium-health main banks, and unhealthy main banks. To account for differences across industries and across time, Average ROA and TFP are each measured relative to the median for the firm's industry for each year. While firm-health cohorts represent approximately one-third of the observations, main-bank-health cohort observations can deviate somewhat from thirds because of the unequal numbers of firms associated with individual main banks.

The top part of Panel A indicates that a disproportionate share of the firms obtaining increased total loans were in the low-ROA cohort, consistent with evergreening behavior by banks. Moreover, this pattern generally holds across the three cohorts based on the firms' main-bank health, in each instance with the shares rising as one moves across columns from left to right. However, the panel provides no evidence that the least financially healthy firms (based on ROA) with unhealthy main banks were more likely to obtain increased loans than were firms with healthy main banks. A similar pattern occurs in the middle part of Panel A for firms obtaining increased main-bank loans. Thus, while we see general evidence consistent with evergreening behavior by banks both for total bank loans and for main-bank loans, we do not observe heightened evergreening behavior by the least-healthy main banks. Alternatively, to the extent that weaker ROA implies stronger loan demand due to weak cash flows, the pattern may primarily reflect banks' willingness to accommodate that loan demand.

However, the lower part of Panel A suggests that secondary-bank behavior differs from that of main banks. In particular, for firms with low ROA, secondary banks were much less likely to increase loans the weaker was the firm's main bank, perhaps because a weak firm with a weak main bank that might be less able to come to the aid of the firm would have a higher probability of defaulting on loans. Interestingly, secondary banks tended to be more likely to increase loans to firms the weaker the health of the firm's main bank for those firms with high or medium ROA, perhaps to meet the firms' loan demand that weaker main banks were unable to accommodate. Thus, this pattern may reflect a combination of firms' stronger loan demand from secondary banks and the judgment of secondary banks that the healthier firms were less likely to default even without strong support from their main bank.

Strikingly, this same pattern is not repeated in Panel B, where firms are separated into cohorts based on their technical health. The top part of the panel shows that the healthiest (TFP) firms are disproportionately represented among those firms obtaining increased total loans when all observations are considered, in contrast to the pattern in Panel A. However, the next three rows provide an interesting contrast when the firms are disaggregated based on the health of their main bank. For firms with the healthiest main banks, the high-TFP firms are even more likely to obtain increased total loans, and the likelihood of increased loans declines as firm health declines. The pattern is similar, although not as exaggerated, for firms with medium-health main banks. However, the pattern is strikingly reversed for firms with unhealthy main banks, with the shares rising as firm technical health deteriorates. The middle part of the panel shows a similar rising pattern for main-bank loans in the first row (all observations) as firm technical health declines. However, that pattern is repeated only for unhealthy main banks. Thus, the patterns for firm health based on technical (TFP) rather than financial (ROA) health are not consistent with evergreening behavior for firms with healthy or medium-health main banks. In contrast, for firms with unhealthy main banks, whether we focus on technical or financial firm health, we see a similar pattern that is consistent with evergreening behavior: the weaker is firm health, the greater the share of the firms receiving increased main-bank loans.

The bottom part of Panel B indicates that secondary banks show a consistent pattern of being less likely to increase loans to a firm the weaker is the firm's technical health. Moreover, the pattern becomes more exaggerated the weaker is the firm's main bank. Thus, the patterns are not consistent with secondary banks' undertaking evergreening behavior; instead, secondary banks are less likely to increase loans the weaker is firm technical health, and even less willing the weaker is the health of the firm's main bank. Unlike unhealthy main banks, secondary banks appear to be more likely to make a business decision based on the likelihood of loan repayment rather than based on bank-firm relationships. Thus, the patterns of bank lending appear to suggest different stories about the extent to which evergreening occurred during Japan's post-bubble period, depending on whether firm health is based on financial health or on technical health. In addition, the contrast between Panels A and B suggests that many of the financially distressed firms that received additional loans may have been technically healthy firms that were only temporarily financially distressed rather than being nonviable firms. Moreover, to the extent that credit was being misallocated, Panel B suggests that the problem can be ascribed to the behavior of unhealthy main banks rather than to Japanese banks more generally. Finally, the patterns are consistent with banks' having the ability to distinguish between viable (technically healthy) firms and nonviable (technically unhealthy) firms, suggesting that evergreening loans represented willful bank behavior.

Table 2 contains the summary statistics for the variables used in the regression analysis. The statistics are presented separately for the boom period (1984 to 1989) and the post-bubble period (1993 to 2000). We show the data for the two periods separately because the focus of our subsequent analysis is on the post-bubble period, when banks were most likely to be evergreening loans to their troubled borrowers.

While many of the variables have similar values for the two periods, a number of the variables do differ notably, as might be expected given the sharp divergence in economic performance between the two subperiods. For example, TFP Growth, Net Investment/Capital, Average ROA, Sales Growth, Change in ROA, and Change in Working Capital each deteriorate from the boom to the post-bubble period. In addition, as a consequence of the progressive deregulation of the Japanese bond markets beginning in the 1980s, Increase in Bonds/Assets is much higher and Current Bonds/Assets is much lower in the boom period as a consequence of the rising reliance on bond financing during the 1980s. Finally, as noted earlier, the separation of firm observations into thirds based on main-bank health is only approximate because of the lumpiness in the number of firms associated with each main bank, with a few banks' serving as the main bank for a large number of firms.

V. Empirical Results

A. *Baseline Results*

The benchmark results are presented in **Table 3**. The first two columns contain the base specification that allows the boom (1984–1989) and post-bubble (1993–2000) subsamples to have different estimated coefficients. As expected, firm technical health, as measured by Log of TFP, has positive estimated coefficients for both subperiods. However, the estimated coefficient is almost twice as large in the post-bubble period. Not only is the effect statistically significant only in the post-bubble period, the estimated coefficient differs significantly (at the 5 percent level) from that for the boom period. This result suggests that when the crisis set in, the technical health of firms became a more important consideration for requesting and receiving additional loans, something that did not seem to matter during the boom years, when firm bankruptcies were less prevalent.

The statistically significant negative estimated coefficients on Average ROA, a primary measure of firm financial health in many previous studies, in both subperiods indicate that firms tend to receive a larger increase in loans, the lower is their ROA. The fact that the negative effect is significant even in the boom years, when banks were not characterized as undertaking the evergreening of loans to unhealthy firms, is consistent with Average ROA reflecting loan-demand effects as well as loan-supply effects. That is, a firm with weak ROA may increase its demand for loans to fund its expenses due to a shortfall of cash flow, although it is not necessarily the case that all banks will accommodate this increase in loan demand. Moreover, the fact that the point estimates for the two subperiods are almost identical suggests that a negative ROA effect in the post-bubble period cannot confidently be interpreted as indicating the presence of evergreening behavior by banks.

Higher sales growth tends to increase the volume of additional loans to the firm, consistent with either a loan-demand effect, or, insofar as banks are more willing to lend to healthier firms, a loan-supply effect. The negative effect of Average Working Capital is consistent with a loan-demand effect, and, as an indicator of loan-supply effects, consistent with banks' providing additional loans to firms in worse financial health (evergreening). Similarly, the effects of both Change in ROA and Change in Working Capital can reflect either loan-demand or loan-supply effects. Here, both variables have negative estimated coefficients in both subperiods, with only that for Change in ROA in the boom period failing to be statistically significant, suggesting that firms obtained larger increases in loans as their financial health deteriorated. While we cannot be sure whether the increased loans associated with deteriorating firm financial health are primarily associated with increased loan demand or increased loan supply, the fact that the effects are larger (in absolute value) in the post-bubble period (when evergreening behavior is thought to have been more likely) and differ significantly from those in the boom period is consistent with an enhanced loan-supply effect associated with evergreening behavior by banks in the post-bubble period.

Current Bonds/Assets serves as an indicator for potential loan demand, insofar as a firm with bonds that mature within the current year may replace those bonds with bank loans, especially if the firm's health has deteriorated to the extent that it will have trouble issuing new bonds to arms-length investors. Consistent with this view, the estimated effects are positive, with the effect for the post-bubble period being larger and statistically significant, although it does not differ significantly from the effect for the boom period. The negative effect of Loans/Assets is consistent with limits on the degree of firms' leverage in the form of bank loans. The negative effect of firm size indicates that smaller firms tended to obtain larger increases in loans (relative to their assets), although it could reflect, at least in part, the fact that larger firms tended to have better access to the bond market. None of the other explanatory variables have statistically significant effects.

Columns 3 and 4 add interactive terms for both TFP and ROA with the bank health dummy variables to investigate the extent to which bank behavior might have changed between the two subperiods in terms of their reactions to either firm financial or technical health. The positive significant coefficients for the post-bubble period that differ significantly from those for the boom period for TFP interacted with both Healthy Main Bank and Unhealthy Main Bank indicate that in the post-bubble period, both healthy and unhealthy main banks paid more attention to firm technical health (relative to medium-health main banks). Given that firm bankruptcies were more prevalent in the post-bubble period, placing greater emphasis on firm technical health during this time is a reasonable response by banks.

