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# Bank Health and Small Business Investment: Evidence from Japan

**HOSONO Kaoru**
Gakushuin University

**MASUDA Akane**

RIETI
Research Institute of Economy, Trade & Industry, IAA

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Kaoru Hosono
Akane Masuda

## Abstract

Does the deterioration in bank health reduce the client firm investment? If so, how large is the effect? We answer these questions for Japanese small manufacturing firms over the period 2001-2003. We find that a firm tends to reduce investment as its main bank deteriorates financial conditions, after controlling for the firm's sales growth, cash flow and the ratio of debt to market-valued total assets. If a major bank exhibits a decline in the capital ratio margin over the required level by 1 percent point, the client firm reduces its investment ratio by about 2.2 percent points. In the case of the firms with its main bank being a credit bank or a credit union, an increase in the bank's non-performing loan ratio by 1 percent point decreases the client firm's investment ratio by 0.43 percent points. On the other hand, for the firms with its main bank being a regional bank, we do not find a significant effect of bank balance sheets on the firm investment.

* Correspondence: Gakushuin University, Mejiro 1-5-1, Toshima-ku, Tokyo 171-8588, email kaoru.hosono@gakushuin.ac.jp (K. Hosono)

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# Bank Health and Small Business Investment: Evidence from Japan

## 1. Introduction

Does weakness in the financial sector affect the real economy? This question attracts a great concern whenever a banking crisis hits an economy. In Japan, banks had been burdened with non-performing loans for nearly 15 years since the early 1990s when land prices and share prices had dropped sharply (Figure 1). At the same time, many small- and medium-sized enterprises (SMEs) faced liquidity shortages and funding problems. Figure 2 shows that loans to SMEs decreased sharply during the 1997-2003 period, when the banking crisis became most severe. On the other hand, Figure 3 shows that SMEs' financial positions worsened in 1997 and 1998 and stayed tight afterwards. Finally, Figure 4 shows that the decline in the investment ratio of manufacturing firms during the 1997-99 period was greater for firms with a small equity size than for firms with larger equity sizes. Casual observations suggest that there seems to be a link between bank health and SMEs' investment, given that many small firms depend largely upon banks when they seek for outside funds.

Though there are some preceding studies that investigate the link between bank health and firm investment, most of the existing evidences focus on the effects of bank health on stock-market-listed firms. This paper aims at filling this gap by examining the relationship between bank health and small business investment using matched samples of about 6000 Japanese small manufacturing firms and their main banks during the period of 2001-2003.

When capital adequacy requirements are enforced, a poorly-capitalized bank may tighten loan conditions or reduce loan supply to avoid government intervention and other regulatory costs. If the bank acquires information through a long-term relationship with a firm, client firms may face difficulty in finding alternative funds because outsiders do not have adequate information. Even if the firm can find alternative finds, it may have to pay a higher cost. Consequently, as the bank deteriorates its balance sheet conditions, the client firm will curtail investment.

This linkage between bank health and firm investment depends on two key factors. First, it depends on to what extent a weak bank tightens the terms or the availability of credit, which, in turn, depends on how strictly the regulatory authorities implement capital adequacy requirements. In Japan, the government introduced the Basel capital standards from fiscal year 1992. Those banks that operate internationally have had to maintain their capital as a proportion of risk-adjusted assets above 8% since then. However, the government initially assisted banks in manipulating regulatory capital to prevent them from falling short of the minimum capital level. Specifically, the government allowed banks to extend loans to those firms that were unlikely to recover, instead of writing off those loans (e.g., Hosono and Sakuragawa, 2002; Peek and Rosengren, 2003). Under such a government forbearance policy, a poorly-capitalized bank may not decrease loan supply. Rather, it may even increase loans to insolvent firms. When two large financial institutions, Hokkaido Takushoku Bank and Yamaichi Securities, failed in 1998, the authorities changed the policy stances and strengthened supervision especially towards major banks. Loans to insolvent firms began to decrease after 1998 (Sakuragawa, 2005). Though the government has required domestically-operating banks to maintain their capital as a proportion of risk-adjusted assets above 4% since March 1998, the implementations towards regional banks, credit banks and credit unions seemed to be more lenient than towards major banks. This tendency became apparent since the Financial Services Agency (FSA) published the *Program for Financial Revival* in October 2002, which declared a target of reducing major banks' NPL ratios to about half by the end of FY 2004. To this aim, the FSA required strict standards for loan loss provisions especially to major banks. Poorly capitalized major banks may have decreased loan supply to a more extent than poorly capitalized regional banks, credit banks or credit unions. Figure 5 shows that major banks decreased loans outstanding to SMEs by about a quarter from 1993: IV to 2003: III, while first-tier regional banks and credit banks decreased loans outstanding to SMEs by about ten percent during the same period. Though second-tier regional banks also decreased loans

outstanding to SMEs by about a quarter during the same period, this is partly due to the fact that a large number of second-tier regional banks were merged by larger banks.

Second, the linkage between bank health and firm investment is stronger as the firm has to pay a higher cost for finding alternative funds. This switching cost, in turn, depends on to what extent the incumbent bank has informational advantage over outside banks. Small business is more likely to incur a higher switching cost; Small business rarely discloses adequate information on its financing conditions as compared with large, listed business. In addition, small business usually does not have sufficient equity to raise funds from arm's length sources. As a result, small business should be more likely to be affected by bank health than large business. Especially in Japan, firms depend largely on bank loans even after regulations on bond issues had been lifted during the mid 1980s.[1]

In sum, by examining Japanese small firms, we should be most likely to detect a linkage between bank health and firm investment. If we could not find the linkage with our sample, it would be unlikely to find the link for other countries or large firms. There is also a practical advantage for examining Japanese firms. The relationships between firms and banks are disclosed in Japan, unlike many other countries including the U.S. This is the case for small firms as well as for large firms.

The rest of this paper is as follows. Section 2 provides surveys on related literature. Section 3 conducts theoretical analyses on the relationship between bank health and the terms of credit. Section 4 describes data and methodology for empirical analyses. Section 5 reports estimation results. Section 6 concludes.

## 2. Related Literature

### A. Theory

If capital market is frictionless, a firm's financial structure is irrelevant to its real activities (the Modigliani-Miller theorem). A firm can obtain funds from many sources and hence does not fall into financial difficulty even if one source of funds is

disrupted. On the other hand, if capital market is characterized by asymmetric information between borrowers and investors, a firm may find it difficult to switch from the investors who have the firm's private information to those who do not have as far as private information is not easily transferable.

Some economists insist that banks can play a role of overcoming the asymmetric information problems. Diamond (1984) argues that delegating monitoring to a financial intermediary is less costly than investors' direct monitoring if the intermediary can sufficiently diversify its loan portfolio and hence investors do not have to monitor the intermediary.

Actually, banks acquire information over time through contract with the firm on a variety of dimensions and use this information in their decisions about the availability and terms of credit to the firm. Berger and Udell (2002), among others, asserted that such relationship lending is one of the most powerful technologies available to reduce information problems in small firm finance.

Even though it is the most efficient way to acquire information, relationship lending has some disadvantages especially when one bank monopolistically acquires information. If the informed bank falls into financial distress and stops lending to the firm, the client firm cannot find alternative financial sources and has to give up profitable investment opportunities. Detragiache, Garellia and Guiso (2000) analyze the determinants of the number of banks that a firm transacts with based on the costs and benefits of relationship lending.

Bank health affects the availability of credit especially under capital adequacy requirements. Thakor (1996) theoretically shows that capital requirements linked solely to credit risk are shown to increase equilibrium credit rationing and provide empirical support.

In Section 3, we present a simple model showing how the bank health affects the availability and the cost of credit thorough the costs that the bank incurs in the face of firm default under capital requirements.

### B. Evidence

Many studies explored the effects of bank health on the real economy in the context of credit crunch (See Bernanke (1993), and Bernanke and Lown (1991), among others, for the U.S.).[2] However, most of the preceding evidences were at the aggregate level and hence difficult to interpret. Even when a positive correlation between bank health and the real economic activities is found at the macroeconomic level, it is often difficult to determine whether bank health affected the real economic activities or vice versa.

Gibson (1995) first used matched samples of firms and their main banks. Analysis of matched samples at the micro level has an advantage over the macro level analysis in that the former is less prone to the reverse causality from firms to banks, because loans to each firm are relatively small for a bank. Gibson used a cross-sectional dataset of stock-market-listed Japanese firms and their main banks in the period 1991-1992 to estimate the effects of bank health on firm investment. After controlling for stock market valuation and cash flow, Gibson (1995) found that investment was lower by 30% at firms that had one of the lowest-rated banks as their main bank. Gibson (1997) applied a similar method to stock-market-listed Japanese firms in 1994-1995. He found that the financial health of the firm's main bank did not significantly affect its investment, though among the subset of bank-dependent firms, investment was lower by over 50% at firms that have one of the lowest-rated banks as their main bank. Nagahata and Sekine (2002) also used matched samples of stock-market-listed Japanese firms and their main banks in the period 1993-2000. After controlling for the firm's sales growth, cash flow, and debt/asset ratio, they found that the main bank's capital ratio had a significant effect on the client firm's investment if the firm had never issued public bonds, while the main bank's capital ratio had no significant effect if the client firm had issued public bonds.[3]

Recently, two studies focus on the relationship between bank health and firm behavior using non-listed, Japanese firms. First, Fukuda, Kasuya and Nakajima (2005) used matched samples of non-listed firms with a capital of 100 million yens or more and their main banks over the period 1997-2003 to estimate firm

investment. After controlling for the firm's estimated marginal Q and cash flow, they found that two bank health measures had a significant effect on firm investment. One of their bank health measures is the margin of regulatory capital over the required level and the other is the non-performing loan ratio. Second, Ogawa (2005) used a survey data conducted by Small Business Agency from 2001 to 2003 and examined the effect of bank health on fixed investment, inventory investment, employment and some other firm activities. He found that the main bank's bad loans as a proportion of total loans negatively affected the firm's growth rate of tangible assets and the number of employees.

We use small business data without any truncation in terms of firm equity or size, while Gibson (1995, 1997) and Nagahata and Sekine (2002 ) used stock-market-listed firms and Fukuda et al., (2005) used non-listed firms with a capital of less than 100 million yens. This paper is complementary to Ogawa (2005) in that Ogawa (2005) investigates the effects of bank health on firm activities in various dimensions, while we focus on firm investment and investigate the difference across the main bank types to consider the possible effects of different regulatory enforcement on bank lending behavior and hence on firm investment.

