Lending to Unhealthy Firms in Japan during the Lost Decade: WTF?

Suparna Chakraborty*

Joe Peek*

Abstract

Using a dataset that matches individual Japanese firms to individual lending institutions, this study revisits the issue of the misallocation of credit in Japan associated with the perverse incentive faced by a bank to provide additional credit to the weakest firms in a bid to avoid realizing loan losses on its own balance sheet. We distinguish between two types of firm distress: financial distress that is marked by a (perhaps temporary) weakening of financial health, and technical distress that reflects weak operational (or technical) capabilities, such as low total factor productivity (TFP). Our results show that while lenders did extend additional credit to financially distressed borrowers, the recipients of additional loans were not necessarily technically distressed; that is, many of the loans did not represent banks "evergreening" loans to "zombie" firms. Furthermore, our analysis shows that many financially distressed firms may have used the additional loans to enhance productivity. Moreover, our results show that the interpretation of previous results that banks evergreened loans to financially distressed firms may reflect loan demand rather than loan supply behavior.

Keywords: total factor productivity, bank lending, Japan, zombie firms, financial crisis

*Chakraborty: University of San Francisco, 2130 Fulton Street, San Francisco, CA 94117 (email: schakraborty2@usfca.edu); Peek: Federal Reserve Bank of Boston, 600 Atlantic Avenue, Boston, MA 02210 (email: Joe.Peek@bos.frb.org). Our particular thanks to Mary Amiti, Jozef Konings, Amil Petrin, Mariana Spatareanu, and Kirk White for their many inputs and kindness in sharing their codes. We also thank William Greene, Takeo Hoshi, Anil Kashyap, and David Weinstein for their helpful suggestions. We also thank Sunayan Acharya for excellent research assistance.

I. Introduction

The long period of economic malaise in Japan following the bursting of the stock market and real estate bubbles of the 1980s presents a number of puzzles, including some with answers that may go against conventional wisdom. The easy one is, of course: How long is a decade? Based on Japan's "Lost Decade," a decade is not necessarily the conventionally defined 10 years. But a much more difficult question concerns the extent to which Japanese banks were "evergreening" loans during this time; that is, extending additional credit to enable unhealthy (zombie) firms to continue making interest payments on existing loans. At this point, the conventional wisdom appears to be that evergreening did occur (for example, Peek and Rosengren 2005; Caballero, Hoshi and Kashyap 2008). Among the various explanations provided for such bank behavior are bank responsibilities emanating from historical bank-firm keiretsu relationships, government pressure on banks to help avoid firm bankruptcies, and the perverse incentives faced by troubled banks to delay the bankruptcy of their unhealthy borrowers that would, in turn, damage the banks' own balance sheets (mutually assured destruction). This study takes a closer look at the latter question by distinguishing between two alternative concepts of firm health: technical and financial. In particular, we ask an important question about the sense in which the firms that Japanese banks were lending to were unhealthy; that is: Which, technical or financial (WTF)?

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 in the context of the financial health of firms, being related to measures based on a firm's balance sheet and income statement rather than to measures of a firm's underlying

technological efficiency (for example, Peek and Rosengren 2005; Caballero, Hoshi, and Kashap 2008). However, because in many cases weak balance sheet and income measures are associated with increased loan demand to address a shortfall in the firm's 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 nonviable zombies, might have been financially distressed but operationally viable. Insofar as lending 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 or sales growth. A technically distressed firm is one that performs poorly (relative to firms in its industry) operationally, here measured by the firm's total factor productivity (TFP). 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 relative prices for 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, additional loans could improve subsequent firm performance. Thus, bank lending to financially distressed but economically viable firms might have beneficial effects. On the other hand, additional loans to a firm that was not fundamentally sound could represent a misallocation of credit by allowing the

firm to merely cover ongoing financial losses, lessening the pressure on management either to make needed structural changes to become a viable firm or to file for bankruptcy (or try to be acquired) to bring to an end its existence as a zombie (nonviable) firm.

In this study, we use a panel dataset that matches individual firm borrowers to individual 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 Kashap (2008) note, manufacturing is the industry least affected by the presence of zombie firms. Still, our comparisons are across manufacturing firms, which do show substantial variation in technical (and financial) health.

A number of possible explanations exist for the differential treatment of firms. For example, banks may have been more willing to provide credit to financially distressed firms if their underlying, long-term technical health was strong. Thus, the first step is to separate the roles played by financial distress and technical distress in determining to whom additional bank credit was provided. The next step is to investigate the extent to which firms that received additional loans used them to improve their operational performance and how any improvements were related to firm characteristics.

We find that financially distressed firms did obtain additional loans, not only in the Lost Decade of the 1990s, but even during the boom period of the 1980s. This result suggests that previous interpretations of increased lending to financially distressed firms may have been misinterpreted as evidence of widespread evergreening of loans when, in fact, it may have, in large part, reflected increased loan demand by financially distressed firms. Thus, 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 2004). That is, during the boom period of the 1980s, banks may not have carefully distinguished among firms using credit risk analysis because default risk was minimal, unlike the post-bubble period experience in the 1990s when large firms did fail and default on loans.

To the extent that a bank loan provides the necessary financial means to overcome temporary liquidity problems and invest in growth-promoting measures, one might expect an increase in bank loans to be positively correlated with an increase in a firm's productivity. In fact, our results indicate that firms that obtained additional loans tended to experience a subsequent increase in TFP, suggesting that bank lending in the 1990s did not necessarily exhibit widespread misallocation of credit.

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, such as through commercial paper and bond issuance, through

financial intermediaries in the form of loans, or some combination, at least for those 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 among the set of countries that are typically considered to have a bank-centered, rather than market-centered, economy. As such, Japanese firms tend to rely more heavily on intermediated credit, with most of that credit being provided by banks. Thus, how banks allocate credit to firms and how those loans are used by the firms are extremely important for the performance of the Japanese economy.

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, 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) each find that bank credit was allocated to relatively 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 dates.

In particular, 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 troubled banks were substantially over reporting their capital, they wanted to avoid reporting further increases in nonperforming loans that would require them to charge off, at least in part, existing loans and add to their loan loss reserves, actions that would reduce their reported capital ratios. One mechanism for doing so is "evergreening" loans, whereby a bank makes additional loans to a troubled firm that can be used to repay interest on the firm's existing loans so that the loans would not go into default. Consequently, troubled borrowers could avoid, or at least delay, declaring bankruptcy.