Columns 5 and 6 repeat this specification, replacing the dependent variable based on total loans with our measure of the increase in main-bank loans, while Columns 7 and 8 use our measure of the increase in secondary-bank loans as the dependent variable. Among the differences noted for main-bank loans, TFP now has a statistically significant effect in the boom period, although Sales Growth in the post-bubble period and Average Working Capital in the boom period are no longer significant. Similarly, Loans/Assets loses its significance in both subperiods, while Tangible Asset Share is now significant in both subperiods, perhaps because main banks focus more on the collateral available for loans. Finally, Unhealthy Main Bank now has a significant positive coefficient for the boom period, although its total effect is complicated by the fact that its interaction with Average ROA now has a significant negative coefficient, consistent with main-bank evergreening behavior through providing larger loans to firms with weaker financial health.

For secondary-bank loans, the negative Average ROA coefficients are not significant, suggesting that secondary banks, unlike main banks, do not tend to provide larger increases in loans to firms in poor financial health. In addition, the TFP*Healthy-Main-Bank effect is not significant, perhaps because the health of the firm's main bank is less relevant for secondary-bank lending than for main-bank lending. On the other hand, secondary banks do tend to increase loans by more to firms with higher TFP if the firm's main bank is unhealthy. This would be consistent with secondary banks' being more likely than main banks to make strictly business decisions by being more willing to satisfy the loan demand of technically healthy firms whose weak main banks are unwilling or unable to do so.

B. Post-Bubble Analysis with Alternative Measures of Firm Health

The Table 3 results cast doubts about the appropriateness of simple balance-sheet and income measures, such as ROA, for identifying evergreening behavior. Given that the estimated ROA effects for the post-bubble period, when evergreening behavior is thought to have been prevalent, are quite similar to those for the boom period, it is quite likely that the estimated effects also (or even primarily) reflect fluctuations in loan demand associated with changes in a firm's cash flow. Therefore, we consider two alternative measures that have been used to identify firms that might be in distress. The first measure of financial distress, used by Hoshi, Kashyap, and Scharfstein (1990), is an indicator, based on a firm's coverage ratio, that takes the value of one in any period *t* if the interest expense of a firm exceeds its operating income in two consecutive years (*t* and *t*-1), following a period (*t*-2) when operating income exceeds interest expense. The second measure, introduced by Caballero, Hoshi, and Kashyap (2008), defines a firm as a "zombie" if its interest gap (the difference between its actual interest payments and a hypothetical lower bound for interest payments for the highest-quality borrowers for that year) is negative; that is, if the firm receives subsidized credit. The hypothetical lower bound for interest payments is based on the market interest rates applicable to various categories of firm debt for the healthiest firms in each year.

Table 4A shows the percentage of financially distressed and zombie firms in our sample, by year, during the post-bubble period. The distressed-firm percentage is high and rising in 1993 and 1994, then declines sharply in 1995, spikes again in 1998, and then drifts downward. The zombie classification produces shares ranging from about 7.5 percent to almost 17 percent of the firms during our sample period. The share increases through 1995, declines somewhat in 1996 before peaking in 1997, and then declines steadily for the rest of our sample period. It is worthwhile to note here that in fiscal years 1997 (calendar year 1998) and 1998 (calendar year 1999), the Japanese government made major capital injections into the banking system (Allen, Chakraborty, Watanabe (2011)). The patterns exhibited by the two alternative measures of financial health are generally similar, although the timing is not exact, and the average magnitudes tend to be larger for zombie firms than for financially distressed firms.

Table 4B shows that, unsurprisingly, financially distressed and zombie firms are less likely to have increased their bonds outstanding or to have increased loans from either their main banks or secondary banks, although the difference relative to non-distressed or non-zombie firms is much greater for secondary-bank loans than for main-bank loans. **Table 4C** shows the correlations between pairs of alternative sources of increased credit. For distressed and zombie firms, increases in bonds are positively correlated with increases in secondary-bank loans, but are negatively correlated with increases in main-bank loans. This is unsurprising, given that bonds are arms-length sources of credit that are based on a firm's fundamentals rather than relationships, while secondary-bank loans are much less tied to bank-firm relationships than are main-bank loans. However, the most striking difference among the correlations is the reversal in sign of the correlation between increases in main-bank loans and secondary-bank loans as we shift to the non-distressed and non-zombie firms. In each instance, the correlations are statistically significant. This suggests that secondary banks are generally willing to go along with main banks in increasing loans to financially healthy firms, but not to evergreen loans to support unhealthy firms.

The next two tables show results from regressions for increases in main-bank loans and increases in secondary-bank loans separately for subsets of firm observations based on the technical health of firms (high-TFP and low-TFP), financial distress (not distressed and distressed), and zombie categories (not a zombie and zombie). For main-bank lending, shown in **Table 5**, the first two columns show the estimated coefficients for high-TFP firms and low-TFP firms. The most striking feature of the two sets of estimates is the similarity of the point estimates of the coefficients in the two columns for the characteristics reflecting firm financial health, loan demand, and firm size. This is consistent with main banks' not making distinctions among firms based on their technical (TFP) health. The negative estimated effects of ROA, Average Working Capital, and Change in ROA indicate that banks do tend to lend more to financially weak firms. In contrast, the estimated coefficients on Healthy Main Bank in the two columns are opposite in sign, and each is statistically significant. Other things being equal, healthy main banks are more likely to increase loans to technically healthy firms and are less likely to increase loans to technically unhealthy firms. While the estimated coefficients on Unhealthy Main Bank have the same sign, the coefficient for low-TFP firms is twice as large and is significant. Thus, unhealthy main banks are more, rather than less, likely to increase loans to technically unhealthy firms. Similarly, the estimated coefficients on Same Keiretsu are opposite in sign, with only the coefficient for technically unhealthy firms being positive and significant. Thus, it appears that both keiretsu relationships and main-bank relationships matter for unhealthy main banks when it comes to helping technically unhealthy firms. While it appears that main banks are able to distinguish between technically healthy and unhealthy firms, healthy and unhealthy main banks react in opposite directions to technically unhealthy firms, with healthy main banks less likely to increase loans and unhealthy main banks more likely to increase loans. Such evidence, along with the Same Keiretsu coefficients, is consistent with evergreening behavior, primarily by unhealthy main banks.

The results for the two alternative sample splits in the remaining four columns appear to tell similar stories, with many of the estimated coefficients being quite similar for distressed and zombie firms, as well as being similar for non-distressed and non-zombie firms. In contrast to the technical health distinctions, the financially distressed distinction and the zombie distinction do not produce pairs of estimated coefficients that tend to be similar. For example, the TFP estimated coefficients are much larger and statistically significant for the non-distressed and non-zombie subsamples, while technical health does not appear to be a consideration for financially unhealthy firms, as was suggested by the results in the first two columns. Sales Growth, an indicator of firm health and loan demand, has a significant effect only for non-distressed and non-zombie firms. While ROA has a significant effect in all four columns, its effect is much larger (in absolute value) for the unhealthy firms, suggesting that main banks are much more likely to increase loans to unhealthy firms the lower is their ROA, consistent with evergreening behavior toward financially weak firms. Similarly, Average Working Capital has a much larger effect for distressed and zombie firms, suggesting that main banks are more willing to meet the demand for funding for firms with low working capital, a potential indicator of a firm's financial weakness. For both the Change in ROA and the Change in Working Capital variables, the negative effects are significant only for non-distressed and non-zombie firms.

While Current Bonds/Assets has a significant effect in all four columns, the point estimates of the coefficients suggest that main banks are more willing to meet the loan demand of distressed or zombie firms, perhaps because such firms are being squeezed out of the bond market due to their poor health and have difficulty rolling over their maturing bonds. Loans/Assets has a significant coefficient only for distressed and zombie firms, consistent with main banks' increasing loans to firms that are relatively unhealthy and already have high loan leverage, consistent with evergreening. Main banks are more willing to lend to troubled firms the more tangible assets (collateral) they have, while for non-distressed and non-zombie firms the effect is of the opposite sign, with main banks' being more willing to increase loans the less collateral a firm has, consistent with collateral being a less-important consideration for healthy firms that are less likely to default.

When it comes to main-bank health, healthy main banks are more likely to increase loans to non-distressed and non-zombie firms, while unhealthy main banks are more likely to increase loans to distressed and zombie firms, consistent with unhealthy main banks' being willing to undertake evergreening behavior. In addition, if a firm is in the main bank's keiretsu, the main bank is more likely to increase loans to the firm, consistent with the main bank's making decisions based on relationships, a characteristic of evergreening behavior. Finally, healthy main banks appear to weigh the technical health (TFP) of distressed and zombie firms more highly than do unhealthy main banks. This suggests that healthy main banks distinguish among financially distressed firms based on their technical health; that is, financially distressed firms that appear to be viable firms are still able to obtain increased loans from healthy main banks. While none of the estimated coefficients are significant for the TFP interaction with unhealthy main banks, note that the signs of the estimated coefficients are opposite for financially unhealthy firms compared to healthy firms.

To summarize, main banks do appear to distinguish between technically healthy and unhealthy firms generally, although they do not respond differently to the firms' financial health based on their technical health category. Instead, the difference shows up only for the measures of main-bank health and keiretsu relationships, and those differences are consistent with unhealthy main banks' undertaking evergreening behavior. However, when it comes to subsets of firms based on their financial distress or zombiness, main-bank behavior consistent with evergreening behavior toward financially weaker firms is more prevalent, appearing across a wide range of the explanatory variables. Moreover, such behavior is relatively stronger for unhealthy main banks than for healthy main banks.