This paper is also related to the literature of relationship banking. Many studies on relationship banking, including Petersen and Rajan (1994), Boot (2000), Boot and Thakor (2000), and Berger and Udel (1995, 2002), found favorable effects of relationship banking on financing in terms of lower interest rates or improved availability of loans. On the other hand, by examining the period when bank health was seriously deteriorated, we can analyze the costs of relationship banking.

Some preceding studies examined the costs of relationship banking in terms of the availability of funds or the terms of credit. Hubbard, Kuttner and Palia (2002), using loan contract data in the U.S. over the period 1987-1992, found that banks with scarce capital tended to charge higher interest rates on loans. Hosono, Sawada and Watanabe (2003) analyzed a survey of Japanese small business over the period 1999-2001. Their results suggest that the main bank's financial positions affect the availability of loans for small firms especially when the firm transacts with a small

number of banks. They also show that about a quarter of the firms whose application for loans was rejected by their main bank could find alternative financing sources. This evidence suggests that loans from the main bank may be substitutable, to some extent, to loans from the secondary bank or some other financial institutions.

Studies on the effects of bank failures on borrowing firms' share prices can also shed lights on the costs of relationship banking, though the existing evidences are mixed. Slovin et al. (1993) examined the case of the near bank failure of Continental Illinois Bank and found a negative effect on the borrowing firms' share prices at the time of the bank's imminent failure. Bae et al. (2002) analyzed Korean banking crises in 1997-1998 and found a negative effect of bank failures on borrowing firms' stock returns. Ongena et al. (2003) analyzed Norwegian banking crises in 1988-1991 and found no significant effect of bank failures on borrowing firms' stock returns. Conducting a case study of one Japanese major bank, Hokkaido Takushoku Bank, Yamori and Murakami (1999) found a negative effect on borrowing firms' share price. Fukuda and Koibuchi (2003) analyzed three Japanese major banks' failures (Hokkaido Takushoku Bank, Long-Term Credit Bank of Japan, and Nippon Credit Bank) and also found a negative effect on borrowing firms' stock returns. On the other hand, Brewer III et al. (2003) examined the same three bank failures and found that borrowing firms' market value decreased on the day when bank failure was released, while the degrees of decrease in market values of borrowing firms were not significantly different from those of non-borrowing firms. Most of these case studies analyzed stock-market-listed companies. One exception is Hori and Takahashi (2004), who examined the effects of the failure of Hokkaido Takushoku Bank using samples including small firms. They found that profitability of borrowing firms were not significantly lower than non-borrowing firms.

Most of the above mentioned studies suggest that weak bank health adversely affected firm performance, which is consistent with the capital crunch view. On the other hand, some recent empirical studies suggest that weak banks extended loans to non-performing firms (zombies) that would otherwise have failed, which is

consistent with the soft budget constraint view (Dewatripont and Maskin, 1995). Hosono and Sakuragawa (2002), using Japanese bank data over the period 1992-1999, found that banks tended to extend loans to non-performing firms if banks had lower market-valued capital or relied more on non-marketable subordinated debt to satisfy the Basel capital standards. Peek and Rosengren (2003) used a panel dataset of stock-market-listed Japanese firms and their main banks over the period 1993-1999 and found that less profitable firms were more likely to obtain bank loans, and the more they were as their main bank exhibited a smaller capital ratio margin over the required level. It should be noted that these two studies analyze the period before the Japanese regulatory authorities strengthened supervision and began to strictly enforce capital regulations in the late 1990s. Caballero, Hoshi, and Kashyap (2004) examined the effects of the presence of "zombies," defined as those firms who obtained loans with the average interest rate below prime rates, on the non-zombies' performance. Using a panel dataset of stock-market-listed firms and their main banks over the period 1981-2003, they found that the investment rate and the growth rate of employment were negatively correlated with the share of zombies in the industry. While their results suggest that banks' perverse lending behavior, which possibly resulted from weak bank health condition, had an adverse effect on the real economy, they focused on the crowding-out effect of zombies in the product and labor market. We are interested in the direct effect of bank health on the borrowing firms.

It is possible that some firms suffer from the capital crunch, while other firms are subject to the soft budget constraint. Hosono (2005) estimated the effects of debt on investment using time-series quarterly data of manufacturing and non-manufacturing industries by three size categories from the *Financial Statements Statistics of Corporations by Industry (FSSC)* published by Ministry of Finance. He found that among the small and medium-sized manufacturing, firms with higher debt-to-asset ratios were likely to invest less over the 1991:1 – 2005:1 period. On the other hand, he did not find a negative effect of debt on investment among the small and large non-manufacturing industries. Among the medium-sized

non-manufacturing industries, he found a *positive* effect of debt on investment. Though he did not examine the effect of bank health on firm investment, his results for non-manufacturing firms are consistent with the soft budget or zombie lending hypothesis. This paper focuses on manufacturing SMEs, for which the credit crunch hypothesis should be most likely to be valid. If we could not find a negative impact of deteriorated bank health on investment among manufacturing firms, it would be difficult to find a capital crunch effect for non-manufacturing firms.

## 3. Theoretical Analysis

Bank health will affect the borrower's cost and availability of funds, which, in turn, will influence the borrower's investment. When banks face capital requirements and/or asymmetric information problems, bank health will affect the regulatory costs and/or the monitoring/verification costs. Banks incur these costs when the borrowing firm defaults. In the following subsections, we first discuss how bank health affect the capital regulation cost and other default costs and then present a formal model that explains the effect of the regulation cost on the borrower's cost and availability of funds.

### A. Bank Health and Capital Regulation Cost

Bank health can affect the costs that a bank incurs in the face of firm default or the risk of firm default in various ways.

First, bank health may affect the monitoring incentive. Close monitoring will enable the bank to control the borrower's risk-taking behavior, which will reduce the risk of default. Close monitoring will also enable the bank to assess the borrower's asset and cash flow, which will eventually reduce the cost for verification and recovery in the case of default. However, monitoring needs a long-term investment in establishing the relationship with the borrower. Financially distressed banks may be forced to reduce such investment. As a result, weaker banks are more likely to incur higher monitoring and verification costs.

More importantly, capital adequacy requirements link bank health with default

costs. Under capital requirements, those banks whose regulatory capital is short of the minimum requirement incur various regulatory costs including mandatory recapitalization, downsizing of assets, mergers, and suspension of some or all business. In addition, these regulatory costs include the non-pecuniary costs that managers incur if they are replaced by the government due to capital shortage. Given the current prompt corrective actions, the marginal cost of these regulatory interventions tends to increase as the capital shortage widens. Consequently, those banks whose regulatory capital is closer to the minimum requirement level incur higher costs when a borrower defaults.

Default costs arising from capital requirements differ how strictly the regulatory authorities implement the regulation. In Japan, as mentioned in Introduction, the actual implementations towards major banks have been stricter towards major banks than towards regional banks, credit banks and credit unions since the late 1990s.

### B. Capital Regulation Cost and the Availability and Terms of Credit

*Setup*

We consider a one-period loan market model in which there is a risk-neutral borrower and a risk-neutral lender (or a bank). The borrower has asset, $A<1$, and a project that needs one unit of outside fund at the beginning of the period. The borrower's asset can serve as collateral. The return of the project is distributed with the marginal distribution of $f(y)$ and is realized at the end of the period. We consider only debt contracts and assume that the bank incurs a cost of $m$ when the borrower defaults. $m$ mainly captures the capital regulation cost. Based on the above argument, we assume that $m$ is a decreasing, convex function of the bank capital, $E$.

**Assumption 1.** $\frac{\partial m}{\partial E}<0$ and $\frac{\partial^2 m}{\partial E^2}>0$.

We hereafter write $m$ instead of $m(E)$ as long as it is not confusing. If we interpret $m$ as the verification cost that the bank needs to know the realized value

of the return, debt contracts naturally arise (e.g., Williamson, 1987).

Let denote the amount that the borrower promises to repay by *D*. Normalizing the gross risk-free interest rate by one, we can write the bank's expected profit from the debt contract as follows.

$$\pi^L(D) = \int_0^{D-A} (y + A - m) f(y) dy + \int_{D-A}^{D} (D - m) f(y) dy + \int_D^{\infty} D f(y) - 1 \qquad (1)$$

The first term in the right hand side is the expected return when the sum of the project return and the borrower's asset falls short of the promised amount of repayment, $y + A < D$. In this region, the bank seizes all the borrower's asset and the project return but incurs the regulation cost. The second term is the expected return when the project return falls short of the promised repayment but the sum of the project return and the borrower's asset exceeds the promised repayment, $y \le D < y + A$. In this case, the lender seizes a part of the borrower's asset by incurring the regulation cost so that he can receive the promised repayment. The third term is the expected return when the project return exceeds the promised repayment, $D \le y$. In this region, the lender receives the promised return without incurring the regulation cost.

On the other hand, the borrower's expected profit is as follows.

$$\pi^B(D) = \int_{D-A}^{\infty} (y + A - D) f(y) dy - A \qquad (2)$$

The sum of the profits of the incumbent bank and the borrower is

$$\pi^L(D) + \pi^B(D) = \int_0^{\infty} y f(y) dy - 1 - m \int_0^{D} f(y) dy \qquad (3)$$

The first two terms of the right hand side is the net present value of the project. The second term denotes the expected capital regulation cost of the bank.

*Equilibrium*

We assume that the borrower makes a take-it-or-leave-it offer to the bank. Under this assumption, the borrower offers the lowest interest rate that makes the bank profit nonnegative. Given that the total surplus, Equation (3) is a decreasing

function of $D$, our assumption that the borrower has all the bargaining power seems to be reasonable. At equilibrium, the bank profit becomes zero as long as it is feasible.

$$\pi^L(D) = 0 \tag{4}$$

We specify the distribution function of the project return to explicitly solve the interest rate, $D$. We assume that the project return is uniformly distributed over $[0, \mu]$, so that $f(y) = \mu^{-1}$. Then,

$$\pi^L(D) = (2\mu)^{-1}\{-D^2 + 2(A + \mu - m^I)D - A^2\} - 1 \tag{5}$$

and

$$\pi^B(D) = (2\mu)^{-1}(\mu + A - D)^2 - A \tag{6}$$

From the bank's zero profit condition, Equation (4), we can derive the following proposition and corollaries, which are illustrated by Figure 6. All the proofs are given by Appendix 1. Though these results certainly depend on our specific assumption on $f(y)$, we believe that the following results hold for a broader set of distributions. Furthermore, some of the following results have been extensively tested in the preceding empirical works.[4]

**Proposition 1.** *If* $A \geq \overline{A} \equiv (\mu - m)^{-1}\mu - 0.5(\mu - m)$ *holds, then, the bank lends to the borrower at the interest rate*

$$D^* = (A + \mu - m) - \{(A + \mu - m)^2 - A^2 - 2\mu\}^{\frac{1}{2}} \tag{7}$$

*Otherwise, the credit market collapses.*

**Corollary 1.** $\dfrac{\partial D^*}{\partial A} < 0$ and $\dfrac{\partial^2 D^*}{\partial A^2} > 0$

As long as the borrower has a sufficient net worth, it can borrow a fund from the bank. The interest rate is smaller as the borrower net worth is larger. The effect of the borrower net worth on the interest rate diminishes as the borrower net worth becomes larger.