Of course, this requires bank regulators to be complicit in allowing such bank behavior, 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 a massive increase in unemployment 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 fact, 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 early injections of public capital into the Japanese banking system were 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.

In fact, 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 distress using two measures based on firm balance sheet and income statements, the return on assets 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 based on measures of financial distress constructed from a firm's balance sheet and income statement as evergreening behavior by banks 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 loans to the firm and its working

capital or return on assets, even if banks have 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 demand for credit.

Caballero, Hoshi and Kashyap (2008) take a different approach for identifying severely distressed, or zombie, firms, focusing on the average interest rates paid by firms rather than looking at a firm's profitability. The idea is that one way for banks to support troubled firms is to provide them with subsidized interest rates on their loans. Thus, they identify zombie firms as those firms obtaining loans at a subsidized interest rate. An alternative measure identifies different degrees of "zombiness" based on the extent to which a firm is subsidized. The extent of the subsidization is based on the difference between the firm's observed interest payments and a hypothesized lower bound for interest payments based on what the highest quality firms would pay.

After measuring the prevalence of zombie firms, Caballero, Hoshi and Kashyap (2008) 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 on healthier firms by 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 these zombie firms. Their results also highlight the decline in 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, 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 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 of 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 to better understand the extent to which credit was misallocated in Japan during the Lost Decade, it also is useful to take the further step to determine the characteristics of those firms that used the additional loans to improve their operational efficiency. For example, Amiti and Weinstein (2013) find that bank loan supply shocks have substantial effects on firm investment. Thus, to the extent that viable firms use additional loans for investment, 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 requires distinguishing between financially distressed, but technically viable firms, and nonviable zombie firms.

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 NEEDS Nikkei Industrial Database. 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. The NEEDS Nikkei Industrial Database 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 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 that is 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 Japanese firm fiscal years are spread throughout the calendar year. While more than 90 percent of our sample has a March fiscal yearend, 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 have formed our regression year observations by splitting the firms between June and July fiscal yearends. 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 yearend 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 the NEEDS Nikkei Industrial Database, we designate as the main bank the bank with the largest volume of loans outstanding to the firm in each fiscal year. 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 changes only when another bank exceeds the volume of loans outstanding to the firm by the current main bank by 10 percent.

Because credit availability may depend on bank health, we control for main bank health using the bank's market-to-book ratio, using market values from the NEEDS 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 (Dodwell).

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 to 1993 immediately following the bursting of the bubbles.

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 9,399 observations from 999 manufacturing firms spanning 27 industries.

Measurement of TFP

Total factor productivity (TFP) plays a key role in our analysis. As such, it is important that we use state-of-the-art techniques for computing firm-level TFP. We follow real business cycle theory and 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:

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

where $Y_{i,j,t,}$ representing 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 $A_{i,j,t}$'s measure total factor productivity, popularly called the Solow residual.

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

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

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 share of capital, labor and material inputs:

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

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 the predicted shocks to TFP or productivity (for a full discussion, see Marschak 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 Fraser (henceforth ACF, 2008) 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 methodology (WLP, see Petrin, White and Reiter 2011) that allows for better measurement of TFP by further correcting 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 logarithm form, are estimated over the period 1980 through 2003 for a set of 27 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 or 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, Rieter and White 2011 use the value-added approach), we follow the suggestions of ACF and Petrin, Reiter and White (2011) and apply 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 where output is measured as gross sales of a firm 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.[1] 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 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 the 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 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, Javorcik and Spatareau 2011). Instead, we choose to include the industry-level average of hours worked by employees as our measure of hours and multiply 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 happen to vary over time. This might have a non-trivial effect on the measurement of the parameters of the production function.

[1] 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.

Applying the WLP (2009) technique to equation (4), we estimate the parameters of the production process, which are then used to calculate the share 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 marker of the technical health of a firm.[2]

IV. Specification

Evergreening refers to the loan supply behavior of banks based on the health of borrowers, as well as possibly the health of the lenders. Consequently, measures of 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 consider two primary hypothesis tests. The first concerns the probability of a firm obtaining additional loans, controlling for firm and bank characteristics, as well as the general macroeconomic environment. The focus is on the distinction between firm financial health and firm technical health as factors determining the probability of a firm obtaining increased loans. Having an increase in loans outstanding compared with the prior year is unambiguous because to do so a firm must request additional loans and be granted additional loans from its potential lenders. On the other hand, ambiguity surrounds situations when loans outstanding to a firm are unchanged or decline from the amount in the prior year. 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, that loans matured and

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

the firm did not request replacement loans, that lenders refused to roll over existing loans, or even that lenders forgave existing loans. These alternative explanations for why loans outstanding were either unchanged or declined have different implications for loan supply and/or demand.

The second hypothesis concerns the use to which additional loans are put by the firms. In particular, are the additional loans used by firms to increase their TFP? And if so, what firm characteristics are associated with firm behavior that leads to any increase in its TFP in the subsequent year.

The baseline random effects probit specification for the evergreening hypothesis is:

$$\Pr(Loan_{i,j,t}) = a_0 + a_1 FIRM_{i,j,t-1} + a_2 BANK_{i,j,t-1} + a_3 AFFILIATION_{i,j,t-1} + a_4 (INDUSTRY_j * YEAR_t) + u_{i,j,t} \,, \quad (5)$$

Following Peek and Rosengren (2005), the dependent variable takes a value one if the change in the firm's total outstanding loans between period t and period (t-1) is positive, and zero otherwise. 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 probability of a firm obtaining increased loans.

FIRM is a vector of firm characteristics that includes Log of TFP, our measure of technical health. It also includes Average ROA, constructed as the average of period (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

sales, as a measure of firm health. Unfortunately, both of these measures of firm health can also 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 measured as 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 periods (t-1) and (t-2)) to capture what perhaps might be a temporary change in a firm's financial health. In particular, a decline in either ROA or working capital might signal a 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 a year. If a firm is unable to issue new bonds to replace the maturing bonds or chooses to replace all or part of the maturing bonds with bank loans, loan demand would 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 real total 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. Because main banks serve widely varying numbers of firms, the three groupings of main banks are based on serving 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, with a value of one if the firm's main bank is in the group, and zero otherwise. The estimated effects are differential effects measured relative to that of the omitted group, medium health main banks. Because evergreening has been shown to be more prevalent among unhealthy banks, these main bank health classification variables would help capture the link between bank health and the granting of additional loans.