Table 6, which repeats the Table 5 regressions but replaces the dependent variable with the increase in secondary-bank loans, shows that evergreening-type behavior is not nearly as apparent for secondary banks, which is unsurprising, given that secondary banks do not have as strong an incentive to aid unhealthy firms with which they have a weaker relationship. For distinctions based on technical health, shown in the first two columns, the point estimates of the two sets of coefficients are not generally similar, although they were generally similar for main banks in the previous table. Secondary banks do appear to distinguish between technically healthy and unhealthy firms. For example, secondary banks are more likely to increase loans the lower is ROA, the lower is working capital, and if the change in working capital is smaller, as long as the firm is technically healthy. Secondary banks also are more likely to increase loans if the firm's main bank is healthy, but are less likely to increase loans if the firm's main bank is unhealthy or has a same keiretsu relationship with the firm.

The final four columns show that while the TFP effect is significant only for non-distressed and non-zombie firms, as was the case for increases in main-bank loans, secondary banks are not much more likely to increase loans to distressed and zombie firms the lower is their ROA, although, as shown in Table 5, main banks are. Moreover, secondary banks are more likely to increase loans to distressed and zombie firms the lower is their Loans/Assets ratio, the direction opposite to that in Table 5. Similarly, the sign is reversed for unhealthy main banks, with secondary banks less likely to increase loans to distressed and zombie firms with unhealthy main banks. The sign of the estimated coefficient is similarly opposite for Same Keiretsu, with secondary banks less likely to increase lending to distressed and zombie firms that are in the same keiretsu as their main bank. Thus, as expected, secondary banks are more likely to make business decisions, placing less weight on bank-firm relationships, and thus be less engaged in evergreening behavior, in part because such relationships tend to be weaker for secondary banks than for main banks.

C. How Do Increases in Credit Influence Future Firm Performance?

The remaining regression tables investigate the contributions of increased credit to improvements in TFP. In particular, the focus is on differences across increases in bonds, main-bank loans, and secondary-bank loans, distinguishing between healthy and unhealthy main banks as well as between healthy and unhealthy firms. To make the comparison with loans, the increase-in-bonds measure is constructed in the same manner as the increase-in-loans measure, taking on a zero value for observations in which the firm's bonds outstanding decline. The comparison across sources of credit is intended to investigate the extent to which credit from different sources is used more or less productively by firms, and whether any differences are associated with the health of the main bank or the health of the firm. For example, it is possible that close relationships provide main banks insights into firm management and operations, so the lenders can distinguish between financially distressed firms that are viable versus those that are nonviable, improving the allocation of credit. On the other hand, because bank-firm relationships underlie banks' evergreening behavior, loans from sources with a stronger incentive to evergreen loans will contribute less, or even detract from, future firm performance. It is also possible that unhealthy firms use credit from all sources less productively, which may help to explain why they are unhealthy, rather than making poor use of only evergreening loans.

Table 7 investigates the extent to which increased credit contributes to subsequent improvements in TFP. Because the effects of increased credit may occur over time, as the funds are invested in new capital or the restructuring of operations, we include two lags of each credit category. The results in Columns 1 and 2 show that increased bonds contribute to enhanced TFP, with the impact larger for high-TFP firms than for low-TFP firms. Increased main-bank loans contribute to enhanced TFP for high-TFP firms, with the estimated total two-period effect being similar to that of increased bonds. However, for low-TFP firms, the effect of increased main-bank loans is negative rather than positive, suggesting that such loans are not used effectively, perhaps because a significant portion of those loans are evergreening loans that are used by the firms to cover current expenses rather than to improve subsequent performance. Increases in secondary-bank loans improve TFP, with the increase being larger for high-TFP firms than for low-TFP firms. Moreover, the total effects are much larger than for bonds or main-bank loans for both high-TFP firms and low-TFP firms. This would be consistent with secondary banks' being very selective in choosing which firms receive their loans, making business decisions rather than basing loans on relationship considerations. These results suggest that firms that are more operationally viable (higher TFP) generally are more likely to make better use of increased credit.

Having a healthy main bank increases the positive impact of main-bank loans for firms in the high-TFP cohort. In contrast, increased main-bank loans from unhealthy main banks are associated with a decline in subsequent TFP for firms in the low-TFP cohort, consistent with unhealthy main banks' increasing loans to weak firms that are in survival mode; that is, evergreening loans to nonviable firms. Increases in secondary-bank loans to firms with healthy main banks increases subsequent TFP, again to a greater extent for high-TFP firms. High-TFP firms with healthy main banks have higher subsequent TFP, other things being equal, while high- or low-TFP firms with unhealthy main banks have lower subsequent TFP. However, the total effect of having a healthy or unhealthy main bank also depends on the interaction terms that contain the main-bank health variables.

Columns 3 and 4 contain the results when the observations are split into firm observations with healthy and unhealthy main banks, avoiding the need to interact the main-bank health indicators with the variables measuring the increase in loans. While each of the estimated coefficients on increases-in-bonds or -loans is statistically significant, the most striking results are associated with increases in main-bank loans. For healthy main banks, the coefficients are positive and substantially exceed those for increases in secondary-bank loans. In sharp contrast, the estimated effects of increases in main-bank loans for firms with unhealthy main banks are negative, suggesting that additional loans from unhealthy main banks are associated with declines in the firms' subsequent TFP. This evidence is consistent with unhealthy main banks' evergreening loans, with the firms using the loans for unproductive activities, such as covering current losses that would allow a nonviable firm to delay bankruptcy rather than undertaking investment or restructuring activities that could enhance the technical efficiency (and survivability) of the firm.

The final four columns contrast healthy firms with financially unhealthy firms, with columns 5 and 6 containing the results for firms not in financial distress and financially distressed firms, respectively, and columns 7 and 8 containing non-zombie firms and zombie firms, respectively. By either distinction between financially healthy and unhealthy firms, the results are quite similar. For healthy firms, increases in bonds and loans are associated with enhanced TFP, with the exception of the negative differential effects for unhealthy main banks, which are not statistically significant. On the other hand, for financially unhealthy firms, increases in main-bank loans also have negative effects, both alone and interacted with the unhealthy-main-bank indicator variable. In addition, both lagged values of the unhealthy-main-bank indicator variable have negative effects that are statistically significant. These results are consistent with main banks' evergreening loans to financially unhealthy firms, with the extent of such evergreening behavior being greater for unhealthy main banks than for healthy main banks.

One channel through which increased credit could enhance TFP is through the firms' using the additional funds for investment. **Table 8** investigates the contribution of various forms of increased credit to net investment. Because net investment would likely be financed by increased credit within the same year, contemporaneous rather than lagged values for increased credit are used as the explanatory variables. Thus, the estimated effects can better be interpreted as reflecting an association rather than as being causal. For high-TFP (operationally viable) firms (column 1), increases in bonds, main-bank loans, and secondary-bank loans are each associated with an increase in net investment. In addition, the association is even stronger if the increase in loans is from a healthy main bank or a secondary bank to a firm with a healthy main bank. In contrast, none of the bank-related estimated coefficients are statistically significant for low-TFP firms, and two effects, those associated with the differential effect of increased loans from unhealthy main banks and the unhealthy-main-bank indicator variable, have negative (but not significant) estimated effects. This suggests that high-TFP firms tend to use increased credit for net investment, in contrast to low-TFP firms. Similarly, columns 3 and 4 suggest that firms with healthy main banks use increased credit for investment, while no such significant relationship is found for firms with unhealthy main banks.

The final four columns indicate similar differences between financially healthy and unhealthy firms. Much as with technically viable firms, financially healthy firms appear to use increased credit to increase investment, with increased loans from healthy main banks and from secondary banks of firms with healthy main banks strengthening the relationship. In contrast, financially unhealthy firms, as was the case with operationally unhealthy firms (column 2), do not have positive significant effects emanating from the bank-related variables. In fact, the only statistically significant coefficient is associated with the negative differential effect for increased loans from unhealthy main banks. Again, this is consistent with evergreening behavior by unhealthy main banks, with the loans being used to keep financially unhealthy firms out of bankruptcy rather than to enhance the viability of the firms.

The **Table 9** specifications investigate the extent to which net investment contributes to improved TFP, as well as the extent to which increased credit has an effect in addition to that operating through the net investment channel. The results indicate that for both technically healthy and financially healthy firms, as well as for firms with healthy main banks, net investment improves firm TFP. In contrast, net investment does not have a significant effect on the subsequent change in TFP for technically or financially unhealthy firms, suggesting that unhealthy firms either do not select high-productivity projects or do not use investment projects efficiently. It also appears that increases in credit tend to enhance the TFP of both technically and financially healthy firms, as well as of firms with healthy main banks, even after controlling for net investment, suggesting that increases in credit operate through other channels in addition to simply funding net investment. In addition, increases in secondary-bank loans further enhance TFP for high-TFP firms with an unhealthy main bank. For financially healthy firms with a healthy main bank, increases in both main-bank loans and secondary-bank loans provide an additional stimulus to TFP. Moreover, having a healthy main bank increases TFP for both technically and financially healthy firms.

In contrast, neither net investment nor increased credit contributes to improving subsequent TFP for low-TFP firms. However, increases in both arms-length bonds and secondary-bank loans, which rely less than main-bank loans on bank-firm relationships, do improve TFP for firms with unhealthy main banks. For financially unhealthy firms, increases in bonds and secondary-bank loans enhance TFP, with an additional boost from secondary-bank loans for firms with healthy main banks. On the other hand, increases in main-bank loans, especially if the main bank is unhealthy, are associated with a deterioration in subsequent TFP of financially unhealthy firms. That is, not only do loans from unhealthy main banks not help a firm's subsequent TFP, such loans actually contribute to a decline in technical efficiency. Again, this provides strong evidence consistent with unhealthy banks' evergreening loans to financially distressed and zombie firms. Moreover, the main-bank health indicators reinforce such a conclusion, with positive coefficients on healthy main banks and negative coefficients on unhealthy main banks, other things being equal.