**Corollary 2.** $\frac{\partial \overline{A}}{\partial E} < 0$, $\frac{\partial D^*}{\partial E} < 0$ and $\frac{\partial^2 D^*}{\partial E^2} > 0$

As the bank equity increases, the borrower is more likely to obtain credit. If the bank has a sufficient equity, the bank lends to the borrower at a lower interest rate as the bank equity increases. The effect of bank equity on the loan interest rate diminishes as the bank equity becomes larger.

**Corollary 3.** $\frac{\partial^2 D^*}{\partial E \partial A} > 0$

The effect of bank equity on the loan interest rate becomes smaller as the borrower net worth becomes larger.

## 4. Empirical Methodology

### A. Specification

We estimate an accelerator-type investment function instead of a Q-type investment function, because a Q-type investment function needs stock price data, but most of our sample firms are not listed on a stock exchange. Our specification is similar to Nagahata and Sekine (2002):

$$\left(\frac{I_{i,t}}{K_{i,t-1}}\right) = \sum_{h=0}^{1} \beta_h \Delta y_{i,t-h-1} + \theta\left(\frac{CF_{it}}{p^k_{i,t-1}K_{i,t-1}}\right) + \phi BS^f_{i,t-1} + \psi BS^b_{i,t-1} + d_t + \eta_i + v_{it} \qquad (8)$$

,where $I_{it}$ is the gross investment at constant prices, $K_{it}$ the replacement value of capital stock at constant prices, $\Delta y_{it}$ the growth rate of sales at constant prices, $CF_{it}$ cash flow, $p^k_{it}$ the price of capital stock, $BS^f$ a firm balance sheet variable, $BS^b$ a bank balance sheet variable, $d_t$ a fixed time effect (year dummies), $\eta_i$ a fixed firm effect (firm dummies), and $v_{it}$ a disturbance. As the dependent variable, we exclude investment in land.

We capture an accelerator effect on investment by including the sales growths. We include cash flow to consider the liquidity constraints that the firm faces (e.g., Fazzari, Hubbard, and Petersen, 1988). In addition, because cash flow tends to

positively correlated with profitability, we can control for profitability by including cash flow. As a firm balance sheet variable, $BS^f$, we choose debts as a proportion of market-valued assets. Because we measure total assets at their market value, declines in the prices of land held by firms, for example, reduce market-valued assets and hence increase the debt/asset ratio.

We are most interested in the coefficient of bank balance sheet variable, $BS^b$. Given the difficulty in accurately measuring bank equity, we choose three alternative proxies to measure bank health: the margin of the regulatory capital ratio over the required level, the ratio of non-performing loans to total loans, and the growth rate of deposits. The capital ratio margin for internationally-active banks is the difference between the capital ratio at the consolidated base of the Basel standards and the required level, 8 %. The capital ratio margin for domestic banks is the difference between the capital ratio based on the domestic standards and the required level, 4%. Non-performing loan ratio is the ratio of risk-management loans to total loans. The coefficients on the capital ratio margin and the deposit growth rate are expected to be positive, while the coefficient on the non-performing loan ratio is expected to be negative.

We include year dummies to capture macroeconomic shocks including the fluctuations in the safe asset interest rate, the GDP growth rates, and the nation-wide movement in land prices. We include firm dummies to control for fixed firm characteristics that cannot be captured by the sales growth, the cash flow ratio or the debt/asset ratio.

We do not include the capital cost in equation (1) for the following reasons. First, the fluctuations in the safe asset return are captured by year dummies. Second, the fluctuations in the firm-specific capital cost should be influenced by the firm's balance sheet and the bank's balance sheet, captured respectively by $BS^f$ and $BS^b$.

Some econometric issues may arise in estimating equation (1). First, reverse causality from firms to banks are less of a problem in a micro level regression than in an aggregate regression, as we mentioned in Section 2.B. This is particularly the

case where firm size is as small as our sample firms. Second, endogenous choice of the main bank by a firm is also a minor problem. If firms with abundant growth opportunities choose a healthy main bank, we may find a positive correlation between bank health and firm investment even without the real effect of bank health on investment. Such a self-selection mechanism causes a bias only when it occurs within our sample period of three years, because we include firm dummies. However, a survey conducted by Small Business Agency in 2002 revealed that the average period during which Japanese small firms continued to deal with the same main bank was 26.4 years (Ogawa, 2005)..

### B. Sample Selection

Our data source for firm financial statements is JADE, a database in which Bureau van Dijk compiled the data from Teikoku Data Bank, containing about 110 thousand firms over 1999-2003. We selected only manufacturing firms because the heterogeneity of technologies are relatively small as compared to non-manufacturing firms. Homogeneous technology is important for our estimation because we estimate an accelerator-type investment function based on the assumption that the capital-ratio ratio is constant among the sample firms. We further selected those firms whose capital is 300 million yens or less or whose regular employees are 300 or less based on the definition of SMEs by the Small Business Law. Among the 20129 firms defined by small manufacturing firms, we excluded those firms whose financial data were not available for two consecutive years and whose main bank data were not available. We are left with about 6000 small manufacturing firms. Because we use two-year lagged values for explanatory variables, our estimation covers the three-year period of 2001-2003. Our sample is an unbalanced panel with about 15,000 total observations.

When we use the main bank's balance sheet variables, our dataset becomes somewhat smaller and covers about 5200 firms, because we cannot identify some firms' main banks as described below.

### C. Identifying the Main Bank

We identify a firm's main bank as the bank for which the firm's trading volume is the largest according to *JADE*. One problem with *JADE* is that it contains only the recent year's bank lists that the firm trades with. Therefore, we assume that the firm did not change the main bank over the sample period. As we mentioned above, this assumption seems to hold for most small firms. When two or more banks merged during the sample period, we could not identify which bank was the firm's main bank. Therefore, we excluded those firms whose main bank had been involved with mergers during the sample period.

The sources of bank financial data are *Nikkei NEEDS Financial Quest*, annual financial statements of banks, *Financial Statements of Credit Banks in Japan,* and *Financial Statements of Credit Cooperatives in Japan*, the last two of which are edited by Financial Book Consultants, Ltd. (*Kinyu tosho konsarutanto sha*).

### D. Data Construction

The replacement value of capital stock, $K_{it}$, is constructed by applying the perpetual inventory method to tangible fixed assets. See Appendix 2 for details.

The real sales growth, $\Delta y_{it}$, is the growth rate of total sales divided by the output price index for manufacturing in the *Input-Output Price Indexes of Manufacturing* published by Bank of Japan.

The cash flow is defined by the sum of after-tax net profits and depreciations for tangible fixed assets.

The debt-asset ratio, $BS^f$, is the ratio of debt to market-valued assets. We convert book-valued tangible fixed assets to market-valued ones by multiplying real capital stock (including land) derived from the perpetual inventory method by the capital price indexes. We do not convert the book values to market values for assets other than tangible fixed assets.

To remove outliers, we excluded those observations whose investment ratio, $I_{i,t}/K_{i,t-1}$ is more than 2. Removed observations occupy about 0.5% (81) of total observations (17203).

Table 1 shows descriptive sample statistics of the variables used in the following regression analyses. In addition to the statistics of all the samples, we divide the sample firms by their main banks into three types: 1) Major banks, i.e., city banks, long-term credit banks, and trust banks, 2) First-tier regional banks and second-tier regional banks, and 3) credit banks and credit unions. Major banks' client firms display a higher investment ratio, sales growth, capital stock-to-sales ratio, cash flow ratio and a lower debt-to-asset ratio than other firms. Comparing the bank balance sheet variables, we see that major banks display a lower capital ratio margin and deposit growth rate. The average non-performing loan ratio is the highest for credit banks and credit unions, following major banks and then regional banks.

## 5. Estimation Results

### 4.1 Does firm net worth affect investment?

We first exclude bank balance sheet variables from Equation (8) to test Corollary 1. This estimation is also useful to check whether our specification yields a plausible and consistent result with preceding studies. Column 1 of Table 2 shows the baseline estimation result for the whole sample. The one-year lagged value of sales growth is significantly positive, consistent with the accelerator hypothesis. The cash flow ratio is also significantly positive, suggesting either that firms face liquidity constraints or that cash flow is correlated with profitability. The debt-to-asset ratio is significantly negative, suggesting that external finance premium increases as the debt-to-asset ratio rises. Our result suggests that firms with their debt-to-asset ratio larger by 1 standard error, i.e., 21.1 percent points, tend to reduce the investment ratio by 8.5%. A negative effect of firm net worth on investment is consistent with the preceding evidence by Ogawa (2003) on Japanese small firms.

To account for a non-linear effect of the debt-to-asset ratio on investment, we use two dummies for the debt-to-asset ratio. One dummy takes the value of one if the one-period lagged debt-to-asset ratio is in the highest quartile and the value of

zero otherwise. The other dummy takes the value of one if the one-period lagged debt-to-asset ratio is in the lowest quartile and the value of zero otherwise. In Column 2, we omit the debt-to-asset ratio and use these two dummies. The coefficient on the lowest quartile dummy is positive and significant, while the coefficient on the highest quartile dummy is negative and significant, as expected. In Column 3, we include the debt-to-asset ratio as well as the two quartile dummies. The two quartile dummies are not significant, while the debt-to-asset ratio is significantly negative. We have not found a strong nonlinearity in the effect of the debt-to-asset ratio on firm investment.

In Column 4, we take into account the stock adjustment process of physical capital by adding the two-period lagged value of the difference in the logarithms of capital stock and sales, $\log(K_{t-2}) - \log(y_{t-2})$, to the explanatory variables. The coefficient on this variable is negative and significant, as is expected, while the two-period lagged value of sales is negative and significant. Importantly, the coefficient on the debt-to-asset ratio is again negative and significant. We further add $\log(K_{t-1}) - \log(y_{t-1})$ and again obtain a negative and significant coefficient on the debt-to-asset ratio (not reported to save space). The negative effect of the debt-to-asset ratio to investment is robust.