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 the firm by evergreening its loans to the troubled 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 probit model controls for firm-specific random effects, and the standard errors are calculated using the observed information matrix (OIM) specification.

While the baseline specification captures the probability of a firm receiving additional loans based on its technical versus financial health, we also consider an alternative specification that replaces the (1,0) dummy variable dependent variable with the magnitude of additional loans that a firm receives if it does obtain additional loans. In other words, while technical and financial health may affect the probability of obtaining additional loans, it may be informative to also consider the determinants of the magnitude of any increase in loans. To this end, we run a Tobit specification of the form:

$$\frac{Loan_{i,j,t}-Loan_{i,j,t-1}}{Asset_{i,j,t-1}} = b_0 + b_1 FIRM_{i,j,t-1} + b_2 BANK_{i,j,t-1} + b_3 AFFILIATION_{i,j,t-1} +$$

$$b_4(INDUSTRY_j * YEAR_t) + v_{i,j,t} \quad (6)$$

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

$$if\ Loan_{i,j,t} - Loan_{i,j,t-1} > 0$$

$$and\ 0\ otherwise$$

Note that as with the initial specification, we truncate any negative change in outstanding loans to zero because we cannot distinguish among the different causes of a decline in outstanding loans.

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

$$TFP\ Growth_{t,t-1} = c_0 + c_1 FIRM_{i,j,t-1} + c_2 BANK_{i,j,t-1} + c_3 AFFILIATION_{i,j,t-1} +$$

$$c_4(INDUSTRY_j * YEAR_t) + w_{i,j,t} \quad (7)$$

The dependent variable is measured as Log of TFP in period t minus Log of TFP in period (t-1). The set of explanatory variables in this equation is the same as in equation (5) except that the

Log of TFP is omitted and a measure of additional loans obtained by the firm in period (t-1) is included. Additional Loans is measured as the increase in loans outstanding to the firm between the ends of periods (t-1) and (t-2) divided by total assets at the end of period (t-2) if loans increased, and zero otherwise. The regression controls for firm-level fixed effects, and the standard errors are robust and clustered at the firm level.

Table 1 provides a sense of how banks, grouped into cohorts based on their health, were allocating loans to firms, with the firms grouped by their relative ROA (reflecting financial health) and relative TFP (reflecting technical health). To account for differences across industries and across time, ROA here is measured relative to the median for the firm's industry for each year. Relative TFP is also measured relative to the median for the firm's industry for each year. In each case, the cohorts represent approximately one-third of the observations. The percentages in the columns represent the share of all firm observations experiencing an increase in loans outstanding among the firms in that category. Panel A indicates that the bottom ROA cohort of firms represented a disproportionate share of the firms obtaining an increase in loans overall. However, it was the low ROA firms with unhealthy main banks that were most likely to obtain an increase in loans, consistent with evergreening by unhealthy banks to unhealthy firms. Still, even the cohort with the healthiest main banks experienced a disproportionate share of low ROA firms obtaining additional loans.

Strikingly, that same pattern is not repeated in Panel B, where firms are separated into cohorts based on their relative TFP. Here, the (technically) healthiest firms are disproportionately represented among those firms obtaining increased loans, both for the total and for each of the three categories based on main bank health. Thus, the patterns of bank

lending appear to suggest different stories about the extent to which evergreening occurred, depending on whether firm health is based on financial health or on technical health. Moreover, the contrast between Panels A and B suggests that many of the technically healthy firms that received additional loans may have, at least temporarily, been financially distressed.

Table 2 presents the information in Panel B of Table 1 year by year for the period from 1984 to 2000. The table shows a shift over time in the proportion of firms obtaining increased loans, with the high TFP cohort share rising at the expense of the low TFP cohort, suggesting that as the Japanese economy deteriorated and firm bankruptcy became more prevalent, banks may have become more careful about the underlying technical health of the firms to which they lent.

Table 3 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). Most of our subsequent analysis is for the post-bubble period when banks were most likely to be evergreening loans to their troubled borrowers.

5. Empirical Results

5.1. Hypothesis 1

The benchmark results are presented in Table 4. The first two columns contain a specification typical of the existing literature that focuses only on a firm's financial health. We allow the boom (1984-1989) and post-bubble (1993-2000) subsamples to have different estimated coefficients. The negative estimated coefficients on Average ROA, the primary measure of firm financial health, indicate an increased probability of receiving additional loans the lower is ROA in both subperiods, with the difference in the estimated effects not being

statistically significant. 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 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 the estimated effect is larger (in absolute value) during the post-bubble years when the evergreening of loans to troubled firms is believed to have been prevalent, the estimated coefficient does not differ significantly from that for the boom years.

Higher sales growth increases the probability of obtaining additional loans, consistent with either a loan demand effect or a loan supply effect if banks are more likely to lend to healthier firms. 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. The negative effect of Loans/Assets is consistent with there being limits on the degree of leverage by firms in the form of bank loans. The negative effect of bank size indicates that larger firms were less likely to obtain additional loans, although that could reflect, at least in part, the fact that larger firms tended to have access to the bond market. None of the other explanatory variables have statistically significant effects.

When the measure of firm technical health, Log of TFP, is included in columns 3 and 4, we find that, unlike in the boom period, having higher TFP is associated with an increased probability of receiving additional loans in the post-bubble period. Moreover, the estimated effect in the post-bubble period differs statistically from that for the boom period. This result suggests that when the crisis set in, the technical health of firms became an 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. In addition, including the measure of firm technical health leaves the estimated effects of Average ROA essentially unchanged.

Table 5 considers three alternative dependent variables, focusing on the post-bubble period when evergreening is more likely to have occurred. In addition to the indicator for a positive change in total loans in column 1, columns 2 and 3 contain the results for the same indicator variables for a positive change in main bank loans and in secondary bank loans, respectively. The distinction between main bank loans and secondary bank loans is made because main banks, due to their long-term relationship with a firm, may be more likely to evergreen loans to troubled firms than are secondary banks, which presumably have weaker connections to the firms for which they are not the main bank. Three additional explanatory variables also are included in the specifications: Change in ROA, Change in Working Capital and Current Bonds/Assets. Negative values for the changes in ROA and working capital can serve as an indicator of deteriorating financial health. Current Bonds/Assets serves as an indicator for potential loan demand, insofar as a firm with bonds that mature within one year may replace those bonds with bank loans, especially if the health of the firm has deteriorated to the extent that they will have trouble issuing new bonds to arms-length investors.