Thus, it appears that unhealthy firms do not choose wisely when it comes to making new investments or using those investments efficiently, focusing instead on simply staying alive. In addition, increased credit appears to improve TFP through other channels in addition to funding net investment, perhaps through funding the costs associated with reducing the number of employees or restructuring the business by selling fixed assets, as suggested by Fukuda and Nakamura (2011). Finally, the overall evidence is consistent with unhealthy main banks' undertaking evergreening behavior toward unhealthy firms.

VI. Conclusion

This study investigates evergreening behavior by Japanese banks during the post-bubble period, defined here as fiscal years 1993–2000. In investigating the extent to which credit was misallocated by increasing loans to unhealthy firms, we distinguish between financial health, which has been the focus of most previous studies, and technical health. We also distinguish among the sources of loans, based on the relative strength of the banks' incentives to evergreen loans, as determined primarily by long-term bank-firm relationships and main-bank health. We then investigate the extent to which additional credit is associated with fixed investment by firms and with increased subsequent productivity, distinguishing among the sources of credit based on bank types with a range of incentives to evergreen loans from strong (unhealthy main banks) to weak (secondary banks), and on firm financial and technical health.

We show that typical measures of financial health reflect a combination of loan-demand effects and loan-supply effects in regressions explaining bank lending behavior, finding similar effects on bank lending in the boom period (1984–1989), in which banks' evergreening behavior is not thought to have played a prominent role, and the post-bubble period (1993–2000), when evergreening behavior is thought to have played a major role. Because we find similar-sized negative estimated effects of measures of financial health, such as ROA, on the magnitude of increased bank loans to firms in both the boom and post-bubble subperiods, such evidence of an inverse relationship in the post-bubble period cannot be interpreted as evidence of wide-scale bank evergreening behavior. Rather, the negative relationship likely reflects increased loan demand emanating from firms suffering from low cash flow.

Evidence based on measures of firm technical health do not suffer from this ambiguity. We find that banks do appear to distinguish clearly between technically healthy and unhealthy firms, with healthy main banks tending to increase loans to high-TFP firms, while unhealthy banks tend to increase loans to low-TFP firms. We find similar differences between healthy and unhealthy main-bank lending behavior when we split firm observations along financial-health lines, using either the Hoshi, Kashyap, and Scharfstein (1990) measure of financially distressed firms or the Caballero, Hoshi, and Kashyap (2008) zombie-firm indicator. Moreover, secondary banks, which have much weaker bank-firm relationships than main banks, do not appear to participate in evergreening behavior. Thus, while not as widespread as previous studies suggest, bank evergreening behavior has occurred, concentrated on technically unhealthy firms by unhealthy main banks.

We next turn to how increased credit is used by firms, distinguishing between the sources of the credit and the health, both technical and financial, of the firms. We find that firms with high TFP make the best use of credit for improving subsequent TFP. Mimicking the divergence in behavior noted in bank lending, loans from secondary banks and healthy main banks are associated with a subsequent improvement in firm TFP, while loans from unhealthy main banks to technically or financially unhealthy firms tend to be associated with deterioration in subsequent firm TFP. Moreover, this effect operates through one or more channels in addition to funding fixed investment directly. This evidence is consistent with unhealthy banks' undertaking evergreening behavior, with the firms misusing the additional credit to simply survive by covering current expenses rather than restructuring operations to return to viability. Thus, the banks with the strongest incentive to evergreen loans are more likely to provide increased loans to the least-viable firms, and the loans from those banks tend to be associated with weaker, rather than stronger, subsequent technical health of the least-viable firms. In contrast, loans from those bank types least likely to evergreen loans tend to enhance the subsequent productivity of financially or technically healthy firms.

References

Ackerberg, Daniel A., Kevin Caves, and Garth Frazer. 2006. “Structural Identification of Production Functions.” UCLA mimeo.

Ahearne, Alan, and Naoki Shinada. 2005. "Zombie Firms and Economic Stagnation in Japan." *International Economics and Economic Policy* 2(4): 363–381.

Allen, Linda, Suparna Chakraborty, and Wako Watanabe. 2011. "Foreign Direct Investment and Regulatory Remedies for Banking Crises: Lessons from Japan." *Journal of International Business Studies* 42 (7): 875–893.

Amiti, Mary, and David Weinstein. Forthcoming. “How Much Do Bank Shocks Affect Investment? Evidence from Matched Bank-Firm Loan Data.” *Journal of Political Economy*.

Amiti, Mary, and David Weinstein. 2011. "Exports and Financial Shocks." *Quarterly Journal of Economics* 126 (4): 1841–1877.

Amiti, Mary, and Jozef Konings. 2007. "Trade Liberalization, Intermediate Inputs, and Productivity: Evidence from Indonesia," *American Economic Review* 97 (5): 1611–1638.

Caballero, Ricardo, Takeo Hoshi, and Anil Kashyap. 2008. "Zombie Lending and Depressed Restructuring in Japan." *American Economic Review* 98 (5): 1943–1977.

Fukuda, Shin-ichi, and Jun-ichi Nakamura. 2011. “Why Did “Zombie” Firms Recover in Japan?” *World Economy* 34 (7): 1124–1137.

Hamao, Yashushi, Jianping Mei, and Yexiao Xu. 2007. "Unique Symptoms of Japanese Stagnation: An Equity Market Perspective." *Journal of Money, Credit and Banking* 39(4): 901–923.

Hoshi, Takeo, and Anil Kashyap. 2001. *Corporate Financing and Governance in Japan*. MIT Press, Cambridge, MA.

Hoshi, Takeo, Anil Kashyap, and David Scharfstein. 1990. “The Role of Banks in Reducing the Costs of Financial Distress in Japan.” *Journal of Financial Economics* 27: 67–88.

Hosono, Kaoru, and Masaya Sakuragawa. 2003. “Soft Budget Problems in the Japanese Credit Market.” Nagoya City University Discussion Papers in Economics 345.

Javorcik, Beata Smarzynska. 2004. "Does Foreign Direct Investment Increase the Productivity of Domestic Firms? In Search of Spillovers through Backward Linkages." *American Economic Review* 94 (3): 605–627.

Javorcik, Beata Smarzynska, and Mariana Spatareanu. 2011. "Does It Matter Where You Come From? Vertical Spillovers from Foreign Direct Investment and the Origin of Investors." *Journal of Development Economics* 96 (1): 126–138.

Levinsohn, James, and Amil Petrin. 2003. "Estimating Production Functions Using Inputs to Control for Unobservables." *Review of Economic Studies* 70(2): 317–342.

Marschak, Jacob, and William H., Andrews, Jr. 1974. “Random Simultaneous Equations and the Theory of Production.” *Econometrica* 12: 143–206.

Olley, Steven, and Ariel Pakes. 1996. "The Dynamics of Productivity in the Telecommunications Equipment Industry." *Econometrica* 64 (6): 1263–1298.

Peek Joe, and Eric Rosengren. 2005. "Unnatural Selection: Perverse Incentives and the Misallocation of Credit in Japan." *American Economic Review* 95 (4): 1144–1166.

______________________2000. "Collateral Damage: Effects of the Japanese Bank Crisis on Real Activity in the United States." *American Economic Review* 90 (1): 30–45.

Petrin, Amil, T. Kirk White, and Jerome Reiter. 2011. "The Impact of Plant-Level Resource Reallocations and Technical Progress on U.S. Macroeconomic Growth." *Review of Economic Dynamics* 14 (1): 3–26.

Sekine, Toshitaka, Keiichiro Kobayashi, and Yumi Saita. 2003. "Forbearance Lending: The Case of Japanese Firms." *Monetary and Economic Studies* 21(2): 69–92.

Tett, Gillian, and David Ibison. 2001. "Tokyo May Have to Support Banks." *Financial Times* New York, September 14.

Wooldridge, Jeffrey. 2009. "On Estimating Firm-Level Production Functions Using Proxy Variables to Control for Unobservables." *Economics Letters* 104 (3): 112–114.