Finally, we investigate whether those firms whose main bank is a government-owned bank were less likely to be affected by their own debt-to-asset ratio. In our sample, about 3.5 % of the firms had a main bank relationship with a government-owned bank. Using the government bank dummy that takes one if the main bank is a government-owned bank and zero otherwise, we see that the interaction term of the government bank dummy and the debt-to-asset ratio is positive (0.396) and significant, while the coefficient of the debt ratio is negative (-0.412) and significant. Again, we found a negative effect of the debt-to-asset ratio on firm investment except for firms with a main bank relationship with a government owned-bank. The government bank seems to make loans regardless of the firm debt-to-asset ratio when it has a main bank relationship with the firm.[5]

### 4.2 Does bank health affect firm investment?

Next we include bank balance sheet variables in Equation (8) to test Corollary 2. Considering that regulatory and supervisory frameworks and actual bank health have been different among bank types, we divide sample firms by the type of their main banks. We exclude the firms whose main bank is a government-owned bank in the following analyses.

#### A. Major banks' client firms

For the firms whose main banks are major banks, Column1 of Table 3A shows that the coefficient on the capital ratio margin is significantly positive. If a major bank exhibits a decline in the capital ratio margin over the required level by 1 percent point, the client firm reduces its investment ratio by about 2.2 percent points. A difference in the bank capital ratio margin by one standard error (1.6%) causes a difference in the investment ratio by 3.4%, about a quarter of the standard error in the investment ratio.

In Column 2, we take into account a nonlinear effect of the bank capital ratio on firm investment by adding a dummy that takes the value of one if the capital ratio margin is less than 2 but more than 1. The coefficient on this dummy shows the difference from the capital ratio margin more than 2, because there was no major bank in our sample that displays a capital ratio margin less than 1. The coefficient on this capital ratio margin dummy is negative and significant, as is expected.

When we use the non-performing loan ratio as a proxy (inverse) to bank equity (Column 3), we see that its coefficient is not significant. On the other hand, when we use the deposit growth ratio (Column 4), we see that its coefficient is positive and significant. These results suggest that major banks' client firms were affected by their main bank's financial conditions.

#### B. Regional banks' client firms

In the case of firms whose main banks are regional banks (Table 3.B), none of the four bank balance sheet variables are significant, though the firm debt-to-asset

ratio is significantly negative. We have not found evidence suggesting that regional banks' client firms were affected by their main bank's financial conditions.

### C. Credit banks' client firms and credit unions' client banks

For the firms whose main banks are credit banks or credit unions (Table 3C), the non-performing loan ratio is significantly negative (Column 3), while the capital ratio margin or the non-performing loan ratio is not significant (Columns 1, 2 and 4). A one percentage point increase in the non-performing loan share leads to the reduction in the client firm investment by 0.47% points. It is also notable that the absolute value of the coefficients the debt-to-asset ratio is relatively small (around 0.3) as compared to the firms with its main bank being a major bank or regional bank (around 0.5).

We interpret our results as follows. The Japanese supervisory authorities urged major banks to reduce non-performing loans. Unhealthy major banks had to reduce small business loans to a greater degree than similarly unhealthy regional banks, credit banks and credit unions. On the other hand, credit banks and credit unions established a longer relationship with client firms than major banks and regional banks, accumulating private information that is not transferable to other banks. Once credit banks and credit unions reduce loans due to accumulated non-performing loans, small firms faced difficulty in finding alternative financing sources and had to reduce investment.

## 4.3 Does bank haaealth hit weaker firms more seriously?

Our theoretical analysis suggests that the effect of bank equity on firm investment is stronger as the firm net worth is smaller (Corollary 3). We test this hypothesis by multiplying the bank health measures by the firm debt-to-asset ratio dummies: one is for the highest quartile and the other is for the lowest quartile.

### A. Major banks' client firms

For major banks' client firms (Table 4A), Column 1 shows that the interaction term of the capital ratio margin and the lowest quartile dummy of the debt-to-asset ratio is significantly negative, and the absolute value of its coefficient (-0.023) is almost the same as the coefficient on the capital ratio margin (0.024), suggesting that firms with a low debt-to-asset ratio were not affected by their main bank's capital ratio. On the other hand, the interaction term of the capital ratio margin and the highest quartile of the debt-to-asset ratio is significantly positive, suggesting that firms with a high debt-to-asset ratio had to reduce investment more than other firms when the main bank capital ratio margin decreased.

Column 2 shows that the interaction term of the non-performing loan ratio with the lowest quartile dummy of the debt-to-asset ratio is not significant, while the interaction term with the highest quartile dummy is positive and significant. Given that the coefficient on the non-performing loan ratio is not significant, these results suggest that a highly indebted firm could increase investment more than other firms as their main banks increased the non-performing loan ratio, which is in opposite to our theoretical prediction.

Column 3 shows the result for the deposit growth rate. We see that neither of the interaction terms of the deposit growth rate with the debt-to-asset ratio dummies is significant.

### B. Regional banks' client firms

For regional banks' client firms (Table 4B), Column 2 suggests that firms in the highest quartile of the debt-to-asset ratio reduced investment more than other firms when the bank increased the non-performing loan ratio, which is consistent with Corollary 3. On the other hand, Columns 1 and 3 suggest that firms in the highest quartile of the debt-to-asset ratio increased investment more than other firms when the bank increased the capital ratio margin or the deposit growth rate, which is in opposite to Corollary 3.

### C. Credit banks' client firms and credit unions' client firms

For credit banks' client firms and credit unions' client firms (Table 4C), Column 3 shows that the interaction terms of the deposit growth rate with the lowest quartile dummy and the highest quartile dummy are both negative and significant. The negative coefficient on the interaction term with the highest quartile dummy is in opposite to our theoretical prediction.

In sum, while we find some evidence that weak firms were more likely to be affected by bank health (in the case of major banks' capital ratio margin and regional banks' non-performing ratio), we also find contradictory evidences. We do not obtain robust results concerning the effect of firm balance sheet on the relationship between bank health and firm investment.

## 6. Conclusion

When capital adequacy requirements are enforced, a poorly-capitalized bank may tighten loan conditions or reduce loan supply to avoid government intervention and other regulatory costs. If the bank acquires information through a long-term relationship with a firm, the client firm may face difficulty in finding alternative funds because outsiders do not have adequate information. Even if the firm can find alternative finds, it may have to pay a higher cost. Consequently, as the bank deteriorates its balance sheet conditions, the client firm will curtail investment. We test this hypothesis using a panel dataset of about 6000 Japanese small firms over the period 2001-2003.

We find that a firm tends to reduce investment as its main bank deteriorates financial conditions, after controlling for the firm's sales growth, cash flow and the ratio of debt to market-valued total assets. If a major bank exhibits a decline in the capital ratio margin over the required level by 1 percent point, the client firm reduces its investment ratio by about 2.2 percent points. In the case of the firms with its main bank being a credit bank or a credit union, an increase in the bank's non-performing loan ratio by 1 percent point decreases the client firm's investment ratio by 0.43 percent points. On the other hand, we do not find a significant effect of

bank balance sheets on the firm investment for the firms with its main bank being a regional bank. The difference by bank type seems to suggest that regulations and supervisions as well as the accumulation of private information influence the link between bank health and firm investment.

We also test the hypothesis that weaker firms are more likely to be affected by bank health. Though we find some evidence supporting this hypothesis, our results are not robust to the measures of bank health or to the bank types.

It should be noted that our results are derived from manufacturing SMEs, for which the credit crunch hypothesis should be most likely to be valid (Hosono, 2005). Nonetheless, this paper bears some important policy implications. To what extent bank health affects firm investment depends on two factors. One factor is how regulatory authorities strictly enforce capital adequacy requirements and supervisions. The other factor is how easily firms' private information can be shared with or transferable to multiple financial institutions. The first factor does not necessarily imply that lenient bank regulations or supervisions can increase firm investment when banks are burdened with non-performing loans. Government forbearance policies will not reduce banks' non-performing loans, and hence constrain investment by those firms that depend solely on their main banks, as the second factor suggests. Restoring bank health seems to be indispensable to support investment by manufacturing SMEs.

## Appendix 1. Proofs of the Proposition and the Corollaries

### Proof of Proposition 1.

If $A \geq \overline{A} \equiv (\mu - m)^{-1}\mu - 0.5(\mu - m)$, $\pi(D) = 0$ implies that

$$D^* = (A + \mu - m) - \left\{(A + \mu - m)^2 - A^2 - 2\mu\right\}^{\frac{1}{2}} \tag{A1}$$

Though there are two values that satisfy $\pi^L(D) = 0$, the borrower offers the lower value of *D*. On the other hand, if $A < \overline{A}$, there is no real number of $D$ that satisfies $\pi^L(D) = 0$.

### Proof of Corollary 1.

$$\frac{\partial D^*}{\partial A} = -\frac{\frac{\partial \pi^L}{\partial A}}{\frac{\partial \pi}{\partial D}} = -\frac{D^* - A}{A + \mu - m - D^*} < 0 \tag{A2}$$

, where the inequality holds by (A1)

$$\frac{\partial^2 D^*}{\partial A^2} = \frac{\mu - m}{(A + \mu - m - D^*)^2} - \frac{\mu - m}{(A + \mu - m - D^*)^2}\frac{\partial D^*}{\partial A} > 0$$

, where the inequality holds by (A2).

### Proof of Corollary 2.

$$\frac{\partial \overline{A}}{\partial m} = 0.5 + \mu(\mu - m)^{-2} > 0$$

By Assumption 1, we get $\frac{\partial \overline{A}}{\partial E} < 0$.

$$\frac{\partial D^*}{\partial m} = -\frac{\frac{\partial \pi^L}{\partial m}}{\frac{\partial \pi}{\partial D}} = \frac{D^*}{A + \mu - m - D^*} > 0 \tag{A3}$$

By Assumption 1, we get $\frac{\partial D^*}{\partial E} < 0$

$$\frac{\partial^2 D^*}{\partial m^2} = \frac{D}{(A+\mu-m-D^*)^2} + \frac{A+\mu-m}{(A+\mu-m-D^*)^2}\frac{\partial D^*}{\partial m} > 0$$

, where the inequality holds by (A3). By Assumption 1, we get $\frac{\partial^2 D^*}{\partial E^2} > 0$.