The estimated coefficients for ROA are quite similar across the three specifications in Table 5, suggesting that main banks and secondary banks based their loan decisions based on a firm's technical health similarly. However, for Average ROA, the estimated effect for secondary bank lenders is only a little more than one-half that (in absolute value) for main banks,

consistent with main banks being more likely to evergreen loans to troubled firms. Moreover, secondary banks place more emphasis on Sales Growth and are less likely to increase loans to firms with a larger loan exposure (higher loan leverage ratio). On the other hand, the estimated negative effects of Average Working Capital, Change in ROA and Change in Working Capital are larger (in absolute value) for secondary banks than for main banks. Still, as in Table 4, the main bank health indicators do not produce statistically significant effects.

Table 6 contains results for specifications similar to those in Table 5 except that the dependent variable is now the change in loans outstanding to the firm, scaled by total firm assets, if the change in loans is positive, and zero otherwise. Because of the change in the dependent variable from a (1,0) dummy variable, we use a Tobit specification rather than a probit specification. Thus, rather than indicating the effect on the probability of obtaining an increase in loans, the estimated coefficients indicate the effect on the magnitude of the increase in loans outstanding to the firm. This contrasts with the results in Table 5 that indicated similar estimated effects on the probability of obtaining increased loans. The negative effect of Average ROA is only slightly less (in absolute value) for secondary banks compared with main banks. Similarly, Sales Growth has a positive effect for secondary bank, but not for main banks, suggesting that secondary banks place more focus on firm financial health. Also, the effect of Current Bonds/Assets is larger for secondary banks, as are the negative effects (in absolute value) for Average Working Capital, Change in ROA, and Change in Working Capital. Another interesting change compared to Table 5, is that Healthy Main Bank now has a significant positive effect for secondary banks. That is, a secondary bank is willing to increase loans to a firm by more if the firm's main bank is healthy. One explanation for such a result is

that if the firm's main bank is healthy and the firm becomes troubled, the main bank is in a better position to help the firm avoid defaulting on its loans.

To here so far

6. Conclusion

xx

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Table 1

Incidence of firms obtaining an increase in loans outstanding by cohorts based on relative financial and relative technical health and by main bank health categories

PANEL A: Firms divided into cohorts on the basis of average ROA

	Loans to Top ROA	Loans to Middle ROA	Loans to Bottom ROA	Number with additional loans
All Banks	27.96%	34.59%	37.45%	2002
Healthy Banks	25.74%	37.72%	36.54%	509
Medium Health Banks	29.23%	39.43%	31.34%	673
Unhealthy Banks	28.29%	28.68%	43.03%	820

PANEL B: Firms divided into cohorts on the basis of TFP

	Loans to Top TFP	Loans to Middle TFP	Loans to Bottom TFP	Number with additional loans
All Banks	38.92%	33.25%	28.24%	2002
Healthy Banks	37.37%	32.61%	30.02%	509
Medium Health Banks	41.01%	32.63%	26.36%	673
Unhealthy Banks	38.17%	34.15%	28.68%	820

Notes: The number of firm observations with a positive change in outstanding loans for each cohort as a percentage of the total number of firm observations with a positive change in outstanding loans made during the period. The number of observations with a positive change in outstanding loans is in column 4. Average ROA is the average return on assets over the last two years. Firms are divided into three groups based on their average ROA or TFP measured relative to the median value of the firm's industry for each year, with approximately one-third of the observations in each category. Banks are divided into three groups based on their market-to-book ratio in each year, with approximately one-third of the firm observations in each category.

Table 2

Percentage distribution of firm observations with a positive change in outstanding loans by total factor productivity cohorts for each year

	Regression Year	TFP High	TFP Medium	TFP Low
1984	July 1984 to June 1985	26.06%	35.11%	38.83%
1985	July 1985 to June 1986	28.01%	34.43%	37.56%
1986	July 1986 to June 1987	26.17%	35.16%	38.67%
1987	July 1987 to June 1988	30.65%	34.69%	34.66%
1988	July 1988 to June 1989	32.10%	35.29%	32.61%
1989	July 1989 to June 1990	36.78%	28.70%	34.52%
1990	July 1990 to June 1991	33.23%	32.62%	34.13%
1991	July 1991 to June 1992	33.88%	34.43%	31.68%
1992	July 1992 to June 1993	30.70%	35.97%	33.33%
1993	July 1993 to June 1994	36.24%	35.76%	28.00%
1994	July 1994 to June 1995	37.5%	31.60%	30.9%
1995	July 1995 to June 1996	36.10%	34.71%	29.19%
1996	July 1996 to June 1997	34.55%	34.55%	30.90%
1997	July 1997 to June 1998	36.23%	34.43%	29.34%
1998	July 1998 to June 1999	36.38%	35.08%	28.54%
1999	July 1999 to June 2000	35.48%	35.08%	29.44%
2000	July 2000 to June 2001	39.60%	29.20%	31.20%

Note: Firms are divided into three cohorts each year based on their TFP relative to the median for their industry, with approximately one-third of firm observations in each cohort.

Table 3: Summary Statistics

	Boom Period				Post Bubble Period			
	Mean	**Standard Deviation**	**Minimum**	**Maximum**	**Mean**	**Standard Deviation**	**Minimum**	**Maximum**
Probability of new loans	0.41	0.49	0	1	0.38	0.49	0	1
Probability of new loans from Main Banks	0.40	0.49	0	1	0.35	0.48	0	1
Probability of new loans from Secondary Banks	0.40	0.49	0	1	0.40	0.49	0	1
Additional Loans/Assets	1.99	4.88	0	87.64	1.64	3.91	0	73.48
Additional Loans from Main Banks/Assets	0.73	1.99	0	36.73	0.60	1.99	0	75.71
Additional Loans from Secondary Banks/Assets	1.44	3.78	0	87.64	1.42	3.39	0	66.01
TFP Growth	18.81	32.66	-85.78	181.18	-26.63	21.22	-68.23	99.32
Log of TFP	4.21	4.34	-3.36	25.44	3.53	4.99	-4.61	29.45
Average ROA	5.32	4.03	-24.79	26.20	2.74	3.36	-14.29	20.53
Sales Growth	4.58	12.32	-49.96	71.13	-1.03	10.07	-62.23	64.13
Average Working Capital	13.28	16.07	-40.58	68.32	15.32	17.24	-91.83	71.72
Change in ROA	-0.05	3.60	-22.65	23.27	-0.28	2.56	-13.91	14.73
Change in Working Capital	0.82	6.27	-36.22	43.98	-0.44	7.01	-175.46	43.01
Current Bond/Assets	0.15	0.55	0	8.62	1.34	3.26	0	24.85
Loans/Assets	24.68	17.25	0.01	105.97	21.81	16.87	0.02	205.25