Table 1: Percentage of Firms Obtaining Increased Loans in each Firm-Health Cohort, for All Banks and for Main-Bank Health Cohorts

PANEL A: Firms divided into cohorts based on average ROA

	High ROA	Medium ROA	Low ROA
	Percentage of Total Firm Observations with Increased Total Loans		
All Observations	30.71	32.29	36.99
Healthy Main Banks	29.85	31.94	38.22
Medium-Health Main Banks	30.88	33.36	35.76
Unhealthy Main Banks	29.71	30.62	39.68
	Percentage of Total Firm Observations with Increased Main-Bank Loans		
All Observations	29.42	32.94	37.64
Healthy Main Banks	27.20	32.69	40.11
Medium-Health Main Banks	30.44	34.49	35.07
Unhealthy Main Banks	30.65	30.99	38.36
	Percentage of Total Firm Observations with Increased Secondary-Bank Loans		
All Observations	30.93	33.65	35.42
Healthy Main Banks	28.63	32.87	38.50
Medium-Health Main Banks	32.19	37.53	30.28
Unhealthy Main Banks	34.43	39.17	26.40

PANEL B: Firms divided into cohorts based on TFP

	High TFP	Medium TFP	Low TFP
	Percentage of Total Firm Observations with Increased Total Loans		
All Observations	35.03	33.87	31.10
Healthy Main Banks	38.78	33.81	27.41
Medium-Health Main Banks	35.37	32.47	32.15
Unhealthy Main Banks	25.44	36.03	38.53
	Percentage of Total Firm Observations with Increased Main-Bank Loans		
All Observations	30.01	34.45	35.54
Healthy Main Banks	39.85	33.79	26.36
Medium-Health Main Banks	36.00	33.33	30.67
Unhealthy Main Banks	24.46	34.34	41.21
	Percentage of Total Firm Observations with Increased Secondary-Bank Loans		
All Observations	37.56	35.45	26.99
Healthy Main Banks	38.97	34.15	26.88
Medium-Health Main Banks	40.16	35.18	24.66
Unhealthy Main Banks	45.97	34.12	19.91

Notes: In the panels above, our sample covers the post-bubble period from 1993 to 2000. Panel A indicates how the firm-year observations with increased loans are distributed across the three Average ROA cohorts, while Panel B indicates how the firm-year observations with increased loans are distributed across the three TFP cohorts. Average ROA is the average return on assets over the two years prior to the year that the increased loans are obtained, while TFP is the total factor productivity of the year prior to the year that the increased loans are obtained. TFP is measured using the Wooldridge-Levisohn-Petrin estimation technique (Wooldridge 2009). Firms are divided into three cohorts based on their Average ROA or on TFP measured relative to the median value of the firm's industry for each year. Main banks are divided into three groups based on their market-to-book ratio in each year.

Table 2: Summary Statistics

	Boom Period				Post-Bubble Period			
	Mean	**Standard Deviation**	**Minimum**	**Maximum**	**Mean**	**Standard Deviation**	**Minimum**	**Maximum**
Increase in Total Loans/Assets	1.65	3.53	0	36.73	1.53	3.10	0	35.98
Increase in Main-Bank Loans/Assets	0.61	1.56	0	36.73	0.47	1.18	0	33.55
Increase in Secondary-Bank Loans/Assets	1.19	2.64	0	36.60	1.23	2.61	0	29.68
TFP Growth	0.16	0.30	-1.01	1.81	-0.27	2.14	-6.82	3.26
Net Investment/Capital	6.75	11.36	-28.51	49.73	0.11	7.75	-19.22	49.90
Log of TFP	4.00	4.36	-3.36	25.44	3.67	4.98	-4.61	29.45
Average ROA	5.31	4.01	-24.79	26.20	2.92	3.38	-14.29	20.53
Sales Growth	4.52	12.28	-49.96	71.13	-1.37	10.17	-60.34	64.13
Average Working Capital	14.64	17.71	-36.18	89.43	15.91	17.31	-62.57	91.28
Change in ROA	-0.06	3.60	-22.65	23.27	-0.48	2.68	-22.01	14.73
Change in Working Capital	1.12	7.85	-52.81	71.42	-0.72	6.95	-66.36	42.28
Current Bonds/Assets	0.15	0.54	0	8.62	1.34	3.27	0	24.85
Loans/Assets	24.54	17.22	0.01	105.97	21.45	16.73	0.02	205.25
Tangible Asset Share	24.70	10.36	1.95	68.72	28.80	12.27	0.47	77.11
Log of Assets	17.53	1.47	13.72	22.70	17.17	2.31	12.26	25.61
Healthy Main Bank (MB)	0.37	0.48	0	1	0.36	0.48	0	1
Unhealthy MB	0.30	0.46	0	1	0.25	0.43	0	1
Same Keiretsu	0.34	0.47	0	1	0.31	0.46	0	1
Increase in Bonds/Assets	2.03	4.78	0	42.34	0.63	2.46	0	65.37

Notes: After eliminating the extreme values (see text), the boom period (1984–1989) consists of 756 firms with 3,514 observations. The post-bubble period (1993–2000) consists of 971 firms with 6,439 observations. When we introduce TFP Growth and Increase in Bonds/Assets in the later specifications, the number of observations is reduced slightly due to the elimination of the extreme values of these two additional variables.

TABLE 3: Benchmark Results - Increase in Loans
Comparison of Boom and Post-Bubble Periods

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	ΔTotal Loans (*t*)/Assets (*t*-1)				ΔMain-Bank Loans(*t*)/Assets (*t*-1)		ΔSecondary-Bank Loans(*t*)/Assets (*t*-1)	
	Boom	Post-Bubble	Boom	Post-Bubble	Boom	Post-Bubble	Boom	Post-Bubble
Log of TFP $_{t-1}$	0.2723	0.4626**[a]	0.3127	0.4166**	0.2651*	0.1703**	0.1498	0.2811*
	(0.2409)	(0.1325)	(0.2479)	(0.1342)	(0.1091)	(0.0622)	(0.2038)	(0.1098)
Average ROA $_{t-1}$	-0.1513**	-0.1282**	-0.1423*	-0.1250**	-0.0760**	-0.0590**	-0.0644	-0.0628
	(0.0371)	(0.0310)	(0.0551)	(0.0449)	(0.0241)	(0.0201)	(0.0455)	(0.0369)
Sales Growth $_{t-1}$	0.0468**	0.0325**	0.0465**	0.0332**	0.0154**	0.0086	0.0414**	0.0303**
	(0.0129)	(0.0114)	(0.0129)	(0.0114)	(0.0056)	(0.0050)	(0.0107)	(0.0094)
Average Working Capital $_{t-1}$	-0.0295**	-0.0370**	-0.0310**	-0.0369**	-0.0075	-0.0112**	-0.0300**	-0.0354**
	(0.0107)	(0.0084)	(0.0107)	(0.0084)	(0.0047)	(0.0038)	(0.0088)	(0.0069)
Change in ROA $_{t-1}$	-0.0517	-0.2008**[a]	-0.0502	-0.2043**[a]	-0.0112	-0.0566**	-0.0536	-0.1789**[a]
	(0.0426)	(0.0418)	(0.0426)	(0.0418)	(0.0183)	(0.0185)	(0.0356)	(0.0346)
Change in Working Capital $_{t-1}$	-0.0425**	-0.0665**[a]	-0.0418**	-0.0681**[a]	-0.0220**	-0.0185**	-0.0289**	-0.0602**[a]
	(0.0161)	(0.0138)	(0.0161)	(0.0138)	(0.0071)	(0.0061)	(0.0134)	(0.0114)
Current Bonds/Assets $_{t-1}$	0.1917	0.3328**	0.1946	0.3324**	0.1338	0.1185**	0.0202	0.2443**
	(0.2367)	(0.0277)	(0.2365)	(0.0277)	(0.1004)	(0.0125)	(0.2016)	(0.0229)
Loans/Assets $_{t-1}$	-0.0350**	-0.0187*	-0.0359**	-0.0189*	-0.0068	0.0024	-0.0218**	-0.0081
	(0.0103)	(0.0087)	(0.0103)	(0.0088)	(0.0044)	(0.0038)	(0.0085)	(0.0070)
Tangible Asset Share $_{t-1}$	0.0143	0.0149	0.0139	0.0147	0.0260**	0.0126**	-0.0078	0.0067
	(0.0159)	(0.0094)	(0.0159)	(0.0094)	(0.0069)	(0.0043)	(0.0130)	(0.0077)
Log of Assets $_{t-1}$	-0.8879**	-0.5520**[a]	-0.8873**	-0.5585**[a]	-0.5029**	-0.3411**[b]	-0.5583**	-0.3365**
	(0.1079)	(0.0833)	(0.1081)	(0.0835)	(0.0486)	(0.0389)	(0.0882)	(0.0677)
Healthy MB $_{t-1}$	0.1087	-0.1402	0.1403	-0.2247	-0.0088	-0.2034	0.1290	0.0203
	(0.2865)	(0.2023)	(0.5492)	(0.3081)	(0.2407)	(0.1396)	(0.4553)	(0.2539)
Unhealthy MB $_{t-1}$	0.0840	0.3517	0.7474	-0.3565	0.6009*	0.0627[a]	0.2922	-0.2490
	(0.3070)	(0.2274)	(0.5479)	(0.3432)	(0.2381)	(0.1520)	(0.4554)	(0.2825)
Same Keiretsu $_{t-1}$	-0.2662	0.0514	-0.2494	0.0164	0.0937	-0.0559	-0.2880	-0.0039
	(0.2818)	(0.2091)	(0.2822)	(0.2095)	(0.1248)	(0.0971)	(0.2311)	(0.1695)

Table 3 Continued:

(Log of TFP*Healthy MB) $_{t-1}$	-0.0536	0.0594**[a]	-0.0424	0.0378*[a]	-0.0025	0.0303
	(0.0679)	(0.0042)	(0.0297)	(0.0187)	(0.0567)	(0.0343)
(Log of TFP*Unhealthy MB) $_{t-1}$	-0.0902	0.1505**[b]	-0.0281	0.0179	-0.0455	0.1319**[a]
	(0.0696)	(0.0448)	(0.0301)	(0.0200)	(0.0578)	(0.0372)
(Average ROA*Healthy MB) $_{t-1}$	0.0299	-0.0418	0.0251	-0.0325	-0.0194	-0.0211
	(0.0716)	(0.0607)	(0.0315)	(0.0276)	(0.0591)	(0.0499)
(Average ROA*Unhealthy MB) $_{t-1}$	-0.0642	0.0479	-0.0923**	0.0146[a]	0.0136	0.0121
	(0.0735)	(0.0660)	(0.0320)	(0.0293)	(0.0607)	(0.0547)

Pseudo R-squared	0.0404	0.0409	0.0535	0.0397
Number of Firm-Year Observations	9, 953	9, 953	9, 953	9, 953

Notes: *: Significant at 5%; **: Significant at 1%. The regressions use a Tobit specification, with standard errors (in parentheses) calculated using the observed information matrix (OIM). [a] and [b] denote that the coefficient for the post-bubble period (1993–2000) differs from that for the boom period (1984–89) at 5% and 1% levels of significance, respectively. In addition to industry*year fixed effects, all regressions control for random effects at the firm level. The dependent variable is measured as the change in loans between periods *t* and (*t*-1) divided by assets in period (*t*-1) if the change in loans is positive, and zero otherwise.