**Proof of Corollary 3.**

From (A2),

$$\frac{\partial^2 D^*}{\partial m \partial A} = -\frac{(D^* - A)}{(A+\mu-m-D^*)^2} - \frac{\mu-m}{(A+\mu-m-D^*)^2}\frac{\partial D^*}{\partial m} < 0$$

, where the inequality holds by (A3). By Assumption 1, we get $\frac{\partial^2 D^*}{\partial E \partial A} > 0$.

## Appendix 2. Construction of Replacement Value of Capital Stock, $K_{it}$

We divide tangible fixed assets into land and other tangible fixed assets and apply the following perpetually inventory method to obtain the market value of capital stock.

$$(p^k K)_{it} = \frac{p_t^k}{p_{t-1}^k}(p^k K)_{i,t-1}(1-\delta) + (p^k I)_{it}$$

The first term on the right hand side is the market-valued capital stock at the end of the previous year deducted by depreciations at a rate of $\delta$, reevaluated at the current market value. The second term is the nominal amounts of current investment. We obtain the initial, benchmark capital stock by multiplying the ratio of market-value to book-value, which in turn we estimate from the *Annual Corporate Financial Statistics* published by Ministry of Finance.[6]

For land, we use the urban land price index for all use as the deflator, $p_t^k$ and the increase in book-valued land as the nominal investment, $(p^k I)_{it}$ as long as the increase in book-value land is not negative. If it is negative, we multiply it with $p_t^k / p_{it*}^k$, where $t*$ denotes the latest year when the firm increased the book-valued land, based on the assumption that firms sell the land that it bought most recently.

For other tangible fixed assets, we apply 7.72% to the depreciation rate, $\delta$, which is borrower from Ogawa and Kitasaka (1998) (all industries, all fixed capital stock). We use the private corporate investment deflator of SNA as the deflator, $p_t^k$.

## Footnotes

[1] For the evidence on the debt structure of Japanese publicly-listed firms after financial deregulation, see, e.g., Hosono (2003).

[2] For the Japanese economy, see Woo (1999), Kang and Stultz (2002), Peek and Rosengren (2000), Klein, Peek and Rosengren (2002), and Ito and Sasaki (2002).

[3] They modified disclosed capital ratio to adjust for possible underestimates of losses from risk-management loans.

[4] Specifically, Bernanke, Gertler and Gilchrist (1996) and Hosono and Watanabe (2002) tested the hypothesis that the effect of borrower net worth on the external finance premium diminishes as the borrower net worth increases.

[5] We formally tested the null hypothesis that the sum of the coefficients on the debt-to-asset ratio and the interaction term of the debt-to-asset ratio with the government bank dummy, and could not reject the null hypothesis.

[6] For the market-to-book ratio of land, we apply the perpetual inventory method using the land price index for all use in the six major banks. The benchmark period that we use for the perpetual inventory method is the second quarter of 1980. We borrow from Ogawa and Kitasaka (1998) (Table A-5) as the market-to-book ratio of land at the benchmark period, 3.98. What we obtain as the market-to-book ratios of land are 1.98 for FY 1998, 1.66 for FY 1999, 1.61 for FY 2000, 1.49 for FY 2001, 1.29 for FY 2002, and 1.26 for FY 2003. For the market-to-book ratio of other tangible fixed assets, we apply the perpetual inventory method assuming that the book-value was identical to the market-value as of the benchmark period, 1980:2. The depreciation rate we used is 7.74 per annum, which is borrowed from Ogawa and Kitasaka (1998) (Table A-2, manufacturing industries). We corrected for the change in samples according to Social Engineering Institute (1976).

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Table 1. Descriptive Sample Statistics

| Variable | Period | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|---|
| **A. All samples** | | | | | | |
| I(t)/K(t-1) | 2001-2003 | 17172 | 0.023 | 0.139 | -0.803 | 1.989 |
| △Sales | 1999-2002 | 26965 | 0.011 | 0.519 | -0.969 | 61.862 |
| Log(Capital Stock)-Log(Sales) | 1999-2001 | 20926 | 1.761 | 2.418 | -4.169 | 7.033 |
| Debt / Asset (t-1) | 2000-2002 | 19644 | 0.595 | 0.211 | 0.014 | 4.521 |
| Cash flow/ Nominal Capital Stock (t-1 | 2001-2003 | 16941 | 0.043 | 0.347 | -14.495 | 17.876 |
| Capital Ratio Margin | 2000-2002 | 11953 | 4.415 | 2.605 | -1.730 | 36.890 |
| Non-Performing Loan Ratio | 2000-2002 | 14184 | 0.083 | 0.030 | 0.007 | 0.315 |
| Deposit growth Ratio | 2000-2002 | 10952 | 0.010 | 0.056 | -0.699 | 1.767 |
| **B. Major banks' client firms** | | | | | | |
| I(t)/K(t-1) | 2001-2003 | 6311 | 0.026 | 0.156 | -0.803 | 1.989 |
| △Sales | 1999-2002 | 9527 | 0.016 | 0.395 | -0.918 | 15.820 |
| Log(Capital Stock)-Log(Sales) (t-2) | 1999-2001 | 7324 | 2.555 | 2.264 | -3.928 | 7.033 |
| Debt / Asset (t-1) | 2000-2002 | 7158 | 0.558 | 0.217 | 0.030 | 4.238 |
| Cash flow/ Nominal Capital Stock (t-1 | 2001-2003 | 6311 | 0.047 | 0.480 | -14.495 | 17.876 |
| Capital Ratio Margin | 2000-2002 | 4109 | 2.455 | 1.554 | -1.730 | 6.790 |
| Non-Performing Loan Ratio | 2000-2002 | 4135 | 0.089 | 0.023 | 0.044 | 0.166 |
| Deposit growth Ratio | 2000-2002 | 1028 | -0.010 | 0.035 | -0.040 | 0.195 |
| **C. Regional banks' client firms** | | | | | | |
| I(t)/K(t-1) | 2001-2003 | 6862 | 0.021 | 0.128 | -0.759 | 1.740 |
| △Sales | 1999-2002 | 10438 | 0.007 | 0.306 | -0.916 | 13.167 |
| Log(Capital Stock)-Log(Sales) (t-2) | 1999-2001 | 8016 | 1.235 | 2.378 | -4.169 | 6.329 |
| Debt / Asset (t-1) | 2000-2002 | 7911 | 0.604 | 0.206 | 0.019 | 4.521 |
| Cash flow/ Nominal Capital Stock (t-1 | 2001-2003 | 6861 | 0.041 | 0.228 | -14.146 | 4.905 |
| Capital Ratio Margin | 2000-2002 | 5707 | 4.916 | 1.523 | 0.000 | 9.180 |
| Non-Performing Loan Ratio | 2000-2002 | 7911 | 0.075 | 0.026 | 0.031 | 0.189 |
| Deposit growth Ratio | 2000-2002 | 7859 | 0.009 | 0.033 | -0.209 | 0.277 |
| **D. Credit banks' client firms and credit unions' client firms** | | | | | | |
| I(t)/K(t-1) | 2001-2003 | 2803 | 0.019 | 0.123 | -0.694 | 1.458 |
| △Sales | 1999-2002 | 4351 | 0.005 | 0.385 | -0.969 | 14.087 |
| Log(Capital Stock)-Log(Sales) (t-2) | 1999-2001 | 3349 | 1.259 | 2.358 | -3.584 | 6.831 |
| Debt / Asset (t-1) | 2000-2002 | 3289 | 0.643 | 0.202 | 0.015 | 2.658 |
| Cash flow/ Nominal Capital Stock (t-1 | 2001-2003 | 2803 | 0.036 | 0.142 | -3.563 | 2.108 |
| Capital Ratio Margin | 2000-2002 | 2137 | 6.847 | 3.625 | 0.420 | 36.890 |
| Non-Performing Loan Ratio | 2000-2002 | 2138 | 0.098 | 0.044 | 0.007 | 0.315 |
| Deposit growth Ratio | 2000-2002 | 2065 | 0.026 | 0.108 | -0.699 | 1.767 |

**Table 2. Investment Function with Firm Balance Sheet Variable**

Dependent variable: I(t)/K(t-1)

| Column | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| △Sales(t-1) | 0.014 ** | 0.009 * | 0.014 ** | 0.043 ** | 0.014 ** |
| | (0.005) | (0.005) | (0.005) | (0.006) | (0.005) |
| △Sales(t-2) | -0.002 | -0.003 | -0.002 | -0.013 ** | -0.002 |
| | (0.004) | (0.004) | (0.004) | (0.004) | (0.004) |
| Log(Capital Stock)-Log(Sales) (t-2) | | | | -0.106 ** | |
| | | | | (0.010) | |
| Cash flow/ Nominal Capital Stock (t-1 | 0.024 ** | 0.017 ** | 0.024 ** | 0.023 ** | 0.024 ** |
| | (0.004) | (0.004) | (0.004) | (0.004) | (0.004) |
| Debt / Asset (t-1) | -0.401 ** | | -0.401 ** | -0.389 ** | -0.412 ** |
| | (0.037) | | (0.041) | (0.037) | (0.038) |
| Debt Ratio Dummy (lowest quartile) (t-1) | | 0.016 * | -0.014 | | |
| | | (0.009) | (0.010) | | |
| Debt Ratio Dummy (highest quartile) (t-1) | | -0.037 ** | -0.012 | | |
| | | (0.008) | (0.008) | | |
| Government Bank Dummy | | | | | 0.396 * |
| * Debt / Asset (t-1) | | | | | (0.214) |
| year2002 | -0.007 ** | -0.010 ** | -0.007 ** | -0.009 ** | -0.007 ** |
| | (0.003) | (0.003) | (0.003) | (0.003) | (0.003) |
| year2003 | -0.005 * | -0.012 ** | -0.005 | -0.007 ** | -0.005 * |
| | (0.003) | (0.003) | (0.003) | (0.003) | (0.003) |
| Constant | 0.264 ** | 0.034 ** | 0.270 ** | 0.449 ** | 0.261 ** |
| | (0.022) | (0.004) | (0.025) | (0.028) | (0.022) |
| Number of observations | 14895 | 14895 | 14895 | 14814 | 14875 |
| Number of firms | 6183 | 6183 | 6183 | 6163 | 6163 |
| Adjusted R-squared | 0.018 | 0.0078 | 0.0185 | 0.0309 | 0.0184 |

1. Numbers in parentheses are standard errors.
2. **, * denote significance levels at 5% and10%, respectively.
3. OLS estimates with a fixed effect model.

