CENTER FOR ADVANCED RESEARCH IN FINANCE

C A R F W o r k i n g P a p e r

CARF-F-122

Impaired Bank Health and Default Risk

Shin-ichi Fukuda
University of Tokyo
Munehisa Kasuya
Bank of Japan
Kentaro Akashi
University of Tokyo

May 2008

CARF is presently supported by AIG, Bank of Tokyo-Mitsubishi UFJ, Ltd., Citigroup, Dai-ichi Mutual Life Insurance Company, Meiji Yasuda Life Insurance Company, Mizuho Financial Group, Inc., Nippon Life Insurance Company, Nomura Holdings, Inc. and Sumitomo Mitsui Banking Corporation (in alphabetical order). This financial support enables us to issue CARF Working Papers.

Impaired Bank Health and Default Risk *

Shin-ichi Fukuda (University of Tokyo)
Munehisa Kasuya (Bank of Japan)
Kentaro Akashi (University of Tokyo)

Abstract

Empirical studies in corporate finance have long been focused on the role of banks in reducing the costs of financial distress. The environment and events in Japan provide a "natural experiment" that allows such empirical studies. The number of bankruptcies steadily increased throughout the 1990s, and peaked in 2000. During this period, Japan's banking sector, in contrast, faced considerable problems regarding the disposal of their bad loans. The purpose of this paper is to investigate how various measures of bank health and how defaults of major trading partners affected the probability of bankruptcy among medium-size firms in Japan. Using probit models, we examine the causes of bankruptcy for unlisted Japanese companies in the late 1990s and early 2000s. We find that several measures of bank-specific financial health have had significant impacts on a borrower's probability of bankruptcy, even when observable characteristics relating to these borrower's financial variables are controlled. In particular, a close bank-firm relationship—which usually reduces the probability of bankruptcy—exacerbates the impacts of a financial crisis, which substantially damages other bank health measures as well.

Key words: Bankruptcy, Bank-firm relationship, Hold-up problem, Unlisted firms
JEL #: G21, G33, G32

---

* Earlier versions of this paper were presented at the Bank of Japan (Research and Statistics Department), the Spring Meeting of JEA (Kyoto Sangyo University, Japan, June 4-5, 2005), the FIRS Shanghai Conference (Grand Hyatt Hotel, China, June 1-3, 2006), and the Three-Country Conference (University of Tokyo, November 17, 2006). We would like to thank Yuichi Abiko, Jie Gan, Chunxin Jia, an anonymous referee, and other conference participants for their helpful comments. Fukuda's research is supported by Center for Advanced Research in Finance (CARF) at the University of Tokyo. The views expressed in this paper are those of authors and do not necessarily reflect those of the Bank of Japan or its Research and Statistics Department.

1. Introduction

Empirical studies in corporate finance have long been focused on the role of banks in reducing the costs of financial distress. One strand of research reveals indirect evidence on the benefits of close bank-firm relationships. Using firm-level data in Japan, Hoshi, Kashyap, and Scharfstein (1990) demonstrated the role of banks in reducing the costs of financial distress for firms that are members of a *keiretsu* (corporate group linked through one main bank). The role of the main bank is particularly important during times of distress, when it changes the affiliated firm's management and board directors (Kang and Shivdasani [1995]; Morck and Nakamura [1999]). Information gathering and monitoring performed by banks may help to overcome informational "free-rider" problems associated with diffuse debt-holding. Firms with strong bank-firm relationships may be better able to overcome financial distress, which gives such firms a more stable, informed, and committed source of financing (Hall and Weinstein [2000]). Using data on small U.S. firms, authors such as Petersen and Rajan (1994) and Berger and Udell (1995) showed that a close bank relationship increases credit availability for small borrowers. Several other studies also suggest that small businesses benefit from a close bank relationship in European countries.[1]

Banking relationships have a cost, however, when bank health is largely impaired. In particular, the so-called "credit hypothesis" proposed that banking crises cause financial disintermediation and can have severe macroeconomic consequences. Bernanke (1983) is a seminal work for the literature and showed that bank failures had contributed to the Great Depression in the United States. Many of the earlier studies tested the credit hypothesis from a macro (economy-wide) perspective (see, among others, Anari, Kolari, and Mason (2005) and the reference therein). But to explore the robustness of the hypothesis, it is equally important to test it from a micro (firm level) perspective. Deteriorating bank health would have much larger impacts on small and medium firms that relied on a close bank relationship in reducing the costs of financial distress. This paper follows this new approach by using micro data from small and medium firms.

In the following analysis, we investigate how the financial health of banks, as well as how the defaults of major trading partners, affected the probability of bankruptcy of medium size firms in Japan. The environment and events in Japan provide a "natural experiment" that allows such empirical testing. First, because of the importance of the main bank system, many Japanese firms rely heavily on bank finance. While the role

[1] See, for example, Harhoff and Körting (1998) and Ferri and Messori (2000).

of banks became relatively smaller for larger companies in the 1990s, banks maintained a dominant role in the financing of smaller firms. Second, Japan experienced a dramatic collapse in the financial condition of its banking system in the 1990s. We should thus be better able to identify the impacts of negative shocks on default risk when a large amount of losses on disposal of non-performing loans damaged the financial health of many banks in the late 1990s. Third, suitable data are available to test the hypothesis based on bank-level and firm-level data. We obtained a detailed list of major lenders for each unlisted company from the Tokyo Shoko Research (TSR) Database Service. We then matched borrowers' financial data to the relevant financial data of the "main banks."

As a firm works more closely with a bank, it finds it harder to raise funds through other means; outside fundraising may also be held up by the bank (Sharpe [1990], Rajan [1992]). The proprietary information about borrowers that banks obtain through their relationships may give them an information monopoly. To the extent that the information monopoly makes switching the bank-firm relationship difficult, bank-specific financial health might affect a borrower's cost of funds, even when observable characteristics relating to borrower risk are controlled. While bank-firm relationships have been found to be important in the United States, such links are likely to be even more important in a country such as Japan, which is is far more reliant on bank financing.