TABLE 4A: Distribution of Firms by Alternative Measures of Firm Health in the Post-Bubble Period

	Distressed Firms (Percent)	Zombie Firms (Percent)	Total Firms
1993	8.82	7.46	736
1994	10.41	9.93	780
1995	6.42	12.24	794
1996	6.23	9.32	806
1997	5.52	16.69	834
1998	9.91	14.41	838
1999	7.58	11.28	824
2000	6.59	9.34	827

Table 4B: Increase in Bonds and Loans by Category of Firms

	Increase in Bonds	Increase in Main-Bank Loans	Increase in Secondary-Bank Loans
Not Distressed (as a percentage of non-distressed firms)	37.62	62.42	68.05
Distressed (as a percentage of distressed firms)	9.02	49.18	16.13
Not a Zombie (as a percentage of non-zombie firms)	35.70	71.32	73.12
Zombie (as a percentage of zombie firms)	14.16	56.94	23.14

Table 4C: Correlation of Bonds and Loans by Category of Firms

	Increase in Bonds	Increase in Main-Bank Loans	Increase in Secondary-Bank Loans	Increase in Bonds	Increase in Main-Bank Loans	Increase in Secondary-Bank Loans
	Not Distressed			**Distressed**		
(1)	1.0000			1.0000		
(2)	-0.0163	1.0000		-0.1651**	1.0000	
	(0.2017)			(0.0151)		
(3)	0.0530**	0.3349**	1.0000	0.2115**	-0.3656**	1.0000
	(0.0000)	(0.0000)		(0.0031)	(0.0051)	
	Not a Zombie			**Zombie**		
(1)	1.0000			1.0000		
(2)	-0.0578**	1.0000		-0.1451**	1.0000	
	(0.0000)			(0.0215)		
(3)	-0.0160**	0.3935**	1.0000	0.2341**	-0.3542**	1.0000
	(0.0000)	(0.0000)		(0.0045)	(0.0015)	

Notes: *: Significant at 5%; **: Significant at 1%. A distressed firm has interest expense that exceeds its operating income in two consecutive years (*t* and *t*-1) but is less than its operating income in the year before these consecutive years (*t*-2). A zombie firm receives subsidized credit; that is, it has actual interest expense less than a hypothetical lower bound based on the average market interest rates applicable to the highest-quality firms in that year. The post-bubble period includes fiscal years 1993–2000.

Table 5: Determinants of Increase in Main-Bank Loans by Alternative Measures of Firm Health

	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent Variable = ΔMain-Bank Loans (*t*)/Assets (*t*-1)					
	High TFP	Low TFP	Not Distressed	Distressed	Not a Zombie	Zombie
Log of TFP $_{t-1}$			0.1754**	0.0379	0.2012**	0.0208
			(0.0611)	(0.2118)	(0.0585)	(0.2062)
Average ROA $_{t-1}$	-0.0603*	-0.0646*	-0.0596**	-0.1964**	-0.0490**	-0.1202**
	(0.0236)	(0.0228)	(0.0141)	(0.0086)	(0.0135)	(0.0398)
Sales Growth $_{t-1}$	0.0165*	0.0142*	0.0092*	0.0071	0.0078*	0.0015
	(0.0063)	(0.0068)	(0.0045)	(0.0132)	(0.0031)	(0.0124)
Average Working Capital $_{t-1}$	-0.0132*	-0.0199**	-0.0097*	-0.0238*	-0.0066*	-0.0217*
	(0.0064)	(0.0060)	(0.0039)	(0.0095)	(0.0028)	(0.0101)
Change in ROA $_{t-1}$	-0.0631*	-0.0693*	-0.0462*	-0.1029	-0.0511**	-0.0816
	(0.0310)	(0.0310)	(0.0184)	(0.0677)	(0.0179)	(0.0510)
Change in Working Capital $_{t-1}$	-0.0022	-0.0029	-0.0205**	-0.0065	-0.0186**	-0.0198
	(0.0103)	(0.0103)	(0.0060)	(0.0167)	(0.0059)	(0.0175)
Current Bonds/Assets $_{t-1}$	0.1564**	0.1551**	0.1126**	0.1737**	0.1132**	0.1976*
	(0.0217)	(0.0216)	(0.0123)	(0.0346)	(0.0112)	(0.0762)
Loans/Assets $_{t-1}$	0.0075	0.0097*	0.0040	0.0075*	0.0049	0.0063*
	(0.0061)	(0.0042)	(0.0057)	(0.0036)	(0.0037)	(0.0031)
Tangible Asset Share $_{t-1}$	0.0034	0.0032*	-0.0137*	0.0080*	-0.0173**	0.0182*
	(0.0072)	(0.0012)	(0.0043)	(0.0033)	(0.0042)	(0.0090)
Log of Assets $_{t-1}$	-0.2334**	-0.2345**	-0.3363**	-0.3802**	-0.3579**	-0.1764*
	(0.0627)	(0.0602)	(0.0043)	(0.1180)	(0.0370)	(0.0615)
Healthy MB $_{t-1}$	0.0801**	-0.0922*	0.2931**	-0.1113	0.2669*	-0.1941
	(0.0131)	(0.0423)	(0.0084)	(0.4128)	(0.1107)	(0.3320)
Unhealthy MB $_{t-1}$	0.0293	0.0564**	0.0893	0.3209*	0.0916	0.1214**
	(0.1651)	(0.0143)	(0.1279)	(0.1452)	(0.1262)	(0.0314)
Same Keiretsu $_{t-1}$	-0.0563	0.0310**	-0.0509	0.0459*	-0.0210	0.0534*
	(0.1760)	(0.0101)	(0.0092)	(0.0196)	(0.0930)	(0.0212)
(Log of TFP*Healthy MB) $_{t-1}$			0.0377*	0.0904**	0.0271**	0.1014**
			(0.0184)	(0.0286)	(0.0067)	(0.0366)
(Log of TFP*Unhealthy MB) $_{t-1}$			0.0152	-0.0271	0.0209	-0.0386
			(0.0197)	(0.0588)	(0.0189)	(0.0664)
Constant	2.7057*	2.7527*	4.5318**	1.3794**	2.1130*	4.7291**
	(1.1532)	(1.1324)	(1.2013)	(0.0855)	(0.0440)	(1.1072)
Pseudo R-Squared	0.0863	0.0564	0.1348	0.1015	0.1714	0.1513
Firm-Year Observations	2,147	2,144	5,491	948	5,279	1,160

Notes: *: Significant at 5%; **: Significant at 1%. The regressions use a Tobit specification, with standard errors (in parentheses) calculated using the observed information matrix (OIM). See Table 4 notes for descriptions of distressed and zombie firm classifications. In addition to Industry*Year fixed effects, all regressions control for random effects at the firm level. The dependent variable is measured as the change in main-bank loans between periods *t* and (*t*-1) divided by assets in period (*t*-1) if the change in loans is positive, and zero otherwise.

Table 6: Determinants of Increase in Secondary-Bank Loans by Alternative Measures of Firm Health