Tangible Asset Share	24.65	10.38	1.95	65.85	28.94	12.41	0.47	77.11
Log of Assets	17.51	1.47	13.72	22.70	17.03	2.38	12.26	25.61
Healthy main bank	0.89	0.31	0	1	0.28	0.45	0	1
Unhealthy main bank	0.08	0.27	0	1	0.42	0.49	0	1
Same Keiretsu	0.34	0.47	0	1	0.31	0.46	0	1

Note: The boom period includes 754 firms and 3,569 observations. The post-bubble period includes 961 firms and 5,730 observations.

Table 4: Baseline Regression, Marginal Effects

	(1)		(2)	
	Boom subperiod	**Post-bubble subperiod**	**Boom subperiod**	**Post-bubble subperiod**
Log of TFP			0.0119	0.0176[a]*
			(0.0175)	(0.0086)
Average ROA	-0.0079**	-0.0127**	-0.0081**	-0.0131**
	(0.0025)	(0.0023)	(0.0026)	(0.0023)
Sales Growth	0.0064**	0.0009	0.0022**	0.0008
	(0.0023)	(0.0008)	(0.0008)	(0.0008)
Average Working Capital	-0.0017*	-0.0035**	-0.0016	-0.0034**
	(0.0008)	(0.0007)	(0.0009)	(0.0006)
Loans/Assets	-0.0029**	-0.0040**	-0.0029**	-0.0040**
	(0.0008)	(0.0007)	(0.0008)	(0.0007)
Tangible Asset Share	0.0006	-0.0003	0.0008	-0.0000
	(0.0011)	(0.0072)	(0.0011)	(0.0007)
Log of Assets	-0.0390**	-0.0162[b]**	-0.0420**	-0.02335[a]**
	(0.0069)	(0.0049)	(0.0076)	(0.0063)
Healthy Main Bank	-0.0092	-0.0035	-0.0088	-0.0028
	(0.0487)	(0.0185)	(0.0487)	(0.0185)
Unhealthy Main Bank	-0.0208	0.0102	-0.0200	0.0098
	(0.0563)	(0.0174)	(0.0563)	(0.0174)
Same Keiretsu	-0.0212	-0.0225	-0.0206	-0.0201
	(0.0202)	(0.0079)	(0.0202)	(0.0164)
Pseudo R-squared	0.0637		0.0635	
Number of Observations	9,299		9,299	
Number of Firms	999		999	

Notes: All regressions include industry*year fixed effects and random effects at the firm level. The dependent variable is a dummy variable that takes a value of one if the change in outstanding loans between periods t and (t-1) is positive, and zero otherwise.

*: Significant at 5%; **: Significant at 1%; Robust standard errors in parentheses.

[a] Denotes that the estimated coefficients for the boom and post-bubble subperiods differ significantly at the 5% level

[b] Denotes that the estimated coefficients for the boom and post-bubble subperiods differ significantly at the 1% level

Table 5: Probit Regression for Post-Bubble Period, Marginal Effects

	(1) Total Loans	(2) Main Bank Loans	(3) Secondary Bank Loans
Log of TFP	0.0252*	0.0225*	0.0217*
	(0.0099)	(0.0098)	(0.0095)
Average ROA	-0.0089**	-0.0083**	-0.0049**
	(0.0024)	(0.0023)	(0.0023)
Sales Growth	0.0024**	0.0008	0.0024**
	(0.0008)	(0.0008)	(0.0008)
Average Working Capital	-0.0031**	-0.0020*	-0.0031**
	(0.0007)	(0.0007)	(0.0006)
Change in ROA	-0.0133**	-0.0076*	-0.0138**
	(0.0031)	(0.0030)	(0.0031)
Change in Working Capital	-0.0043**	-0.0018	-0.0045**
	(0.0010)	(0.0010)	(0.0010)
Current Bonds/Assets	0.0194**	0.0189**	0.0168**
	(0.0022)	(0.0021)	(0.0022)
Loans/Assets	-0.0031**	0.0003	-0.0024**
	(0.0007)	(0.0007)	(0.0006)
Tangible Asset Share	-0.0003	0.0017*	0.0002
	(0.0007)	(0.0007)	(0.0007)
Log of Assets	-0.0338**	-0.0374**	-0.0231**
	(0.0065)	(0.0064)	(0.0060)
Healthy Main Bank	-0.0079	-0.0202	0.0093
	(0.0183)	(0.0180)	(0.0182)
Unhealthy Main Bank	0.0021	0.0093	0.0296
	(0.0173)	(0.0169)	(0.0169)
Same Keiretsu	-0.0169	-0.0189	0.0005
	(0.0166)	(0.0163)	(0.0153)
Pseudo R-squared	0.0865	0.0847	0.0774
Number of Observations	5,730	5,730	5,719
Number of Firms	961	961	959

Notes: All regressions include industry*year fixed effects and random effects at the firm level. The dependent variable is a dummy variable that takes a value of one if the change in outstanding loans between periods t and (t-1) is positive, and zero otherwise. Robust standard errors in parentheses.
*: Significant at 5%; **: Significant at 1%.