A strand of empirical research has supported the conclusion that close bank relationships were a liability when bank health deteriorated in Japan. Gibson (1995) found that firm investment was sensitive to the main bank's rating. Kang and Stulz (2000) showed that firms that relied more on bank finance suffered significantly larger wealth losses during the first three years of the 1990s. Klein, Peek, and Rosengren (2002) found that the financial difficulties of Japanese banks reduced the number of FDI projects by Japanese firms into the United States.[2] All of these studies, however, used the data set on listed firms, so that their implications were relevant only for large firms in Japan. Previous studies thus say little about the extent of impacts bank health had on the default risk of small and medium borrowers. The use of firm-level data of unlisted firms is useful in detecting the effects of bank health on its borrower's default risk, because unlisted firms not only have stronger reliance on bank finance but also face higher default risk. In addition, reverse causality from firms to banks will be

[2] In other related studies, authors such as Ito and Sasaki (2002) and Woo (2003) explored the existence of "capital crunch" by using the data of individual Japanese banks.

less of a problem in a firm-level regression for unlisted firms than for listed firms. The firm's default may damage the bank's financial health if the firm's loans from its bank were a substantial chunk of the bank's capital. This is likely for some listed firms but less likely for unlisted firms. The use of unlisted firms' data thus allows us to avoid possible simultaneous bias without using ad hoc instrument variables.

In investigating the impacts of bank health on the probability of bankruptcy, we explore the causes of two types of bankruptcy: "bankruptcy for liquidation purposes" aimed at company liquidation (extinction) and "bankruptcy for reconstruction purposes" whereby the company pays off its debts while remaining in business. By incorporating recent contributions on multinomial probit models, we estimate a trinomial probit model as well as a binominal probit model for a sample of 6,266 unlisted Japanese companies in the late 1990s and the early 2000s. Previous empirical studies have found that a company is more likely to fail if it is unprofitable, highly leveraged, and suffers from cash-flow difficulties.[3] Our probit models confirm this standard result. We find, however, that several measures of bank-specific financial health as well as defaults of major trading partners have additional impacts on a borrower's probability of bankruptcy, even when observable characteristics relating to this borrower's financial variables are controlled.

In previous literature, several studies have investigated the performances of small and medium firms using the firm-level data of unlisted firms in Japan. In particular, authors such as Omura et al. (2002) and Saito and Tachibanaki (2004) investigated the determinants of defaults of unlisted firms in Japan. These previous studies, however, did not explore the bank effects on borrowers' performances by using a matched sample of borrowers and banks.[4] Our study is thus new in showing that several measures on bank-specific financial health, such as ratios of nonperforming loans, have additional impacts on a borrower's probability of bankruptcy in Japan.

We use three alternative measures to measure bank health: (i) ratios of nonperforming loans (NPLs), (ii) a relative measure of bank stock valuation, and (iii) bank failures. For comparison, we also investigate the impacts of defaults of parent companies and other major trade partners. Among the three bank health measures, ratios of NPLs are backward-looking, and are only loosely related to a bank's economic

[3] Altman (1968) is one of the earliest studies. Recent contributions include Lennox (1999), Shumway (2001), and Hillegeist, Keating, Cram, and Lundstedt (2003).
[4] Schaede (2005) discussed the financial system on small-firm financing in Japan. Fukuda, Kasuya, and Nakajima (2005) investigated the relationship between financial distress and corporate investment in Japan by using firm-level data. They did not, however, examine the impacts of bank health on borrowers' default risk.

value. We, in contrast, find that the backward-looking measure had as many significant impacts as the forward-looking stock market valuation did. This suggests that deterioration of both backward-looking and forward-looking measures had been important in tightening the banks' lending attitudes and in increasing the borrowers' default risk under the financial turbulence in Japan. Failures of the main banks had a positive but less- significant impact on a borrower's probability of bankruptcy. Defaults of parent companies and other major trading partners, however, had very large impacts on a borrower's probability of bankruptcy. During the period of financial turbulence, small firms could have financial support from the government when the main bank failed. But that was not the case when parent companies defaulted. This implies that defaults of non-financial firms had larger contagious effects in increasing the default risk of vertically related smaller firms in the late 1990s and early 2000s in Japan.

A noteworthy finding in the paper is that multiple banking relationships had two opposite impacts on a borrower's probability of bankruptcy. We find that multiple bank relationships worsened the default risk of borrowing firms but reduced the negative impacts of impaired bank health. The result is a reconfirmation of a previous finding by Houston and James (2001), which investigated a similar issue in a different framework. A bank-firm relationship becomes loose when the firm borrows from multiple banks. To the extent that the relation reduces the costs of financial distress, the number of bank lenders would have a negative correlation with the probability of bankruptcy. However, a hold-up problem under a close bank-firm relationship intensifies the link between bank-specific financial health and a borrower's cost of funds. The impacts of the bank health measures under the financial crisis would thus be mitigated when the number of bank lenders is large.

Our paper proceeds as follows. After presenting our hypothesis in Section 2, Section 3 specifies the basic model and explains our data. Section 4 reports our main empirical results. Section 5 provides our interpretations on the marginal impacts of bank health deterioration on bankruptcy probabilities. Section 6 explores the impacts of multiple banking relationships. Section 7 discusses predictability of our probit models, and Section 8 summarizes our main results and considers their implications.

2. Outline of the Model

(1) Motivation and Hypothesis

After the crash of the stock market, the number of bankruptcies in Japan steadily

increased throughout the 1990s, and the total amount of debt outstanding of bankrupt firms peaked in 2000 (see Figure 1). The number of bankruptcies was very moderate for listed companies. In contrast, there were dramatic increases in bankruptcies among small and medium firms in the late 1990s and early 2000s. The low profitability of small and medium firms might be one source of the problem. The strong reliance on bank finance could, however, be another source that diminishes access to alternative sources of funding.

The “Tankan Survey” of the Bank of Japan shows that the lending attitudes of financial institutions became very tight in the late 1990s. The lending attitudes for large companies were also tight but only temporarily. Restrictive attitudes toward small and medium companies, in contrast, persisted and showed slow recovery throughout the 1990s and early 2000s (see Figure 2). Evidence supports the view that small and medium companies have more serious problems in finding alternative sources of funding during financial turbulence.

Since the early 1990s, the Japanese banking sector had faced considerable problems disposing loans that had gone bad. The problems became particularly serious in the late 1990s, when several major financial institutions turned out to be in default. To the extent that bank health does matter, deterioration of bank health would tighten the bank's lending attitude, and might increase the borrowers' default risk, particularly among smaller firms. The hypothesis we will test in the following analysis is the extent of the impact several measures of bank health had on the probability of bankruptcy of unlisted firms in Japan in the late 1990s and early 2000s. We test directly the effects of a variety of bank health measures on default risks of unlisted borrowing firms in Japan. According to previous empirical studies, a firm has a larger default risk when it has a larger debt-asset ratio, larger interest payments, and smaller profits. In the following model, we include these borrower's financial variables as benchmark explanatory variables. We then add several bank-related variables to allow the identity of its main bank to affect a firm's default risk.