	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent Variable = ΔSecondary Bank Loans(*t*)/Assets (*t*-1)					
	High TFP	**Low TFP**	**Not Distressed**	**Distressed**	**Not a Zombie**	**Zombie**
Log of TFP $_{t-1}$			0.2856**	0.0573	0.2758*	0.0453
			(0.1097)	(0.5599)	(0.1094)	(0.2115)
Average ROA $_{t-1}$	-0.0612**	-0.0213	-0.0535*	-0.0111	-0.0799**	-0.0105*
	(0.0201)	(0.0455)	(0.0260)	(0.2596)	(0.0260)	(0.0051)
Sales Growth $_{t-1}$	0.0433**	0.0211**	0.0292**	0.0234	0.0336**	0.0178
	(0.0152)	(0.0065)	(0.0096)	(0.0337)	(0.0101)	(0.0230)
Average Working Capital $_{t-1}$	-0.0576**	-0.0246*	-0.0376**	-0.0240	-0.1461**	-0.0210
	(0.0123)	(0.0121)	(0.0069)	(0.0320)	(0.0362)	(0.0192)
Change in ROA $_{t-1}$	-0.2350**	-0.0664	-0.1517**	-0.0835	-0.3546**	-0.2114
	(0.0640)	(0.0596)	(0.0355)	(0.1766)	(0.1115)	(0.1152)
Change in Working Capital $_{t-1}$	-0.0557**	-0.0717**	-0.0953**	-0.0713	-0.0687**	-0.0173
	(0.0211)	(0.0200)	(0.0116)	(0.0455)	(0.0118)	(0.0338)
Current Bonds/Assets $_{t-1}$	0.3421**	0.2645**	0.2468**	0.3060**	0.2273**	0.2565*
	(0.0392)	(0.0413)	(0.0233)	(0.0914)	(0.0222)	(0.1391)
Loans/Assets $_{t-1}$	-0.0202	-0.0347*	-0.0084	-0.0764*	-0.0081	-0.0514*
	(0.0127)	(0.0153)	(0.0044)	(0.0312)	(0.0072)	(0.0182)
Tangible Asset Share $_{t-1}$	-0.0210	0.0514*	0.0047	0.0145**	0.0047	0.0037**
	(0.0150)	(0.0225)	(0.0078)	(0.0031)	(0.0080)	(0.0010)
Log of Assets $_{t-1}$	-0.3283**	0.0347	-0.3411**	0.0271	-0.3653**	-0.1049
	(0.0987)	(0.1191)	(0.0678)	(0.3168)	(0.0672)	(0.2400)
Healthy MB $_{t-1}$	0.0319*	0.0961*	0.1413*	0.1719	0.1187*	0.0815
	(0.0115)	(0.0351)	(0.0069)	(0.1732)	(0.0432)	(0.2116)
Unhealthy MB $_{t-1}$	0.0154	-0.2424**	-0.0469	-0.2114*	-0.0698	-0.5951**
	(0.0121)	(0.0761)	(0.2373)	(0.1013)	(0.2477)	(0.1214)
Same Keiretsu $_{t-1}$	-0.0410	-0.3698*	-0.0503	-0.1817*	-0.0230	-0.2285*
	(0.2829)	(0.1273)	(0.1721)	(0.0742)	(0.1718)	(0.1016)
(Log of TFP*Healthy MB) $_{t-1}$			0.1444**	0.1215**	0.1098**	0.0815*
			(0.0201)	(0.0386)	(0.0267)	(0.0386)
(Log of TFP*Unhealthy MB) $_{t-1}$			-0.0975	-0.0379	-0.0205	-0.0145
			(0.0813)	(0.0288)	(0.0947)	(0.0563)
Constant	7.5488*	-2.5136*	5.4682*	1.5588	5.8936*	-3.2811
	(3.6781)	(1.1614)	(2.2531)	(5.7527)	(2.1647)	(5.1449)
Pseudo R-Squared	0.0783	0.0546	0.1615	0.0816	0.1813	0.1643
Firm-Year Observations	2,147	2,144	5,491	948	5,279	1,160

Notes: *: Significant at 5%; **: Significant at 1%. The regressions use a Tobit specification, with standard errors (in parentheses) calculated using the observed information matrix (OIM). See Table 4 notes for descriptions of distressed and zombie firm classifications. In addition to Industry*Year fixed effects, all regressions control for random effects at the firm level. The dependent variable is measured as the change in secondary-bank loans between periods *t* and (*t*-1) divided by assets in period (*t*-1) if the change in loans is positive, and zero otherwise.

TABLE 7: TFP Growth and Credit

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Dependent Variable: Log TFP (*t*) – Log TFP (*t*-1)							
VARIABLES	**High TFP**	**Low TFP**	**Healthy Main Banks**	**Unhealthy Main Banks**	**Not Distressed**	**Distressed**	**Not a Zombie**	**Zombie**
(Increase in bonds)$_{t-1}$	0.0208**	0.0066**	0.0201**	0.0165*	0.0321**	0.0119**	0.0403**	0.0115*
	(0.0041)	(0.0015)	(0.0051)	(0.0073)	(0.0056)	(0.0043)	(0.0046)	(0.0052)
(Increase in bonds)$_{t-2}$	0.0147**	0.0021*	0.0154*	0.0087*	0.0143**	0.0040	0.0046*	0.0016
	(0.0018)	(0.0009)	(0.0073)	(0.0031)	(0.0052)	(0.0032)	(0.0021)	(0.0075)
(Increase in MB loans)$_{t-1}$	0.0140*	-0.0359*	0.0326**	-0.0116*	0.0119**	-0.0092	0.0409*	-0.0112
	(0.0070)	(0.0122)	(0.0096)	(0.0058)	(0.0032)	(0.0181)	(0.0199)	(0.0531)
(Increase in MB loans)$_{t-2}$	0.0293*	-0.0092*	0.0525**	-0.0337**	0.0561*	-0.0379*	0.0403**	-0.0275*
	(0.0110)	(0.0035)	(0.0229)	(0.0090)	(0.0235)	(0.0168)	(0.0018)	(0.0117)
(Increase in secondary-bank (SB) loans)$_{t-1}$	0.0387**	0.0184**	0.0247**	0.0150*	0.0221*	0.0103	0.0615**	0.0006
	(0.0142)	(0.0065)	(0.0078)	(0.0067)	(0.0100)	(0.0072)	(0.0090)	(0.0118)
(Increase in SB loans)$_{t-2}$	0.0634**	0.0181**	0.0026*	0.0081**	0.0316*	0.0046	0.0377**	0.0026
	(0.0188)	(0.0047)	(0.0011)	(0.0011)	(0.0127)	(0.0079)	(0.0096)	(0.0093)
(Increase in MB loans *Healthy MB)$_{t-1}$	0.3527**	0.0339			0.0772*	0.0036	0.0346*	0.0034
	(0.0700)	(0.0327)			(0.0295)	(0.0285)	(0.0120)	(0.0847)
(Increase in MB loans *Healthy MB)$_{t-2}$	0.1277*	0.0332			0.0234	0.0053	0.0255	0.0117
	(0.0516)	(0.0355)			(0.0424)	(0.0293)	(0.0363)	(0.0283)
(Increase in MB loans *Unhealthy MB)$_{t-1}$	-0.0258	-0.0424**			-0.0087	-0.0142**	-0.0234	-0.0486**
	(0.0575)	(0.0114)			(0.0292)	(0.0067)	(0.0351)	(0.0078)
(Increase in MB loans*Unhealthy MB)$_{t-2}$	-0.0154	-0.0063**			-0.0184	-0.0160	-0.0091	-0.0208
	(0.0709)	(0.0014)			(0.0428)	(0.0325)	(0.0454)	(0.0226)
(Increase in SB loans*Healthy MB)$_{t-1}$	0.0420*	0.0163**			0.0100**	0.0150*	0.0117**	0.0179*
	(0.0211)	(0.0032)			(0.0031)	(0.0071)	(0.0008)	(0.0082)
(Increase in SB loans*Healthy MB)$_{t-2}$	0.0391	0.0110			0.0145**	0.0031*	0.0127*	0.0012
	(0.0308)	(0.0071)			(0.0046)	(0.0012)	(0.0054)	(0.0108)
(Increase in SB loans*Unhealthy MB)$_{t-1}$	-0.0211	-0.0022			-0.0039	-0.0105	-0.0127	-0.0263
	(0.0295)	(0.0087)			(0.0154)	(0.0134)	(0.0148)	(0.0213)
(Increase in SB loans*Unhealthy MB)$_{t-2}$	-0.0095	-0.0098			-0.0070	-0.0064	-0.0021	-0.0331
	(0.0356)	(0.0065)			(0.0212)	(0.0136)	(0.0179)	(0.0230)

Table 7 Continued:								
(Healthy MB)$_{t-1}$	0.2714**	0.0222			0.1089*	0.0130**	0.0747*	0.0101*
	(0.0853)	(0.0203)			(0.0425)	(0.0030)	(0.0317)	(0.0046)
(Healthy MB)$_{t-2}$	0.0545	0.0341			0.0416	0.0377	0.0148	0.0216
	(0.0874)	(0.0177)			(0.0435)	(0.0304)	(0.0364)	(0.0413)
(Unhealthy MB)$_{t-1}$	-0.1426*	-0.0060**			-0.1606**	-0.0620*	-0.0562	-0.1751**
	(0.0703)	(0.0009)			(0.0444)	(0.0301)	(0.0399)	(0.0523)
(Unhealthy MB)$_{t-2}$	-0.2857**	-0.0120*			-0.0462	-0.0737*	-0.0441	-0.0797*
	(0.0915)	(0.0059)			(0.0464)	(0.0311)	(0.0471)	(0.0341)
Firm-Year Observations	1,834	1,828	2,011	1,401	4,589	904	4,507	986
Adjusted R- Squared	0.6104	0.5413	0.5614	0.5012	0.5563	0.4267	0.5643	0.5132

Notes: *: significant at 5% level; **: significant at 1% level. Standard errors are robust and clustered at the firm level. In addition to the variables shown above, all regressions also include Log of Assets, Average Working Capital, Tangible Asset Share, and Loan Share, each lagged one period, and a constant term. The coefficients on these additional controls are not included for brevity and can be obtained from the authors. In addition, all tables also include firm and year fixed effects to control for unobserved variations in firm characteristics and yearly events. The sample period includes fiscal years 1993–2000.