**Table 3 Investment Function with Firm and Bank Balance Sheet Variables**

**A. Major Banks' Client Firms**
**Dependent variable: I(t)/K(t-1)**

| Column | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| △Sales(t-1) | 0.030 * | 0.030 * | 0.030 * | 0.006 |
| | (0.016) | (0.016) | (0.016) | (0.078) |
| △Sales(t-2) | 0.000 | 0.000 | 0.003 | 0.099 |
| | (0.014) | (0.014) | (0.014) | (0.064) |
| Cash flow/ Nominal Capital Stock (t-1) | 0.011 | 0.011 | 0.011 | -0.086 |
| | (0.008) | (0.008) | (0.008) | (0.267) |
| Debt / Asset (t-1) | -0.575 ** | -0.579 ** | -0.574 ** | -0.468 |
| | (0.104) | (0.104) | (0.104) | (0.842) |
| Capital Ratio Margin | 0.022 * | | | |
| | (0.013) | | | |
| Dummy for 1<Capital Ratio Margin<2 (t-1) | | -0.163 ** | | |
| | | (0.056) | | |
| Non-Performing Loan Ratio (t-1) | | | 0.007 | |
| | | | (0.324) | |
| Deposit Growth Ratio (t-1) | | | | 0.787 * |
| | | | | (0.464) |
| year2002 | -0.041 ** | -0.185 ** | -0.026 ** | 0.016 |
| | (0.013) | (0.055) | (0.010) | (0.066) |
| year2003 | -0.030 ** | -0.178 ** | -0.019 | 0.049 |
| | (0.012) | (0.056) | (0.015) | (0.071) |
| Constant | 0.318 ** | 0.521 ** | 0.357 ** | 0.235 |
| | (0.062) | (0.080) | (0.067) | (0.459) |
| Number of observations | 3249 | 3249 | 3275 | 775 |
| Number of firms | 1957 | 1957 | 1966 | 748 |
| Adjusted R-squared | 0.0353 | 0.0396 | 0.033 | 0.3189 |

1. Numbers in parentheses are standard errors.
2. **, * denote significance levels at 5% and10%, respectively.
3. OLS estimates with a fixed effect model.

**Table 3 Investment Function with Firm and Bank Balance Sheet Variables**

**B. Regional Banks' Client Firms**
**Dependent variable: I(t)/K(t-1)**

| Column | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| △Sales(t-1) | 0.025 ** | 0.025 ** | 0.019 ** | 0.020 ** |
| | (0.008) | (0.008) | (0.008) | (0.008) |
| △Sales(t-2) | -0.001 | -0.001 | -0.004 | -0.004 |
| | (0.007) | (0.007) | (0.006) | (0.006) |
| Cash flow/ Nominal Capital Stock (t-1) | 0.032 ** | 0.032 ** | 0.045 ** | 0.049 ** |
| | (0.009) | (0.009) | (0.009) | (0.009) |
| Debt / Asset (t-1) | -0.471 ** | -0.476 ** | -0.522 ** | -0.529 ** |
| | (0.062) | (0.062) | (0.054) | (0.054) |
| Capital Ratio Margin | -0.001 | | | |
| | (0.003) | | | |
| Dummy for 0<Capital Ratio Margin <1 (t-1) | | 0.028 | | |
| | | (0.017) | | |
| Dummy for 1<Capital Ratio Margin<2 (t-1) | | 0.013 | | |
| | | (0.034) | | |
| Non-Performing Loan Ratio | | | -0.008 | |
| | | | (0.170) | |
| Deposit growth Ratio | | | | 0.004 |
| | | | | (0.065) |
| year2002 | 0.004 | 0.004 | 0.005 | 0.005 |
| | (0.005) | (0.005) | (0.004) | (0.004) |
| year2003 | 0.010 ** | 0.010 * | 0.010 ** | 0.010 ** |
| | (0.005) | (0.005) | (0.005) | (0.005) |
| Constant | 0.305 ** | 0.304 ** | 0.332 ** | 0.336 ** |
| | (0.041) | (0.038) | (0.034) | (0.032) |
| Number of observations | 4342 | 4342 | 6083 | 6045 |
| Number of firms | 1887 | 1887 | 2554 | 2550 |
| Adjusted R-squared | 0.0276 | 0.0286 | 0.0309 | 0.0327 |

1. Numbers in parentheses are standard errors.
2. **, * denote significance levels at 5% and10%, respectively.
3. OLS estimates with a fixed effect model.

**Table 3 Investment Function with Firm and Bank Balance Sheet Variables**

**C. Credit Banks' Client Firms and Credit Unions' Client Firms**
**Dependent variable: I(t)/K(t-1)**

| Column | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| △Sales(t-1) | -0.001 | -0.001 | -0.001 | -0.001 |
| | (0.010) | (0.010) | (0.010) | (0.010) |
| △Sales(t-2) | 0.001 | 0.000 | 0.001 | 0.000 |
| | (0.010) | (0.010) | (0.010) | (0.010) |
| Cash flow/ Nominal Capital Stock (t-1) | 0.055 * | 0.054 * | 0.055 * | 0.055 * |
| | (0.029) | (0.029) | (0.029) | (0.030) |
| Debt / Asset (t-1) | -0.305 ** | -0.302 ** | -0.293 ** | -0.288 ** |
| | (0.105) | (0.105) | (0.105) | (0.107) |
| Capital Ratio Margin | -0.005 | | | |
| | (0.005) | | | |
| Dummy for 0<Capital Ratio Margin <1 (t-1) | | -0.005 | | |
| | | (0.111) | | |
| Dummy for 1<Capital Ratio Margin<2 (t-1) | | 0.006 | | |
| | | (0.037) | | |
| Non-Performing Loan Ratio | | | -0.470 ** | |
| | | | (0.239) | |
| Deposit growth Ratio | | | | -0.071 |
| | | | | (0.045) |
| year2002 | 0.012 * | 0.011 | 0.017 ** | 0.009 |
| | (0.008) | (0.007) | (0.008) | (0.008) |
| year2003 | 0.008 | 0.006 | 0.014 | 0.005 |
| | (0.009) | (0.009) | (0.010) | (0.009) |
| Constant | 0.245 ** | 0.211 ** | 0.246 ** | 0.205 ** |
| | (0.078) | (0.068) | (0.070) | (0.070) |
| Number of observations | 1561 | 1561 | 1561 | 1504 |
| Number of firms | 710 | 710 | 710 | 673 |
| Adjusted R-squared | 0.014 | 0.0131 | 0.0177 | 0.0158 |

1. Numbers in parentheses are standard errors.
2. **, * denote significance levels at 5% and10%, respectively.
3. OLS estimates with a fixed effect model.

Table 4 Investment Function with Firm and Bank Balance Sheet Variables

A. Major Banks' Client Firms
Dependent variable: I(t)/K(t-1)

| Column | 1 | 2 | 3 |
|---|---|---|---|
| △Sales(t-1) | 0.031 * | 0.031 * | 0.011 |
| | (0.016) | (0.016) | (0.083) |
| △Sales(t-2) | -0.001 | 0.004 | 0.079 |
| | (0.014) | (0.014) | (0.064) |
| Cash flow/ Nominal Capital Stock (t-1) | 0.012 | 0.011 | -0.102 |
| | (0.008) | (0.008) | (0.276) |
| Debt / Asset (t-1) | -0.769 ** | -0.625 ** | -0.472 |
| | (0.115) | (0.107) | (0.922) |
| Capital Ratio Margin (t-1) | 0.024 * | | |
| | (0.013) | | |
| Debt Ratio Dummy (lowest quartile) (t-1) | -0.023 ** | | |
| * Capital Ratoi Margin (t-1) | (0.010) | | |
| Debt Ratio Dummy (highest quartile) (t-1) | 0.023 ** | | |
| * Capital Ratoi Margin (t-1) | (0.008) | | |
| Non-Performing Loan Ratio (t-1) | | -0.059 | |
| | | (0.334) | |
| Debt Ratio Dummy (lowest quartile) (t-1) | | 0.040 | |
| * Non-Performing Loan Ratio (t-1) | | (0.221) | |
| Debt Ratio Dummy (highest quartile) (t-1) | | 0.432 ** | |
| * Non-Performing Loan Ratio (t-1) | | (0.208) | |
| Deposit growth Ratio (t-1) | | | 0.722 |
| | | | (0.528) |
| Debt Ratio Dummy (lowest quartile) (t-1) | | | 0.780 |
| * Deposit Growth Ratio (t-1) | | | (0.752) |
| Debt Ratio Dummy (highest quartile) (t-1) | | | -0.611 |
| * Deposit Growth Ratio (t-1) | | | (0.810) |
| year2002 | -0.040 ** | -0.026 ** | 0.024 |
| | (0.013) | (0.010) | (0.066) |
| year2003 | -0.027 ** | -0.018 | 0.048 |
| | (0.012) | (0.015) | (0.070) |
| Constant | 0.426 ** | 0.382 ** | 0.240 |
| | (0.068) | (0.068) | (0.508) |
| Number of observations | 3249 | 3275 | 775 |
| Number of firms | 1957 | 1966 | 748 |
| Adjusted R-squared | 0.0462 | 0.036 | 0.406 |

1. Numbers in parentheses are standard errors.
2. **, * denote significance levels at 5% and10%, respectively.
3. OLS estimates with a fixed effect model.