(2) Definition of Bankruptcy

To measure default risk, we define bankruptcy as "a company that is experiencing difficulties in its management and that can no longer discharge the liabilities it must pay off."[5] We divide bankruptcy into two categories: "bankruptcy for liquidation

5 More specifically, we define "bankruptcy" in the event that a company is recognized as corresponding to any of the following seven cases: (1) drawing unpaid notes two times and business is suspended, (2) dissolution of the company (when the representative admits to being bankrupt), (3) applying for the Corporate Rehabilitation Law, (4)

purposes" and "bankruptcy for reconstruction purposes." In the classification, “bankruptcy for liquidation purposes” includes "bankruptcy," "special liquidation," and most cases of voluntary liquidation, while “bankruptcy for reconstruction purposes” includes "the Corporate Reorganization Act," "the Civil Reorganization Act," "Commercial Law Dissolution,” and a small part of voluntary liquidation. The former corresponds to Chapter 7 in U.S. bankruptcy law, and the latter to Chapter 11. The classification follows that of TSR Database Service. In the Unites States, there are a number of studies that compared the costs of the two types of bankruptcies: Chapter 7 vs. Chapter 11.[6] The evidence suggests that Chapter 11 cases were better at retaining value throughout the bankruptcy process. Exploring the sources of two types of bankruptcies has important implications.

(3) Alternative Measures of Bank Health

There are several alternative proxies to measure bank health. In the following analysis, we use three bank health measures: (i) ratios of nonperforming loans (NPLs), (ii) a relative measure of bank stock valuation, and (iii) bank failures.[7] The first measure of bank health is ratios of NPLs. In Japan, the banks sometimes underreported the amount of nonperforming loans on their book to conceal the true extent of their problems. However, nonperforming loans continued to accumulate until 2001, causing huge losses on the disposal of non-performing loans for the banks. As a result, NPL ratios were regarded as an important indicator to measure bank health throughout the 1990s and into the early 2000s. In particular, the Japanese government repeatedly warned the banks that it was imperative to solve the non-performing loans problems to recover confidence in Japan's financial system. It is thus highly possible that increases in NPL ratios would increase borrowers' default risk through the tightening of lending attitudes among banks.

The second measure is a relative measure of bank stock valuation. We use a proxy that measures how a bank's stock price had changed after a benchmark year. The

---

applying for dissolution arrangement under the Commercial Code, (5) applying for the Civil Rehabilitation Law, (6) applying for bankruptcy, and (7) applying for commencement of special liquidation proceedings to the court. The above can be classified broadly into "voluntary liquidation," consisting of (1) and (2), and " legal liquidation," consisting of (3) and (4).

[6] Some recent contributions include Bris, Welch, and Zhu (2004).

[7] Risk-based bank capital asset ratios could be another bank health measure. But the ratios had been highly contaminated measures in Japan because the government not only changed the definitions frequently but also allowed a lot of arbitrary accounting to boost those ratios.

benchmark year is 1990, after which Japanese stock prices started to collapse. The relative stock valuation is thus an indicator of how the bank's market valuation had changed after the prolonged leak of speculative bubbles. While the ratios of NPLs are backward-looking, stock prices are forward-looking. The forward-looking market valuation of a bank is sometimes volatile, and can deviate from its real economic value. However, the forward-looking measure has a preferable property, since what matters to the firm is the availability of the bank's help if it gets into financial distress.

The third measure is bank failures. Bank failures arise in extreme cases in which bank health has deteriorated dramatically. However, the number of bank failures was highly limited. In addition, during the period of financial turbulence in Japan, small firms could get financial support from the government when their main banks failed. The measure may thus capture the impacts of catastrophic but very rare events on bank health deterioration. For comparison, we also explore the impacts of defaults of parent companies and major trade partners in the following analysis. For smaller firms, loans from parent companies and other major trading partners sometimes substitute for short-term bank loans. The comparison might focus on the health deterioration impacts of substitutable loan suppliers.

3. The Model and the Data

(1) The Multinomial Probit Model

To test our hypothesis, we estimate a trinomial-probit model as well as a binomial-probit model based on (unbalanced) panel data from Japanese unlisted companies. When estimating the trinomial-probit model, we divide the firms into three categories: (A) firms that went bankrupt for liquidation purposes, (B) firms that went bankrupt for reconstruction purposes, and (C) firms that did not go bankrupt. Let individual firm i choose among a set of mutually exclusive alternatives: Category A, B, and C. Assume that the (unobserved) latent variable for Category A, B, and C is expressed as linear functions of explanatory variables

$$\begin{aligned} y^{A}{}_{it}^{*} &= \alpha + \beta' x_{it} + \gamma' z_{it} + \varepsilon^{A}{}_{it}, \\ y^{B}{}_{it}^{*} &= \delta + \lambda' x_{it} + \phi' z_{it} + \varepsilon^{B}{}_{it}, \\ y^{C}{}_{it}^{*} &= 0, \end{aligned} \qquad (1)$$

where x_{it} is a k×1 vector of financial variables, z_{it} is a m×1 vector of bank health measures, β and λ are k×1 coefficient vectors, γ and ϕ are m×1 coefficient vectors, and i

indexes individuals. We normalize (1) by restricting the latent variable for Category C to be zero. (ε^A_{it}, ε^B_{it}) is a vector of alternative-specific disturbances that follow independent bivariate normal distribution with zero mean and covariance matrix

$$\begin{bmatrix} 1 & \rho \\ \rho & 1 \end{bmatrix} \tag{2}$$

Category A is chosen if $y^{A*}_{it} \geq y^{B*}_{it}$ and $y^{A*}_{it} \geq y^{C*}_{it}$, Category B is chosen if $y^{B*}_{it} > y^{A*}_{it}$ and $y^{B*}_{it} > y^{C*}_{it}$, and Category C is chosen otherwise. We can thus define the trinomial probit model as follows

$$\begin{aligned}
y^A_{it} &= 1 \quad \text{if } \alpha + \beta' x_{it} + \gamma' z_{it} + \varepsilon^A_{it} \geq \delta + \lambda' x_{it} + \phi' z_{it} + \varepsilon^B_{it} \text{ and } \alpha + \beta' x_{it} + \gamma' z_{it} + \varepsilon^A_{it} \geq 0, \\
&= 0 \quad \text{otherwise,} \\
y^B_{it} &= 1 \quad \text{if } \delta + \lambda' x_{it} + \phi' z_{it} + \varepsilon^B_{it} > \alpha + \beta' x_{it} + \gamma' z_{it} + \varepsilon^A_{it} \text{ and } \delta + \lambda' x_{it} + \phi' z_{it} + \varepsilon^B_{it} > 0, \\
&= 0 \quad \text{otherwise,} \\
y^C_{it} &= 1 \quad \text{if } \alpha + \beta' x_{it} + \gamma' z_{it} + \varepsilon^A_{it} < 0 \text{ and } \delta + \lambda' x_{it} + \phi' z_{it} + \varepsilon^B_{it} \leq 0, \\
&= 0 \quad \text{otherwise,}
\end{aligned} \tag{3}$$

where $y^A_{it} = 1$ if the company went bankrupt for liquidation purposes, $y^B_{it} = 1$ if the company went bankrupt for reconstruction purposes, and $y^C_{it} = 1$ if the company did not go bankrupt.