Table 6: Tobit Regressions, Post-Bubble Period

	(1) Total Loans	(2) Main Bank Loans	(3) Secondary Bank Loans
Log of TFP	0.5969**	0.2774**	0.4512**
	(0.1485)	(0.0869)	(0.1287)
Average ROA	-0.1246**	-0.0951**	-0.0773*
	(0.0354)	(0.0203)	(0.0309)
Sales Growth	0.0369**	-0.0033	0.0291*
	(0.0126)	(0.0071)	(0.0115)
Average Working Capital	-0.0450**	-0.0134*	-0.0356**
	(0.0101)	(0.0057)	(0.0085)
Change in ROA	-0.2082**	-0.0137	-0.2177**
	(0.0462)	(0.0262)	(0.0425)
Change in Working Capital	-0.0813**	-0.0156	-0.0728**
	(0.0152)	(0.0086)	(0.0138)
Current Bonds/Assets	0.4187**	0.1792**	0.3140**
	(0.0310)	(0.0179)	(0.0284)
Loans/Assets	-0.0367**	0.0041	-0.0020
	(0.0104)	(0.0056)	(0.0085)
Tangible Asset Share	0.0016	0.0163**	0.0110
	(0.0109)	(0.0061)	(0.0092)
Log of Assets	-0.8011**	-0.4990**	-0.4783**
	(0.0966)	(0.0558)	(0.0804)
Healthy Main Bank	0.1187	-0.0884	0.5641*
	(0.2742)	(0.1597)	(0.2501)
Unhealthy Main Bank	0.1188	0.1935	0.4426
	(0.2567)	(0.1479)	(0.2295)
Same Keiretsu	-0.0437	-0.0304	0.0420
	(0.2447)	(0.1408)	(0.2040)
Constant	13.1050**	6.9053**	5.2958*
	(2.7673)	(1.5815)	(2.6345)
Pseudo R-squared	0.0348	0.0335	0.0309
Number of Observations	5,730	5,730	5,719
Number of Firms	961	961	959

Notes: All regressions include Industry*Year fixed effects and fixed effects at the firm level. The dependent variable is the percentage change in outstanding loans between periods t and (t-1), divided by total assets in period (t-1) when the change in outstanding loans is positive, and zero otherwise. Robust standard errors, clustered at the firm level in parentheses.
*: Significant at 5%; **: Significant at 1%.

Table 7: Probit Regressions for Post-Bubble Period, Marginal Effects

	(1) Total Loans		(2) Main Bank Loans	(3) Secondary Bank Loans
Log of TFP	0.0285**	0.0281**	0.0266*	0.0219*
	(0.0100)	(0.0104)	(0.0103)	(0.0100)
Average ROA	-0.0059*	-0.0069*	-0.0057*	-0.0030
	(0.0028)	(0.0028)	(0.0028)	(0.0027)
TFP*Average ROA	-0.0009*	-0.0007*	-0.0008*	-0.0006*
	(0.0004)	(0.0003)	(0.0004)	(0.0003)
Sales Growth	0.0024**	0.0023**	0.0008	0.0024**
	(0.0008)	(0.0008)	(0.0008)	(0.0008)
Average Working Capital	-0.0031**	-0.0026**	-0.0017*	-0.0030**
	(0.0007)	(0.0008)	(0.0007)	(0.0007)
TFP*Average Working Capital		-0.0001	-0.0001	-0.0001
		(0.0001)	(0.0001)	(0.0002)
Change in ROA	-0.0132**	-0.0111**	-0.0063	-0.0132**
	(0.0031)	(0.0037)	(0.0035)	(0.0036)
TFP*Change in ROA		-0.0006*	-0.0004	-0.0002*
		(0.0003)	(0.0006)	(0.0001)
Change in Working Capital	-0.0043**	-0.0026**	-0.0006	-0.0043**
	(0.0010)	(0.0008)	(0.0012)	(0.0012)
TFP*Change in Working Capital		-0.0001	-0.0004	-0.0001
		(0.0002)	(0.0002)	(0.0002)
Current Bonds/Assets	0.0194**	0.0215**	0.0210**	0.0185**
	(0.0022)	(0.0028)	(0.0027)	(0.0028)
TFP*Current Bonds/Assets		-0.0006	-0.0006	-0.0004
		(0.0005)	(0.0004)	(0.0004)
Loans/Assets	-0.0031**	-0.0030**	0.0003	-0.0024**
	(0.0007)	(0.0007)	(0.0007)	(0.0006)
Tangible Asset Share	-0.0004	-0.0004	0.0016*	0.0002
	(0.0008)	(0.0007)	(0.0007)	(0.0007)
Log of Assets	-0.0343**	-0.0344**	-0.0377**	-0.0240**
	(0.0065)	(0.0065)	(0.0064)	(0.0060)
Healthy Main Bank	-0.0082	-0.0179	-0.0294	-0.0074
	(0.0183)	(0.0225)	(0.0223)	(0.0223)
Unhealthy Main Bank	0.0016	-0.0149	0.0188	-0.0014
	(0.0173)	(0.0123)	(0.0208)	(0.0208)
TFP*Healthy Main Bank		0.0027*	0.0023*	0.0046
		(0.0013)	(0.0011)	(0.0037)
TFP*Unhealthy Main Bank		0.0045	-0.0026	0.0084*
		(0.0034)	(0.0033)	(0.0033)
Same Keiretsu	-0.0162	-0.0159	-0.0170	0.0004
	(0.0166)	(0.0166)	(0.0163)	(0.0153)
Pseudo R- Squared	0.0323	0.0322	0.0327	0.0283
Number of Observations	5,730	5,730	5,730	5,719
Number of Firms	961	961	961	959

Note: All regressions include industry*year fixed effects and random effects at the firm level. The dependent variable is a dummy variable that takes a value of one if the change in outstanding loans between periods t and (t-1) is positive, and zero otherwise. Robust standard errors in parentheses.
*: Significant at 5%; **: Significant at 1%.