Table 4 Investment Function with Firm and Bank Balance Sheet Variables

B. Regional Banks' Client Firms
Dependent variable: I(t)/K(t-1)

| Column | 1 | 2 | 3 |
|---|---|---|---|
| △Sales(t-1) | 0.024 ** | 0.019 ** | 0.020 ** |
| | (0.008) | (0.008) | (0.008) |
| △Sales(t-2) | -0.001 | -0.005 | -0.004 |
| | (0.007) | (0.006) | (0.006) |
| Cash flow/ Nominal Capital Stock (t-1) | 0.032 ** | 0.045 ** | 0.048 ** |
| | (0.009) | (0.009) | (0.009) |
| Debt / Asset (t-1) | -0.452 ** | -0.505 ** | -0.531 ** |
| | (0.066) | (0.058) | (0.054) |
| Capital Ratio Margin (t-1) | 0.001 | | |
| | (0.003) | | |
| Debt Ratio Dummy (lowest quartile) (t-1) | -0.002 | | |
| * Capital Ratoi Margin (t-1) | (0.003) | | |
| Debt Ratio Dummy (highest quartile) (t-1) | -0.004 * | | |
| * Capital Ratoi Margin (t-1) | (0.002) | | |
| Non-Performing Loan Ratio (t-1) | | 0.101 | |
| | | (0.175) | |
| Debt Ratio Dummy (lowest quartile) (t-1) | | -0.195 | |
| * Non-Performing Loan Ratio (t-1) | | (0.167) | |
| Debt Ratio Dummy (highest quartile) (t-1) | | -0.301 ** | |
| * Non-Performing Loan Ratio (t-1) | | (0.131) | |
| Deposit growth Ratio (t-1) | | | 0.134 |
| | | | (0.089) |
| Debt Ratio Dummy (lowest quartile) (t-1) | | | -0.151 |
| * Deposit Growth Ratio (t-1) | | | (0.172) |
| Debt Ratio Dummy (highest quartile) (t-1) | | | -0.327 ** |
| * Deposit Growth Ratio (t-1) | | | (0.142) |
| year2002 | 0.003 | 0.005 | 0.004 |
| | (0.005) | (0.004) | (0.004) |
| year2003 | 0.010 * | 0.010 ** | 0.010 ** |
| | (0.005) | (0.005) | (0.005) |
| Constant | 0.294 ** | 0.322 ** | 0.337 ** |
| | (0.043) | (0.037) | (0.032) |
| Number of observations | 4342 | 6083 | 6045 |
| Number of firms | 1887 | 2554 | 2550 |
| Adjusted R-squared | 0.0289 | 0.033 | 0.0342 |

1. Numbers in parentheses are standard errors.
2. **, * denote significance levels at 5% and10%, respectively.
3. OLS estimates with a fixed effect model.

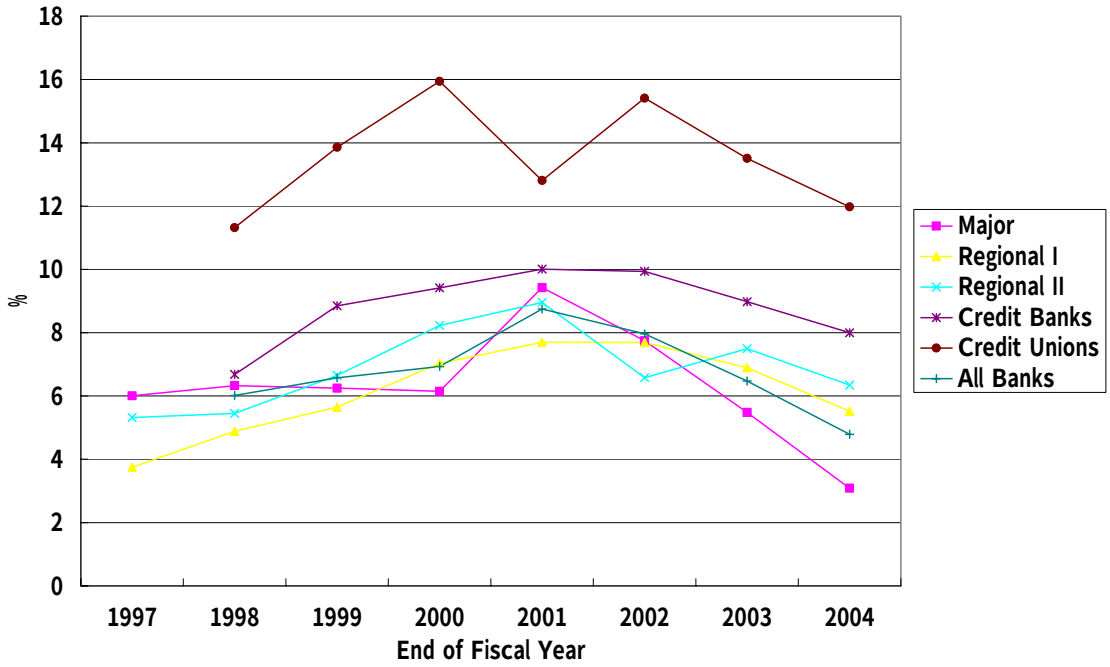
Table 4 Investment Function with Firm and Bank Balance Sheet Variables

C. Credit Banks' Client Firms and Credit Unions' Client Firms
Dependent variable: I(t)/K(t-1)

| Column | 1 | 2 | 3 |
|---|---|---|---|
| △Sales(t-1) | -0.001 | -0.001 | -0.001 |
| | (0.010) | (0.010) | (0.010) |
| △Sales(t-2) | 0.001 | 0.001 | 0.001 |
| | (0.010) | (0.010) | (0.010) |
| Cash flow/ Nominal Capital Stock (t-1) | 0.047 | 0.054 * | 0.054 * |
| | (0.030) | (0.029) | (0.030) |
| Debt / Asset (t-1) | -0.374 ** | -0.330 ** | -0.293 ** |
| | (0.117) | (0.119) | (0.107) |
| Capital Ratio Margin (t-1) | -0.005 | | |
| | (0.005) | | |
| Debt Ratio Dummy (lowest quartile) (t-1) | -0.006 | | |
| * Capital Ratoi Margin (t-1) | (0.004) | | |
| Debt Ratio Dummy (highest quartile) (t-1) | 0.001 | | |
| * Capital Ratoi Margin (t-1) | (0.002) | | |
| Non-Performing Loan Ratio (t-1) | | -0.452 * | |
| | | (0.249) | |
| Debt Ratio Dummy (lowest quartile) (t-1) | | -0.235 | |
| * Non-Performing Loan Ratio (t-1) | | (0.282) | |
| Debt Ratio Dummy (highest quartile) (t-1) | | 0.023 | |
| * Non-Performing Loan Ratio (t-1) | | (0.173) | |
| Deposit growth Ratio (t-1) | | | 0.006 |
| | | | (0.053) |
| Debt Ratio Dummy (lowest quartile) (t-1) | | | -0.392 ** |
| * Deposit Growth Ratio (t-1) | | | (0.172) |
| Debt Ratio Dummy (highest quartile) (t-1) | | | -0.220 ** |
| * Deposit Growth Ratio (t-1) | | | (0.102) |
| year2002 | 0.013 * | 0.017 ** | 0.006 |
| | (0.008) | (0.008) | (0.008) |
| year2003 | 0.010 | 0.015 | 0.003 |
| | (0.009) | (0.010) | (0.009) |
| Constant | 0.293 ** | 0.270 ** | 0.211 ** |
| | (0.086) | (0.079) | (0.069) |
| Number of observations | 1561 | 1561 | 1504 |
| Number of firms | 710 | 710 | 673 |
| Adjusted R-squared | 0.0171 | 0.019 | 0.0259 |

1. Numbers in parentheses are standard errors.
2. **, * denote significance levels at 5% and10%, respectively.
3. OLS estimates with a fixed effect model.

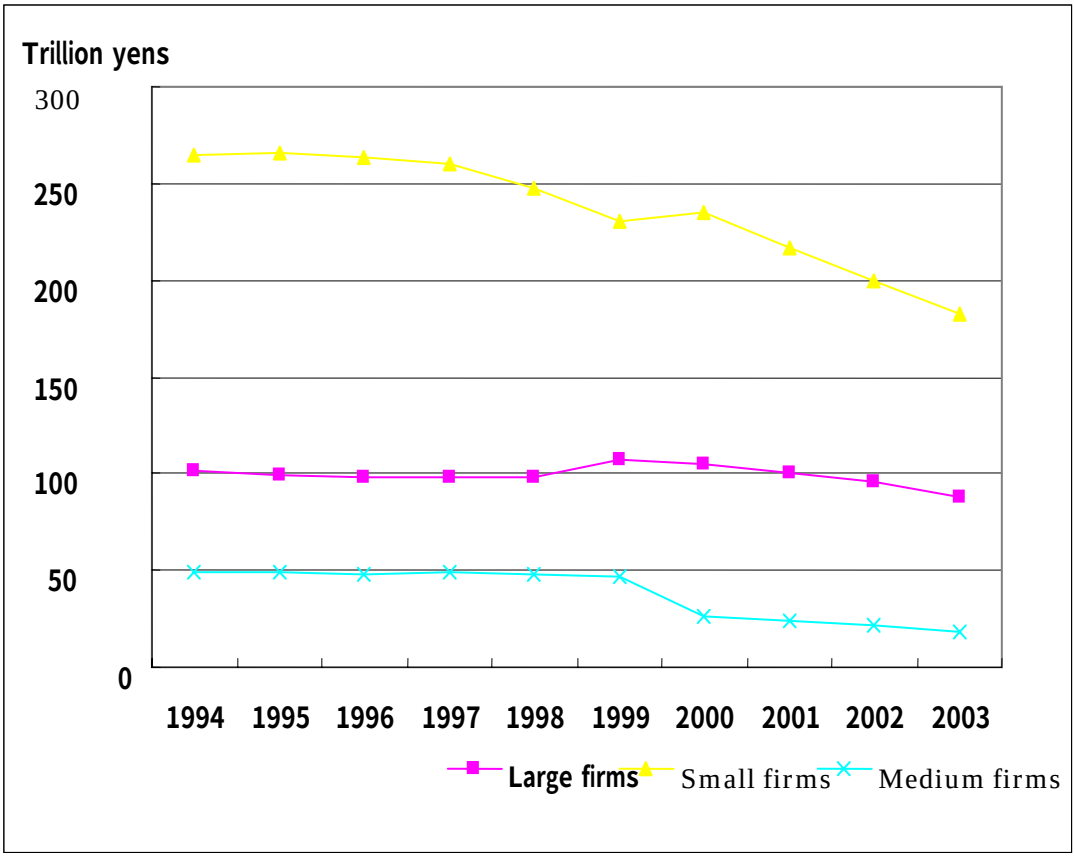
Figure 1. Risk-Management Loans Ratio




Note: Risk-management loans as a proportion of total loans are depicted.