It is easy to see that when $\alpha = \delta$, $\beta = \lambda$, $\gamma = \phi$, and $\varepsilon^A_{it} = \varepsilon^B_{it}$, the trinomial probit model is degenerated into a standard binomial probit model where either Category A or Category B is chosen if $y^{A*}_{it} = y^{B*}_{it} > y^{C*}_{it}$ and Category C is chosen otherwise. When estimating the binomial-probit model, we divide the firms into two categories: (a) firms that went bankrupt and (b) firms that did not go bankrupt.

(2) Data of Financial Variables

The explanatory vector x_{it} denotes a vector of financial variables of unlisted companies. For the financial variables, we use “debt-asset ratio,” “interest payments-output ratio,” “profits-asset ratio,” and “special losses-asset ratio.” The choice of the variables follows several previous studies in Japan. We define “debt-asset ratio,” “profits-asset ratio,” and “special losses-asset ratio” as total outstanding bank borrowings, operating profits, and special losses respectively, normalized by total assets. We also define “interest payments-output ratio” as total interest payments divided by total sales plus liquid assets.

Bankruptcy is usually triggered by default on debt servicing. A company is thus more likely to fail if it is unprofitable and highly leveraged. For firms with low growth opportunities, high leverage reduces a firm's ability to finance investment through a liquidity effect. In extreme cases, a firm's debt overhang could be large enough to prevent it from raising funds to finance positive net present value projects. In contrast, a company with a healthy cash-flow has relatively easy access to internal finance, so it is less likely to go bankrupt than a company with cash-flow problems. We therefore expect that a firm is likely to have a larger default risk when it has a larger debt-asset ratio, larger interest payments, smaller profits, and larger special losses.

We collected the firm-level financial data of Japanese non-financial firms that are *not* listed on any stock exchange in Japan. The data are taken from TSR Database Service. Unless the data are incomplete, the data set covers the period from 1996 through 2002. The data cover all available financial data of non-financial corporations with capital in excess of 100 million yen. We, however, excluded the data of public firms, non-profit organizations, firms that had no borrowings from banks, and firms for which relevant financial variables are missing. It allows us to use the data of 6,266 Japanese unlisted firms. Among those, 150 went bankrupt for reconstruction purposes and 168 for liquidation purposes from 1997 to 2003.

One may argue that we should use not only the data of medium-size firms but also the data of smaller ones. The use of smaller-size firms' data may provide some useful information because the smaller firms have stronger reliance on bank finance, and face higher default risk. The accounting data of smaller unlisted firms, however, are likely to be missing, and are thus less reliable. It's clear that both costs and benefits exist in using the data of smaller size firms in the analysis.

Table 1-1 reports the average, standard deviation, maximum, and minimum of each financial variable for all firms and bankrupt firms in our sampled unlisted companies. We see that "debt-asset ratio," "interest payments-output ratio," and "special losses-asset ratio" are higher for bankrupt firms, while "profits-asset ratio" is much smaller for bankrupt firms. The simple comparison supports the view that a company is more likely to fail if it is unprofitable, highly leveraged, and suffers cash-flow difficulties.

Table 1-2 reports the corresponding data of 2,138 listed companies in Japan. "Debt-asset ratio" and "interest payments-output ratio" are on average higher for our unlisted companies than for the listed companies. Standard deviation of "debt-asset ratio" is, however, larger for the unlisted companies. "Profits-asset ratio" and "special losses-asset ratio" are smaller for our unlisted companies. However, when we focus on

bankrupt firms, the difference between the unlisted and the listed companies is negligible for each financial variable.

(3) Bank Health Data

The explanatory vector z_{it} denotes a vector of several alternative measures on financial health of the "main banks." As for the three alternative measures of bank health, we constructed the data by the following steps. First, we identified the name of the firm's lenders based on *CD Eyes,* supplied by TSR Database Service. Like the Japan Company Handbook, *CD Eyes* provides a list of major lenders for each unlisted company. The order of the listed lenders is based on how close the bank-firm relationships are. We defined the "main bank" as the bank that appears first in the list. We then collected the relevant financial data of the "main banks" from *Financial Statements of All Banks*, published by the Japan Bankers Association. The data set covers the period from 1996 through 2003.

To calculate a proxy for ratios of NPLs, we use risk management loans divided by total assets. Using the standards set by the Federation of Bankers Associations of Japan, each bank discloses the amount of "risk management loans" each year. Risk management loans are comprised of "past due loans" in arrears by three months or more, and "restructured loans" with changes in terms and conditions, as well as loans to borrowers in legal bankruptcy. For large banks, the standards after 1998 became comparable to the United States SEC standards adopted for the public disclosure of bad loans. However, the standards—which cover a wider range of non-performing loans—were different before 1998. Moreover, the definition of risk management loans changed frequently for other smaller banks (that is, regional banks, second regional banks, Shinkin Banks, and Shinyo Kumiai). In calculating the NPL ratios, we thus use only those of the major banks (that is, city banks, trust banks, and long-term credit banks) and distinguish those before and after 1998 as two different variables in the analysis.

The relative stock valuation we use in the following analysis is the logged difference of the bank's stock price between the end of each year and the end of 1990. We took 1990 as a benchmark year because the Japanese stock market crashed in early 1991. Because of availability, the data cover only those for listed banks, although most of the main banks are listed ones in our sample. We excluded stock valuation of failed banks in the analysis, even when they were kept listed in the stock market. We added a dummy to the main banks for which stock prices are missing.

We capture the impacts of bank failures by a dummy variable. The bank failure

dummy takes one when the main bank failed, and zero otherwise. The definition of "bank failure" follows the Financial Services Agency in Japan. It only includes banks that the government declared insolvent. During the period of financial turbulence, small firms could have financial support from the government when the government identified that their main banks failed in Japan. Therefore, although a bank failure would arise in an extreme case in which the bank's health deteriorated dramatically, their impacts on small firms might be ambiguous. For comparison, we also explore the impacts of defaults of parent companies and major trade partners in the analysis. *CD Eyes* provides a list of parent companies and major trading partners for each unlisted company. Some of the companies in the list are unlisted companies. We, however, use only listed companies as parent companies and major trading partners because reverse causality from the unlisted firm will be less of a problem when parent companies and major trading partners are listed firms. Default information of parent companies and major trade partners is based on data from the Tokyo Shoko Research (TSR) Database Service.