Table 8: Probit Regression Marginal Effects

	(1) Total Loans	(2) Main Bank Loans	(3) Secondary Bank Loans
TFP High*ROA High	0.0093	-0.0219	-0.0230
	(0.0282)	(0.0278)	(0.0271)
TFP Middle*ROA High	-0.0854**	-0.0618*	-0.0801**
	(0.0028)	(0.0278)	(0.0276)
TFP Low*ROA High	-0.0450	-0.0577*	-0.0322*
	(0.0310)	(0.0285)	(0.0197)
TFP High*ROA Middle	0.0121	0.0026	0.0053
	(0.0275)	(0.0267)	(0.0265)
TFP Low*ROA Middle	-0.0183	-0.0155	-0.0054
	(0.0282)	(0.0273)	(0.0273)
TFP High*ROA Low	0.0408*	0.0139*	0.0262*
	(0.0201)	(0.0063)	(0.0102)
TFP Middle*ROA Low	0.0535*	0.0417	0.0107*
	(0.0280)	(0.0273)	(0.0046)
TFP Low*ROA Low	-0.0072	-0.0153	-0.0193**
	(0.0273)	(0.0265)	(0.0063)
Sales Growth	0.0022*	0.0007	0.0024**
	(0.0008)	(0.0008)	(0.0008)
Average Working Capital	-0.0029**	-0.0019**	-0.0031***
	(0.0007)	(0.0007)	(0.0006)
Change in ROA	-0.0137**	-0.0082**	-0.0141**
	(0.0031)	(0.0030)	(0.0031)
Change in Working Capital	-0.0046**	-0.0020*	-0.0047**
	(0.0010)	(0.0010)	(0.0010)
Current Bonds/Assets	0.0187**	0.0183**	0.0159**
	(0.0022)	(0.0021)	(0.0022)
Loans/Assets	-0.0029**	0.0005	-0.0023**
	(0.0007)	(0.0006)	(0.0006)
Tangible Asset Share	-0.0001	0.0017*	0.0000
	(0.0008)	(0.0007)	(0.0007)
Log of Assets	-0.0294**	-0.0321**	-0.0164**
	(0.0054)	(0.0054)	(0.0051)
Healthy Main Bank	-0.0088	-0.0216	0.0092
	(0.0183)	(0.0180)	(0.0181)
Unhealthy Main Bank	0.0015	0.0087	0.0294
	(0.0173)	(0.0169)	(0.0168)
Same Keiretsu	-0.0209	-0.0219	-0.0026
	(0.0165)	(0.0163)	(0.0151)
Pseudo R- Squared	0.0331	0.0312	0.0277
Number of Observations	5,730	5,730	5,719
Number of Firms	961	961	959

*: Significant at 5%; **: Significant at 1%; Robust standard errors in parentheses.

Note: All regressions include industry*year fixed effects and random effects at the firm level. The dependent variable is a dummy variable that takes a value 1 if the change in outstanding loans between two consecutive years is positive and 0 otherwise. All regressions contain industry*year fixed effect and random effects at firm level.

Table 9: Probit Regression Marginal Effects

	(1) Total Loans	(2) Main Bank Loans	(3) Secondary Bank Loans
TFP High* Healthy Bank	0.0126	-0.0103	0.0106*
	(0.0309)	(0.0304)	(0.0052)
TFP Middle*Healthy Bank	-0.0211	-0.0461	-0.0198
	(0.0304)	(0.0298)	(0.0301)
TFP Low*Healthy Bank	0.0001	-0.0425	0.0079
	(0.0321)	(0.0316)	(0.0314)
TFP High*Medium Healthy Bank	0.0319*	-0.0041	0.0012**
	(0.0119)	(0.0285)	(0.0003)
TFP Low*Medium Healthy Bank	-0.0190*	-0.0300	-0.0287
	(0.0093)	(0.0282)	(0.0287)
TFP High*Unhealthy Bank	0.0409*	0.0055*	0.0198*
	(0.0209)	(0.0027)	(0.0097)
TFP Middle*Unhealthy Bank	0.0129	0.0160**	0.0168
	(0.0282)	(0.0027)	(0.0277)
TFP Low*Unhealthy Bank	-0.0288	-0.0262	0.0247
	(0.0289)	(0.0281)	(0.0279)
Average ROA	-0.0091**	-0.0084**	-0.0045*
	(0.0024)	(0.0023)	(0.0022)
Sales Growth	0.0023**	0.0008	0.0024**
	(0.0008)	(0.0008)	(0.0008)
Average Working Capital	-0.0030**	-0.0020**	-0.0032**
	(0.0007)	(0.0007)	(0.0006)
Change in ROA	-0.0133**	-0.0077*	-0.0139**
	(0.0031)	(0.003)	(0.0031)
Change in Working Capital	-0.0044**	-0.0019	-0.0046**
	(0.0010)	(0.0010)	(0.0010)
Current Bonds/Assets	0.0190**	0.0185**	0.0164**
	(0.0022)	(0.0021)	(0.0022)
Loans/Assets	-0.0029**	0.0004	-0.0024**
	(0.0007)	(0.0007)	(0.0006)
Tangible Asset Share	-0.0001	0.0017*	-0.0000
	(0.0008)	(0.0007)	(0.0007)
Log of Assets	-0.0287**	-0.0318**	-0.0156**
	(0.0055)	(0.0054)	(0.0051)
Same Keiretsu	-0.0215	-0.0222	-0.0024
	(0.0165)	(0.0163)	(0.0152)
Pseudo R- Squared	0.0322	0.0310	0.0265
Number of Observations	5,730	5,730	5,719
Number of Firms	961	961	959

*: Significant at 5%; **: Significant at 1%; Robust standard errors in parentheses.

Note: All regressions include industry*year fixed effects and random effects at the firm level. The dependent variable is a dummy variable that takes a value 1 if the change in outstanding loans between two consecutive years is positive and 0 otherwise. All regressions contain industry*year fixed effect and random effects at firm level.

Table 10: Determinants of Increases in TFP

VARIABLES	(1)	(2)	(3)
Additional Loans/Assets	0.0088**	0.0142**	0.0107**
	(0.0023)	(0.0047)	(0.0022)
Average ROA	-0.0034	-0.0039	-0.0028
	(0.0045)	(0.0045)	(0.0045)
Sales Growth	0.0008	0.0011	0.0009
	(0.0012)	(0.0012)	(0.0012)
Average Working Capital	0.0063**	0.0061**	0.0070**
	(0.0017)	(0.0017)	(0.0018)
Change in ROA	-0.0079*	-0.0092*	-0.0088*
	(0.0039)	(0.0050)	(0.0049)
Change in Working Capital	0.0030	0.0028	0.0029
	(0.0019)	(0.0019)	(0.0019)
Current Bonds/Assets	0.0115**	0.0115**	0.0118**
	(0.0036)	(0.0036)	(0.0036)
Tangible Asset Share	0.0057*	0.0054	0.0069*
	(0.0028)	(0.0028)	(0.0029)
Log of Assets	-1.3739**	-1.3727**	-1.3831**
	(0.0112)	(0.0113)	(0.0106)
Healthy Main Bank	0.0144	0.0140	0.0077
	(0.0250)	(0.0251)	(0.0252)
Unhealthy Main Bank	-0.0449*	-0.0456*	-0.0491*
	(0.0198)	(0.0200)	(0.0202)
Same Keiretsu	-0.0119	-0.0058	0.0026
	(0.0600)	(0.0605)	(0.0636)
Constant	23.2859***	23.2482***	23.2801***
	(0.2198)	(0.2241)	(0.2032)
Industry*Year Fixed Effects	YES	YES	YES
Firm Fixed Effects	YES	YES	YES
R squared	0.3882	0.3779	0.3580
Number of Observations	5,730	5,730	5,719
Number of Firms	961	961	959

*: Significant at 5%; **: Significant at 1%; Robust standard errors, clustered at the firm level in parentheses
Note: The dependent variable if the TFP growth between two consecutive regression years. In column (1) the variable additional loans capture the change in total loans divided by lagged total assets. In column (2) additional loans capture the change in main bank loans divided by lagged total assets, while in column (3) additional loans are change in secondary bank loans divided by lagged total assets.