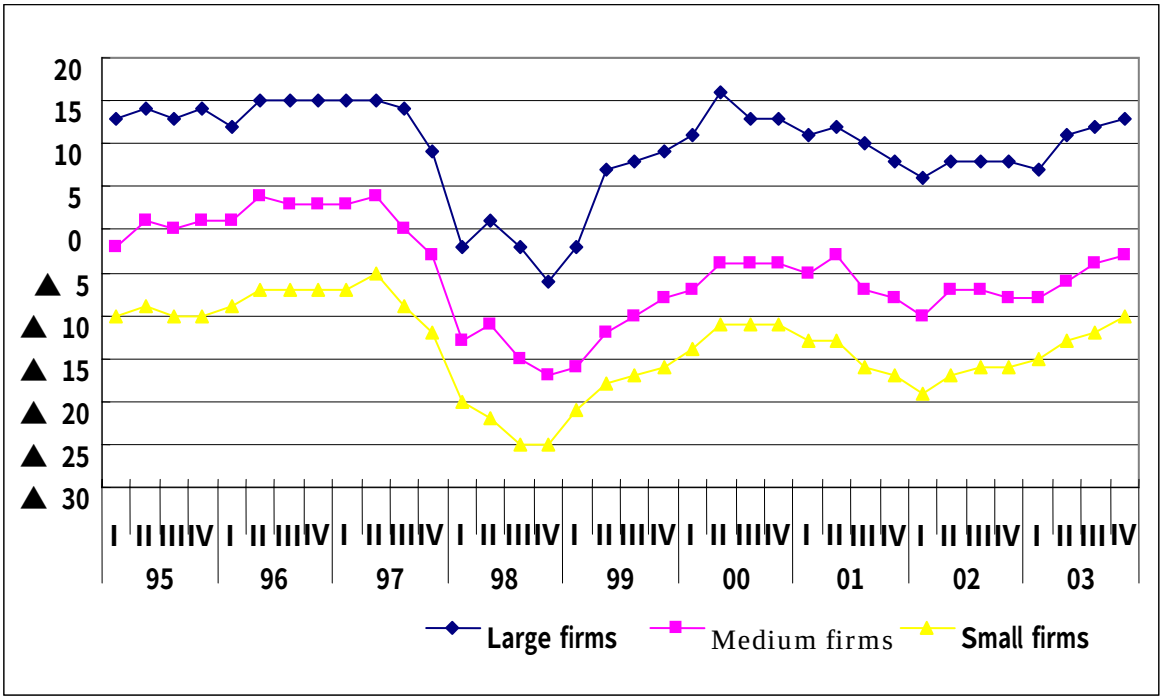
Source: Financial Services Agency web site: http://www.fsa.go.jp

Figure 2. Loans Outstanding of Domestic Banks by Firm Size




Source: *Financial and Economic Statistics Monthly,* by Bank of Japan.

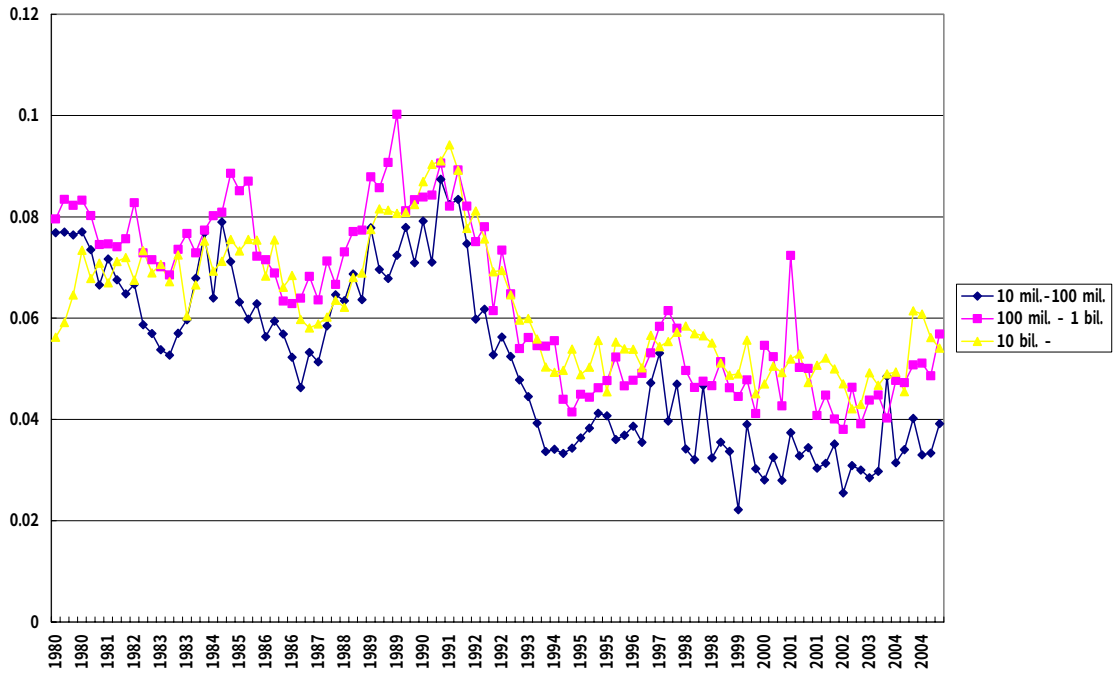
Figure 3. Diffusion Index of Financial Positions by Firm Size




Note: Diffusion index of "easy" minus "tight".

Source: *Short-term Economic Survey of Enterprises in Japan (TANKAN)*, by Bank of Japan.

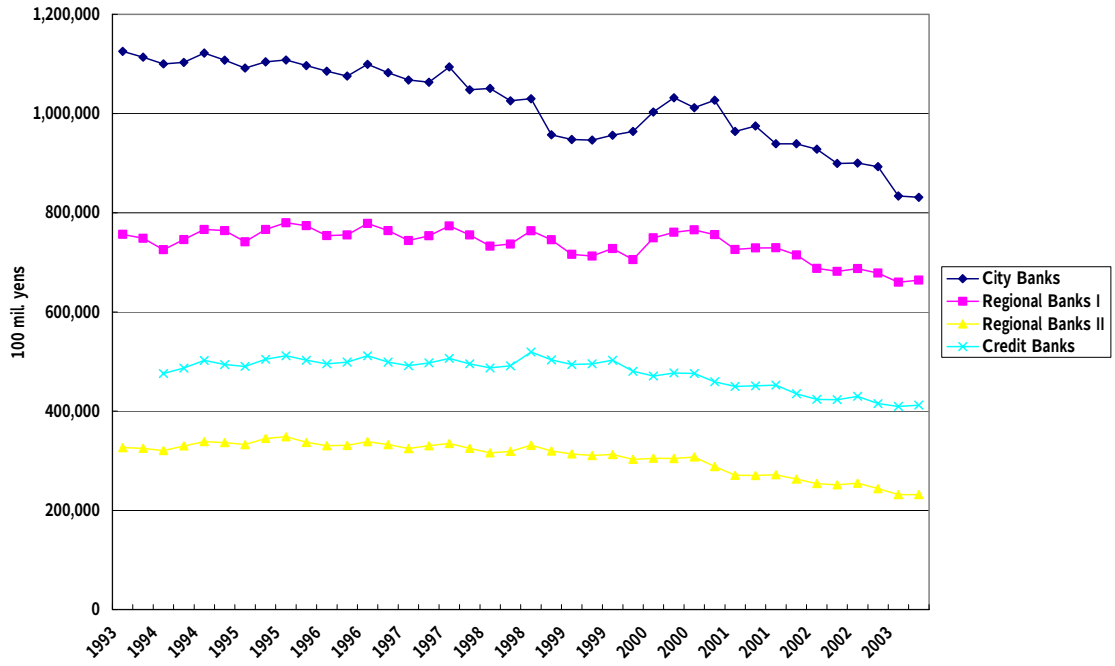
Figure 4. Investment-to-Capital Stock Ratio for Manufacturing Firms by Equity Size




Note. The ratios of increases in tangible assets other than land to the previous period's tangible assets other than land are depicted.

Source: *Financial Statements Statistics of Corporations by Industry* by Ministry of Finance.

Figure 5. Loans Outstanding to SMEs by Bank Type

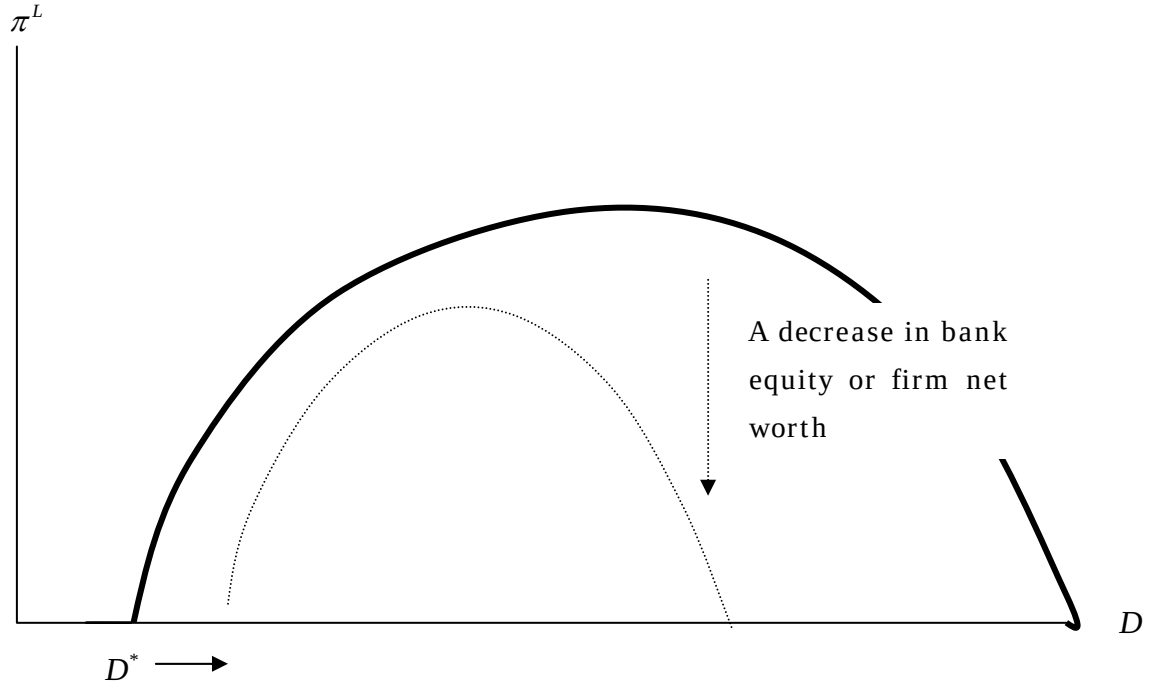



Note. Quarterly data. For credit banks, the sum of loans outstanding to manufacturing industries and non-manufacturing industries are depicted.

Source: *Financial and Economic Statistics Monthly,* by Bank of Japan.

Figure 6. The Interest Rate and the Bank Profit

Case 1. Borrower net worth is high.




Case 2. Borrower net worth is low.