Table 2 reports types of the "main" banks and distributions of the number of lending bank lenders. It states that nearly 60 percent of the "main" banks are either city banks, long-term credit banks, or trust banks, and 28 percent of the "main" banks are first regional banks. This implies that large listed banks still play dominant roles as "main" banks, even for most unlisted medium-size firms in our sample.

Table 3 reports basic statistics (i.e., average, standard deviation, minimum, and maximum) of NPL ratios and the relative stock valuation for the "main" banks. The average of NPL ratios amounts to 4.09 percent during our sample period. The standard deviation of NPL ratios is also high, implying that ratios of NPLs that were well above 10 percent for several banks. On average, NPL ratios tend to be higher for bankrupt firms than for surviving ones, while the stock valuation is smaller for bankrupt firms.

4. Empirical Results

(1) Impacts of the Selected Financial Variables

Table 4 summarizes the estimation results of our binomial and trinomial probit models. To allow industry-specific factors, it reports the results with industrial dummies. Before looking at the bank health effects, we check whether the selected financial variables have sensible impacts on probabilities of bankruptcies in the table. "Debt-asset ratio," "interest payments-output ratio," and "special losses-asset ratio"

have positive impacts, while "profits-asset ratio" has negative impacts. All of the impacts are statistically significant in increasing bankruptcy probability in the binomial probit model. The results are consistent with previous empirical evidence in that a firm is likely to have a larger default risk when it has a larger debt-output ratio, larger interest payments, and smaller profits. Among the selected financial variables, "profits-asset ratio" had the largest impact in magnitude. "Debt-asset ratio" had the second-largest.

Even in the trinomial probit model, "debt-asset ratio" and "interest payments-output ratio" are statistically significant in increasing bankruptcy probability for both reconstruction and liquidation purposes. "Debt-asset ratio" had a larger impact for liquidation purposes. Reflecting the fact that interest payments are suspended for troubled firms, "interest payments-output ratio," however, had a larger impact for reconstruction purposes. "Special losses-asset ratio" is, in contrast, statistically significant only for liquidation purposes. This may imply that large capital losses were a source of liquidation for troubled firms. "Profits-asset ratio" had the largest impact in the magnitude. But its significance level is marginal, which is a reflection of the heterogeneous impacts.

As for the dummy variables, some of the industry dummies have statistically significant impacts. In particular, the dummy for the construction industry always has a significantly positive impact, while those for the transportation and communication industries always have a significantly negative impact. The dummy for unlisted banks is positive but is not statistically significant.

(2) The Impacts of the Alternative Measures of Bank Health

More interesting results are observed when we look at the impacts of the three alternative measures of bank health: (i) ratios of NPLs, (ii) a relative bank stock valuation, and (iii) bank failures. It is easy to see that both NPL ratios and stock valuation have expected impacts on a borrower's probability of bankruptcy, even when observable characteristics relating to these borrower's financial variables are controlled. That is, the coefficient of the stock valuation took a negative sign, while those of NPL ratios took a positive sign. This implies that the impaired bank health measures tightened the bank's lending attitude, and consequently increased the borrower's default risk in the late 1990s and early 2000s.

Both of the NPL ratios before and after 1998 had statistically significant impacts in increasing probabilities in the binomial probit model. Solving the non-performing loans problems was regarded as an important indicator to recover confidence in the

Japanese financial system. It is thus highly possible that the banks' attempts to improve these ratios increased the borrowers' default risk through the tightening of lending. The alternative measures on NPL ratios, however, had different impacts in the trinomial probit model, although they always took expected sign. The NPL ratios before 1998 had significant impacts only for liquidation purposes, while the NPL ratios after 1998 had significant impacts only for reconstruction purposes.

The relative stock valuation had a statistically significant negative impact in increasing bankruptcy probability in the binomial probit model. The stock valuation is an indicator that reflects the forward-looking market valuation of the banks. The result implies that a decline in the market valuation of the bank increased the borrower's bankruptcy probability. The stock valuation is, however, statistically significant only for reconstruction purposes in the trinomial probit model.

Finally, failures of the main bank always had an expected positive impact, which was significant for reconstruction purposes in the trinomial model. However, the impact was statistically less significant in the binomial model. The impact may be less significant partly because the number of bank failures was very small in our sample.[8] It may also reflect the fact that small firms could have financial support from the government when the government identified that their main banks failed in Japan. In the late 1990s and early 2000s, the credit guarantee system provided special business stabilization guarantees (safety net guarantees) to small and medium companies when correspondent financial institutions went bankrupt. The less-significant impacts may provide indirect evidence that the credit guarantee system mitigated the costs of bank failures in the late 1990s and early 2000s. Defaults of parent companies and major trade partners, in contrast, had significant impacts in increasing bankruptcy probability for reconstruction purposes. The impacts are particularly large for defaults of parent companies. This may reflect the fact that small firms might not have financial supports from the government even when their parent companied defaulted.

5. Interpretations of the Marginal Impacts

In the last section, we showed that the bank health measures, as well as defaults of parent companies and major trade partners, had expected impacts on a borrower's probability of bankruptcy, even when observable characteristics relating to these borrower's financial variables are controlled. In a bank-centered system like Japan,

[8] In Japan, the number of bank failures had been very small because a number of distressed banks are merged out under regulatory assistance.

poor bank performance should be more costly for smaller firms that obtain most of their external financing from the bank with which they've established a relationship. It is thus highly possible that small and medium firms that relied more on bank finance faced significantly large default risk when bank health deteriorated. Our empirical results clearly support this view.

The estimated coefficients, however, suggest that marginal impacts vary across different explanatory variables, especially in the trinomial probit model. The purpose of this section is to explore the different impacts each bank health measure had in increasing two types of bankruptcies. In the analysis, we define a hypothetical "average firm" that takes the average values of all financial variables and bank health measures among the sampled firms that had one of the major banks as the main bank after 1998. We then investigate how the probability of bankruptcy of the average firm would increase when each of the health measures deteriorated.