TABLE 8: Net Investment and Credit – Contemporaneous Relationship

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Dependent Variable: Net Investment (*t*)/Tangible Fixed Assets (*t*-1)							
VARIABLES	**High TFP**	**Low TFP**	**Healthy Main Banks**	**Unhealthy Main Banks**	**Not Distressed**	**Distressed**	**Not a Zombie**	**Zombie**
Increase in bonds	0.4765**	0.2109	0.3629**	0.0106	1.3437**	0.6106	1.3316**	0.2506
	(0.1132)	(0.1061)	(0.0850)	(0.1590)	(0.0646)	(1.1199)	(0.0666)	(0.1967)
Increase in MB loans	0.7466*	0.2439	0.3012*	0.0665	1.3453**	0.9848	1.2158**	0.7044
	(0.3358)	(0.6558)	(0.0983)	(0.3793)	(0.2367)	(2.0004)	(0.2472)	(0.7586)
Increase in SB loans	0.3312**	0.1233	0.4252**	0.1291	2.1172**	0.3436	1.1555**	0.0610
	(0.1248)	(0.1843)	(0.1320)	(0.1366)	(0.0818)	(1.9994)	(0.0052)	(0.1505)
Increase in MB loans*Healthy MB	0.9390*	0.0695			1.3275**	1.0026	1.2256**	1.4687
	(0.3613)	(0.7367)			(0.2533)	(2.6856)	(0.3260)	(0.7881)
Increase in MB loans*Unhealthy MB	0.5750	-0.1044			-0.0237	-7.1190*	0.0647	-5.2392*
	(0.5788)	(0.8766)			(0.3901)	(3.6707)	(0.4279)	(2.5124)
Increase in SB loans*Healthy MB	0.5984*	0.1838			0.3592**	0.1529	0.3999*	0.1644
	(0.2126)	(0.2323)			(0.1337)	(1.4112)	(0.1580)	(0.3317)
Increase in SB loans*Unhealthy MB	0.0763	0.0397			0.2048	0.8061	0.2345	0.5502
	(0.2188)	(0.2767)			(0.1417)	(0.6099)	(0.1630)	(0.4010)
Healthy MB	0.4650	0.0025			-0.1481	-1.6185	-0.1677	-0.0904
	(0.5316)	(0.5448)			(0.1017)	(0.9473)	(0.1042)	(0.1884)
Unhealthy MB	0.6847	-0.3043			-0.0036	-1.5863	0.0026	-0.1178
	(0.6339)	(0.6888)			(0.0350)	(0.8574)	(0.0383)	(0.0767)
Firm-Year Observations	1,834	1,828	2,011	1,401	4,589	904	4,507	986
Within R-squared	0.1964	0.1604	0.2089	0.1372	0.1401	0.1943	0.1436	0.1725

Notes: *: significant at 5% level; **: significant at 1% level. Standard errors are robust and clustered at the firm level. In addition to the variables shown above, all regressions also include Log of Assets, Average Working Capital, Tangible Asset Share, Loan Share, and a constant term. The coefficients on these additional controls are not included for brevity and can be obtained from the authors. In addition, all tables also include firm and year fixed effects to control for unobserved variations in firm characteristics and yearly events. The sample period includes fiscal years 1993–2000.

TABLE 9: TFP Growth, Net Investment, and Credit

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Dependent Variable = Log TFP(t) – Log TFP(t-1)							
VARIABLES	**High TFP**	**Low TFP**	**Healthy Main Banks**	**Unhealthy Main Banks**	**Not Distressed**	**Distressed**	**Not a Zombie**	**Zombie**
(Net investment)$_{t\text{-}1}$	0.0061**	-0.0014	0.0036**	0.0002	0.4847**	0.0007	0.4325**	-0.0004
	(0.0014)	(0.0009)	(0.0003)	(0.0008)	(0.0015)	(0.0009)	(0.0015)	(0.0009)
(Net investment)$_{t\text{-}2}$	0.0016*	-0.0001	0.0023*	-0.0015	0.0325**	0.0006	0.0943*	-0.0015
	(0.0008)	(0.0007)	(0.0011)	(0.0017)	(0.0011)	(0.0014)	(0.0414)	(0.0014)
(Increase in bonds)$_{t\text{-}1}$	0.0211*	-0.0007	0.0173*	0.0126*	0.2513**	0.0239**	0.0820**	0.0014*
	(0.0106)	(0.0029)	(0.0008)	(0.0058)	(0.0123)	(0.0034)	(0.0057)	(0.0007)
(Increase in bonds)$_{t\text{-}2}$	0.0037	-0.0039	0.0018	0.0041	0.1546**	0.0162**	0.0644**	0.0089**
	(0.0044)	(0.0029)	(0.0052)	(0.0059)	(0.0431)	(0.0052)	(0.0054)	(0.0028)
(Increase in MB loans)$_{t\text{-}1}$	0.0289*	0.0087	0.0601*	0.0099	0.8654**	-0.0142	0.0524*	-0.0430*
	(0.01311)	(0.0166)	(0.0242)	(0.0287)	(0.1134)	(0.0208)	(0.0211)	(0.0211)
(Increase in MB loans)$_{t\text{-}2}$	0.0479*	-0.0032	0.0441*	0.0137	0.3899**	-0.0526*	0.0456*	-0.0859*
	(0.0186)	(0.0132)	(0.0205)	(0.0204)	(0.1275)	(0.0246)	(0.0211)	(0.0303)
(Increase in SB loans)$_{t\text{-}1}$	0.0098**	-0.0039	0.0187*	0.0057*	0.0432**	0.0203**	0.0342**	0.0171**
	(0.0018)	(0.0058)	(0.0071)	(0.0021)	(0.0105)	(0.0099)	(0.0987)	(0.0015)
(Increase in SB loans)$_{t\text{-}2}$	0.0114	-0.0078	0.0086	0.0051*	0.7345**	0.0302*	0.0408**	0.0012
	(0.0110)	(0.0081)	(0.0102)	(0.0024)	(0.1146)	(0.0123)	(0.0061)	(0.0101)
(Increase in MB loans*Healthy MB)$_{t\text{-}1}$	0.0139	0.0025			0.7913**	0.0413	0.4327**	0.0315*
	(0.0345)	(0.0292)			(0.1235)	(0.0314)	(0.0087)	(0.0132)
(Increase in MB loans*Healthy MB)$_{t\text{-}2}$	0.0282	0.0220			0.4539**	0.0315*	0.0500*	0.0084
	(0.0370)	(0.0183)			(0.0987)	(0.0142)	(0.0201)	(0.0281)
(Increase in MB loans*Unhealthy MB)$_{t\text{-}1}$	0.0145	-0.0156			-0.0143	-0.0252*	-0.0132	-0.0473*
	(0.0405)	(0.0201)			(0.0543)	(0.0112)	(0.0096)	(0.0201)
(Increase in MB loans*Unhealthy MB)$_{t\text{-}2}$	-0.0695	-0.0185			-0.0796	-0.0217	-0.0143	-0.0190*
	(0.0369)	(0.0170)			(0.3143)	(0.0444)	(0.0089)	(0.0072)
(Increase in SB loans*Healthy MB)$_{t\text{-}1}$	0.0133	0.0042			0.3038**	0.0105*	0.2015**	0.0154*
	(0.0109)	(0.0073)			(0.0842)	(0.0043)	(0.0701)	(0.0057)
(Increase in SB loans*Healthy MB)$_{t\text{-}2}$	0.0015	0.0046			0.7631**	0.0132**	0.2436**	0.0764**
	(0.0150)	(0.0088)			(0.2456)	(0.0041)	(0.0065)	(0.0235)

Table 9 Continued:								
(Increase in SB loans*Unhealthy MB)$_{t-1}$	0.0113**	-0.0037			-0.0154	-0.0190	-0.0187	-0.0314
	(0.0026)	(0.0076)			(0.0125)	(0.0132)	(0.0765)	(0.1243)
(Increase in SB loans*Unhealthy MB)$_{t-2}$	0.0316*	-0.0045			0.0456	-0.0007	-0.0324	-0.0183
	(0.0112)	(0.0086)			(0.0865)	(0.0228)	(0.0224)	(0.0246)
(Healthy MB)$_{t-1}$	0.1220*	0.0057			0.4404**	0.1127**	0.2043**	0.0987*
	(0.0497)	(0.0207)			(0.0875)	(0.0428)	(0.0564)	(0.0415)
(Healthy MB)$_{t-2}$	0.0430*	0.0101			0.0812*	0.0530*	0.0514*	0.0193*
	(0.0137)	(0.0178)			(0.0387)	(0.0215)	(0.0221)	(0.0071)
(Unhealthy MB)$_{t-1}$	0.0883	-0.0075			-0.0564	-0.1517**	-0.1042	-0.1784*
	(0.0554)	(0.0281)			(0.0413)	(0.0437)	(0.0812)	(0.0841)
(Unhealthy MB)$_{t-2}$	-0.0765	-0.0050			-0.0561	-0.0797	-0.0389	-0.0785
	(0.0663)	(0.0299)			(0.0435)	(0.0466)	(0.0742)	(0.0516)
Firm-Year Observations	1,834	1,828	2,011	1,401	4,589	904	4,507	986
R-squared	0.7272	0.6501	0.7174	0.6858	0.1727	0.1965	0.1534	0.2015

Notes: *: significant at 5% level; **: significant at 1% level. Standard errors are robust and clustered at firm level. In addition to the variables shown above, all regressions also include Log of Assets, Average Working Capital, Tangible Asset Share, and Loan Share, each lagged one period, and a constant term. The coefficients on these additional controls are not included for brevity and can be obtained from the authors. In addition, all tables also include firm and year fixed effects to control for unobserved variations in firm characteristics and yearly events. The sample period includes fiscal years 1993–2000.