Table 11: Impact of bank health on additional loan usage to increase TFP

VARIABLES	(1)	(2)	(3)
Additional Loans/Assets	0.0092**	0.0123*	0.0141**
	(0.0039)	(0.0069)	(0.0056)
Average ROA	-0.0034	-0.0038	-0.0030
	(0.0045)	(0.0045)	(0.0045)
Sales Growth	0.0008	0.0010	0.0010
	(0.0012)	(0.0012)	(0.0012)
Average Working Capital	0.0064***	0.0063***	0.0072***
	(0.0017)	(0.0017)	(0.0018)
Change in ROA	-0.0078	-0.0087*	-0.0089*
	(0.0049)	(0.0050)	(0.0049)
Change in Working Capital	0.0030	0.0029	0.0030
	(0.0019)	(0.0019)	(0.0019)
Current Bonds/Assets	0.0116***	0.0118***	0.0118***
	(0.0036)	(0.0036)	(0.0036)
Tangible Asset Share	0.0059**	0.0058**	0.0069**
	(0.0028)	(0.0029)	(0.0029)
Log of Assets	-1.3742***	-1.3732***	-1.3839***
	(0.0113)	(0.0114)	(0.0106)
Healthy Main Bank	0.0270	0.0184	0.0301
	(0.0273)	(0.0258)	(0.0286)
Unhealthy Main Bank	-0.0505**	-0.0547***	-0.0511**
	(0.0228)	(0.0209)	(0.0227)
Same Keiretsu	-0.0090	-0.0018	0.0115
	(0.0595)	(0.0598)	(0.0637)
(Additional Loans/Assets)*Healthy Main Bank	0.0074	0.0096*	0.0159**
	(0.0058)	(0.0043)	(0.0080)
(Additional Loans/Assets)*Unhealthy Main Bank	0.0032	-0.0148*	0.0009
	(0.0051)	(0.0073)	(0.0060)
Constant	23.1210***	23.4027***	23.2489***
	(0.2167)	(0.2248)	(0.2052)
Industry*Year Fixed Effects	YES	YES	YES
Firm Fixed Effects	YES	YES	YES
R squared	0.3722	0.3722	0.3801
Number of Observations	5,730	5,730	5,719
Number of Firms	961	961	959

*: Significant at 5%; **: Significant at 1%; Robust standard errors, clustered at the firm level in parentheses

Note: The dependent variable if the TFP growth between two consecutive regression years. In column (1) the variable additional loans capture the change in total loans divided by lagged total assets. In column (2) additional

loans capture the change in main bank loans divided by lagged total assets, while in column (3) additional loans are change in secondary bank loans divided by lagged total assets.

Table 12: Impact of firm characteristics on additional loan usage

VARIABLES	(1)	(2)	(3)
Additional Loans	0.0123**	0.0163	0.0120**
	(0.0033)	(0.0084)	(0.0026)
Average ROA	-0.0036	-0.0042	-0.0038
	(0.0046)	(0.0045)	(0.0047)
Sales Growth	0.0003	0.0004	0.0003*
	(0.0013)	(0.0003)	(0.0001)
Average Working Capital	0.0058**	0.0052**	0.0062**
	(0.0016)	(0.0017)	(0.0017)
Change in ROA	-0.0126*	-0.0104*	-0.0108*
	(0.0055)	(0.0051)	(0.0052)
Change in Working Capital	0.0024	0.0025	0.0025
	(0.0019)	(0.0019)	(0.0019)
Current Bonds/Assets	0.0107**	0.0108**	0.0109**
	(0.0035)	(0.0036)	(0.0036)
Log of Assets	-1.3731**	-1.3723**	-1.3820**
	(0.0113)	(0.0114)	(0.0106)
Healthy Main Bank	0.0134	0.0148	0.0078
	(0.0249)	(0.0250)	(0.0253)
Unhealthy Main Bank	-0.0444*	-0.0448*	-0.0485*
	(0.0199)	(0.0200)	(0.0203)
Same Keiretsu	-0.0072	-0.0012	0.0054
	(0.0600)	(0.0600)	(0.0637)
Additional Loans*Average ROA	-0.0003	-0.0001	0.0001
	(0.0006)	(0.0013)	(0.0006)
Additional Loans*Sales Growth	0.0002*	0.0004*	0.0002*
	(0.0001)	(0.0002)	(0.0001)
Additional Loans*Average Working Capital	-0.0003*	-0.0002*	-0.0003**
	(0.0001)	(0.0001)	(0.0001)
Additional Loans*Change in ROA	-0.0014**	-0.0002*	-0.0012**
	(0.0002)	(0.0001)	(0.0003)
Additional Loans*Change in Working Capital	0.0000	0.0001	0.0000
	(0.0002)	(0.0007)	(0.0003)
Constant	23.4274**	23.2304**	23.7676**
	(0.2060)	(0.2023)	(0.1908)
Industry*Year Fixed Effects	YES	YES	YES
Firm Fixed Effects	YES	YES	YES
R squared	0.3722	0.3722	0.3801
Number of Observations	5,730	5,730	5,719
Number of Firms	961	961	959

*: Significant at 5%; **: Significant at 1%; Robust standard errors, clustered at the firm level in parentheses
Note: The dependent variable if the TFP growth between two consecutive regression years. In column (1) the variable additional loans capture the change in total loans divided by lagged total assets. In column (2) additional loans capture the change in main bank loans divided by lagged total assets, while in column (3) additional loans are change in secondary bank loans divided by lagged total assets.