Table 5 summarizes the results. It reports the changes of the bankruptcy probability when the NPL ratios after 1998 increased by one percentage point, or when the relative stock valuation declined by one percent. It also reports the changes of the bankruptcy probability when the main bank failed, when a trading partner defaulted, or when a parent company defaulted, respectively. The NPL ratios and the relative stock valuation had similar impacts on the bankruptcy probability. In the binomial probit model, the probability of bankruptcy would increase by 0.09 percentage points for every one-percent increase in NPL ratios, while it would increase by 0.11 percentage points if the relative stock valuation of the main bank decline by one percent. The marginal impacts are relatively moderate. The impacts are, however, far from negligible, undergoing financial turbulence where the NPL ratios piled up and the stock prices dropped dramatically. They would have been critical under a financial crisis.

The trinomial probit model shows that the marginal impacts on bankruptcy are more important for reconstruction purposes than for liquidation purposes. The probability of bankruptcy for reconstruction purposes would increase by 0.08 percentage points for every one-percent increase of the NPL ratios, while it would increase by 0.07 percentage points for each one-percent decline of the relative stock valuation. After 1998, the Financial Services Agency (FSA) established the basic guidelines for financial inspections and gradually started its strict financial inspections of banks. Under the circumstances, the banks increased reconstruction of their troubled client firms when the amount of nonperforming loans piled up. Moreover, because of their forward-looking properties, a decline in the stock price was a market signal that the Japanese bank would be in trouble in the near future. Responding to the market

signal, the bank might increase reconstruction of its troubled client firms to recover its market value.

As for the marginal effects of the default dummies, a main bank failure and a major trading partner's default had smaller impacts than did a parent company's default. The impacts of the rare events on bankruptcy are, however, far from negligible for reconstruction purposes. If the main bank fails, the probability of bankruptcy would increase by 0.59 percentage points for reconstruction purposes, while it would increase only by 0.07 percentage points for liquidation purposes. If the major trading partner defaults, the probability of bankruptcy would increase by 0.59 percentage points for reconstruction purposes, while it would increase only by 0.21 percentage points for liquidation purposes.

The table suggests that the catastrophic effects are very large when a parent company defaults. If one of the parent companies defaults, the probability of bankruptcy would increase by 3.58 percentage points in the binomial probit model. In the trinomial model, the probability of bankruptcy for reconstruction purposes would increase by 3.36 percentage points. The impacts are extremely significant, particularly in increasing bankruptcy probability for reconstruction purposes. This implies that the defaults of parent firms had contagious effects in increasing default risk of vertically related smaller firms in the late 1990s and early 2000s in Japan.

It is noteworthy that all of the default dummies had larger marginal effects on bankruptcy for reconstruction purposes than those for liquidation purposes. This probably reflects the fact that main bank failures as well as defaults of trading partners or parent companies are external shocks that are not directly related to the financial health of the unlisted firms. The external shocks increase default risk of the unlisted firms. When they are not accompanied by health deterioration of the unlisted firms, however, it is likely that the firms choose bankruptcy for reconstruction purposes rather than for liquidation purposes.

6. The Role of Multiple Banking Relationships

The benefits from a bank-borrower relationship stem mainly from having a single bank with proprietary information about the borrower, which may make more credit available at lower cost. Therefore, other things being equal, borrowing from multiple banks may be costly (higher transaction costs, duplicated effort, free-rider problem, etc.) and informationally inefficient relative to relationship lending by a single bank. Firms may, however, benefit from multiple banks to avoid a "hold-up" problem, in which a

single bank may exploit its market power and extract excessive rents. In particular, to the extent that a borrower faces switching costs in a relationship with an individual bank, it would be costly to borrow from a single lender if its primary bank is in financial distress. This implies that default risk would be more sensitive to our bank health measures if the bank-firm relationship is close.

In this section, we examine these implications based on our probit models. To measure a favorable impact of a close bank-borrower relationship, we include the number of bank lenders in the last period as an explanatory variable. To the extent that a close bank-borrower relationship has a role in reducing the costs of financial distress for borrowers, we expect that the number of bank lenders in the previous period will have a positive impact on the bankruptcy probability. We also add a coefficient dummy of multiple banking relationships to NPL ratios, one of our bank health measures. The coefficient dummy takes one if the number of its bank lenders in the last period is equal to or greater than three, and zero otherwise. To the extent that a close bank-borrower relationship exacerbates a "hold-up" problem, the coefficient dummy would reduce the impact of bank health deterioration on the bankruptcy probability. We thus expect that the coefficient dummy has a negative sign for the NPL ratios.

Table 6 summarizes the estimation results of our probit models. The table reports the case in which we add the coefficient dummy to the NPL ratios after 1998. As in Table 4, "debt-asset ratio," "interest payments-output ratio," and "special losses-asset ratio" have positive impacts, while "profits-asset ratio" has negative impacts. Without the coefficient dummy, the impacts of the three alternative measures of the bank health are also similar to those in Table 4. The inclusion of the number of bank lenders and the coefficient dummy did not change our basic results.

More interesting results are, however, observed when we look at the impacts of the number of bank lenders. The number of bank lenders itself has a significant positive impact on the bankruptcy probability. This implies that, given the bank health measures, a close bank-firm relationship reduces the probability of bankruptcy. The implication is reconfirmed in Figure 3, which shows the percentages of bankrupt firms for each number of bank lenders. When the number of bank lenders is less than three, the percentage of bankrupt firms is less than 0.52, even for all bankruptcies. When the number is between four and five, the percentage goes up to 0.9, but is still less than one. However, when the number exceeds six, the percentage is always greater than one. In particular, when the number of bank lenders is 10, the percentage exceeds two. The results are essentially the same even if we classify the types of bankruptcies into two

categories. One may argue a possibility of reverse causality, that default risk increases the number of bank lenders. However, the number of bank lenders is highly stable over time; it is very rare that firms switch lending banks. It is thus very unlikely that firms increased lenders when they face unexpected financial distress during our short time span.

In Table 6, the coefficient dummy of NPL ratios, in contrast, reduces the impact of bank health deterioration on the bankruptcy probability. The sign of each coefficient dummy was negative, although its significance level is marginal. This implies that when various measures of bank health deteriorated, multiple banking relationships would mitigate the tightened bank's lending attitude, and reduce borrowers' default risk in the late 1990s and early 2000s.

The result implies that multiple bank relationships might have both costs and benefits. They are costly when they cause too much competition ex post, which may discourage lending to small and medium firms that have few alternative sources of funding. They are, however, beneficial when they reduce the value of information acquisition to any one individual bank, which avoids the hold-up problem.

7. Predictability of the Model

In this paper, we have found that several measures of bank-specific financial health as well as borrower's financial variables have significant impacts on a borrower's probability of bankruptcy. Highly significant coefficients in the probit models suggest the usefulness of our approach in predicting a borrower's default risk under impaired bank health. The purpose of this section is to explore some predictability of our binomial probit model in detecting borrower's bankruptcies. Economic models usually show poor performance in predicting rare events (see, for example, Greene's [2003] p.685). Since the average bankruptcy rate is only 1.0% in our sample, our probit models also tended to show relatively low bankruptcy probabilities, even for bankrupt firms. However, several alternative performance measures show the usefulness of our model in predicting bankruptcies.

First, when we compare ex-ante bankruptcy probabilities between bankrupt firms and non-bankrupt firms, our probit model on average shows much higher bankruptcy probability for bankrupt firms than for non-bankrupt firms. For example, in the binomial model in Section 6, average ex-ante bankruptcy probability is 3.35% for bankrupt firms and 1.00% for non-bankrupt firms. The average predicted probability

for bankrupt firms is more than three times that for non-bankrupt firms.[9]

Second, when we compare bankruptcy probabilities of individual firms, the ex-ante bankruptcy probability exceeds 1% (that is, average bankruptcy rate) for most bankrupt firms but does not for most non-bankrupt firms. Figure 4 shows a histogram of bankruptcy probabilities predicted by the binomial model in Section 6. It is easy to see that distribution in the histogram is almost flat for bankrupt firms but is highly skewed toward zero for non-bankrupt firms. The percentage of firms whose ex-ante bankruptcy probability is more than 5% is 19% among bankrupt firms but only 2% among non-bankrupt firms. In contrast, the percentage of firms whose ex-ante bankruptcy probability is below 1% is only 22% among bankrupt firms but 68% among non-bankrupt firms. Since average bankruptcy probability is 1.0% in our sample, this implies that firms whose bankruptcy probability exceeds the average bankruptcy rate are likely to default in the next period.

Third, the inclusion of bank-specific financial health measures improves the predictability of our probit models. We can see this by comparing performance of our binomial probit model in Section 6 with and without bank-specific financial health measures.[10] When we estimate the model without bank-specific financial health measures, average ex-ante bankruptcy probability drops from 3.35% to 2.64% for bankrupt firms while it goes up from 1.00% to 1.01% for non-bankrupt firms. Without bank-specific financial health measures, the share of firms whose ex-ante bankruptcy probability exceeds 5% drops from 19% to 10% among bankrupt firms, while the share of firms whose ex-ante bankruptcy probability is below 2% goes up from 48% to 53% among bankrupt firms. The inclusion of bank-specific financial health measures is useful in providing warning messages for possible bankruptcies in the next period.

8. Conclusions

In this paper, we investigated how various measures of bank health and how defaults of major trading partners affected the probability of bankruptcy among medium-size firms in Japan. Using probit models, we found that several measures of bank-specific financial health have significant impacts on a borrower's probability of bankruptcy,

[9] In the experiment, non-bankrupt firms include firms that survived in the present year but defaulted in the following years. If we focus solely on these firms, average ex-ante bankruptcy probability goes up to 2.09%. The average predicted probability is more than twice that of the other non-bankrupt firms.

[10] The model without bank-specific financial health measures excludes three bank health measures and defaults of parent companies and a major trade partner from its explanatory variables.

even when observable characteristics relating to these borrower's financial variables are controlled. The inclusion of bank-specific financial health measures was useful in providing warning messages for possible bankruptcies in the next period.

After the collapse of the Japanese stock market in the early 1990s, the Japanese banking sector began to face considerable problems, many of which limited its ability to renew loans and to extend new loans to firms. The problems became especially serious in the late 1990s, when several major financial institutions turned out to be in default. If firms are highly dependent on obtaining funds from banks with which they have a historical relationship, one would expect that firms that relied more on finance from troubled banks suffered significantly larger default risks. Our empirical results support this view, particularly for the firms with a close banking relationship, using the firm-level data of unlisted Japanese companies in the late 1990s and early 2000s.

In his survey article, Boot (2000) pointed out that banking relationships have negative effects not only with respect to the hold-up problem but also for the soft-budget constraint problem. A bank with an impaired balance-sheet might attempt to "gamble for resurrection" and hence might increase risky lending to zombie firms. The banks could reduce the reported amount of nonperforming loans on their books and inflate their reported capital, as long as it makes sufficient credit available to the firm to enable it to make interest payments on the outstanding loans from the bank. Consequently, a bank may continue lending to troubled firms to provide sufficient financing to keep otherwise economically bankrupt firms alive. Some recent studies supported the view for listed firms (for example, Peek and Rosengren [2003]). However, our results suggest that the view is less likely to hold for unlisted firms. Unlisted firms in our sample are too small for troubled banks to gamble for resurrection. Rather, it is possible that smaller firms' ability to raise external financing was impaired, and became more likely to default when the financial condition of Japanese banks deteriorated.

References

Altman, E.I., (1968), "Financial Ratios, Discriminant Analysis and the Prediction of Corporate Bankruptcy," *Journal of Finance* 23, pp. 589-609.

Anari, A., J.W. Kolari, and Mason, J.R., (2005), "Bank Asset Liquidation and the Propagation of the U.S. Great Depression," *Journal of Money, Credit, and Banking* 37, pp. 753-773.

Berger, A.N., and G.F. Udell, (1995), "Relationship Lending and Lines of Credit in Small Firm Finance," *Journal of Business* 68, pp. 351-381.

Bernanke, B.S., (1983), "Nonmonetary Effects of the Financial Crisis in Propagation of the Great Depression," *American Economic Review*, 73, pp. 257-76.

Boot, A.W.A., (2000), "Relationship Banking: What Do We Know?" *Journal of Financial Intermediation* 9, pp. 7–25.

Bris, A., I. Welch, and N. Zhu, (2004), "The Costs of Bankruptcy: Chapter 7 Cash Auctions vs. Chapter 11 Bargaining," Yale ICF Working Paper No.04-13.

Ferri, G., and M. Messori, (2000), "Bank-firm Relationships and Allocative Efficiency in Northeastern and Central Italy and in the South," *Journal of Banking and Finance* 24, pp. 1067–1095.

Fukuda, S., M. Kasuya, and J. Nakajima, (2005), "Bank Health and Investment: An Analysis of Unlisted Companies in Japan," CIRJE Discussion Paper F-330, University of Tokyo.

Gibson, M., (1995), "Can Bank Health Affect Investment? Evidence from Japan," *Journal of Business* 68, pp. 281-308.

Greene, W.H., (2003), *Econometric Analysis, 5th Edition*, New Jersey: Prentice Hall.

Hall, B.J., and D.E. Weinstein, (2000), "Main Banks, Creditor Concentration, and the Resolution of Financial Distress in Japan," in M. Aoki and G.R. Saxonhouse, eds., *Finance, Governance, and Competitiveness in Japan*, New York: Oxford University Press, pp. 64-80.

Harhoff, D., and T. Körting, (1998), "Lending Relationships in Germany: Empirical Results from Survey Data," *Journal of Banking and Finance* 22, pp. 1317–1354.

Hillegeist, S.A., E.K. Keating, D.P. Cram, and K.G. Lundstedt, (2003), "Assessing the Probabilities of Bankruptcy Prediction," working paper, Northwestern University.

Hoshi, T., A. Kashyap, and D. Scharfstein, (1990), "The Role of Bank in Reducing the Costs of Financial Distress in Japan," *Journal of Financial Economics* 27, pp. 67-88.

Houston, J.F., and C.M. James, (2001), "Do Relationships Have Limits? Banking Relationships, Financial Constraints, and Investment," *Journal of Business* 74, pp.

347-374.

Ito, T., and Y. N. Sasaki, (2002), “Impacts of the Basel Capital Standard in Japanese Banks Behavior,” *Journal of the Japanese and International Economies* 16, pp. 372-397.

Kang, J.-K., and A. Shivdasani, (1995), “Firm Performance, Corporate Governance, and Top Executive Turnover in Japan,” *Journal of Financial Economics* 38, pp. 29-58.

Kang, J.-K., and R.M. Stulz, (2000), "Do Banking Shocks Affect Firm Performance? An Analysis of the Japanese Experience," *Journal of Business,* 73, pp. 1-23.

Klein, M. W., Peek, J., and E.S. Rosengren, (2002), “Troubled Banks, Impaired Foreign Direct Investment: The Role of Relative Access to Credit,” *American Economic Review*, 92, pp. 664-682.

Lennox, C., (1999), “Identifying Failing Companies: A Revaluation of the Logit, Probit and DA Approaches,” *Journal of Economics and Business* 51, pp. 347-364.

Morck, R., and M. Nakamura, (1999), “Banks and Corporate Control in Japan,” *Journal of Finance* 54, pp. 319-339.

Omura, K., M. Kusumi, S. Minakami, and K. Shiomi, (2002), “Financial Characteristics of Bankrupt Firms and Lending Behavior of Financial Institutions,” (in Japanese) Discussion Paper Series 02-5, Director General for Economic Assessment and Policy Analysis, Cabinet Office.

Peek, J., and E.S. Rosengren, (2003), "Unnatural Selection: Perverse Incentives and the Misallocation of Credit in Japan," NBER Working Paper 9643.

Petersen, M., and R. Rajan, (1994), “The Benefits of Lending Relationships: Evidence from Small Business Data,” *Journal of Finance* 49, pp. 3-37.

Rajan, R., (1992), “Insiders and Outsiders: The Choice Between Relationship and Arm’s Length Debt,” *Journal of Finance* 47, pp. 1367-1400.

Saito, T., and T. Tachibanaki, (2004), “Empirical Analysis of Survival and Bankruptcy of Small and Medium Firms (in Japanese),” RIETI Discussion Paper Series 04-J-004.

Schaede, U., (2005), “The "Middle-Risk Gap" and Financial System Reform: Small-Firm Financing in Japan,” *Monetary and Economic Studies* 23, pp. 149-176.

Sharpe, S., (1990), "Asymmetric Information, Bank Lending and Implicit Contracts: A Stylized Model of Customer Relationships." *Journal of Finance*, 45(4), pp. 1069-1087.

Shumway, T., (2001), “Forecasting Bankruptcy More Accurately: A Simple Hazard Model,” *Journal of Business* 74, pp. 101-124.

Woo, D., (2003), “In Search of ‘Capital Crunch’: Supply Factors Behind the Credit Slowdown in Japan,” *Journal of Money, Credit, and Banking,* Part 1, 35, pp. 1019-1038.

Table 1-1 Basic Statistics of the Financial Data: The Case of Unlisted Firms

(%)

	all firms	bankrupt firms
Debt/total asset (average)	43.10	65.63
(standard deviation)	37.92	37.62
(maximum)	2846.30	358.18
(minimum)	0.00	9.79
Special Loss/total asset (average)	2.34	6.18
(standard deviation)	8.57	21.26
(maximum)	507.61	242.92
(minimum)	0.00	0.00
Interest Payments/Output (average)	0.88	1.50
(standard deviation)	2.44	1.83
(maximum)	239.20	21.29
(minimum)	0.00	0.00
Profits/total asset (average)	2.45	0.21
(standard deviation)	5.92	7.13
(maximum)	63.54	17.67
(minimum)	-235.01	-82.74

Notes 1) The number of firms is 6,266, of which 318 firms went bankrupt.

2) The sample period is 1997 to 2003.

3) The data of bankrupt firms are those of a year ahead of their bankruptcies.

Source: TSR Database Service.

Table 1-2 Basic Statistics of the Financial Data: The Case of Listed firms

(%)

	all firms	bankrupt firms
Debt/total asset (average)	33.21	45.00
(standard deviation)	86.33	23.25
(maximum)	4638.80	160.71
(minimum)	0.01	4.94
Special Loss/total asset (average)	3.24	8.80
(standard deviation)	8.36	15.21
(maximum)	324.06	74.31
(minimum)	0.00	0.01
Interest Payments/Output (average)	0.43	1.15
(standard deviation)	0.42	0.75
(maximum)	7.74	4.27
(minimum)	0.00	0.18
Profits/total asset (average)	4.46	-0.04
(standard deviation)	12.21	2.61
(maximum)	485.98	7.56
(minimum)	-110.60	-6.73

Notes 1) The number of firms is 2,138, of which 63 firms went bankrupt.

2) The sample period is 1996 to 2001.

3) The data of bankrupt firms are those of a year ahead of their bankruptcies.

Source: Japan Development Bank Company Database.

Table 2　Types of Main Banks

City, Trust, Long-term Credit Banks	57.16
First Regional Banks	27.91
Second Regional Banks	4.09
Shinkin and Shinkumi	5.38
Unknown	5.44

Table 3　Basic Statistics of Main Banks

	all firms	bankrupt firms
NLP ratio (%)　(average)	4.09	4.49
(standard deviation)	3.18	3.29
(maximum)	33.97	33.97
(minimum)	1.43	1.43
Relative measure of stock valuation　(average)	-0.86	-1.01
(standard deviation)	0.87	0.93
(maximum)	0.22	0.00
(minimum)	-3.52	-3.27

Note: The relative measure of stock valuation is the logged difference of the stock price from the benchmark year of 1990.

Table 4-1 Estimation Result of the Binomial Probit Model

	Coef.		standard err.
Const.	0.23		(0.61)
Debt/asset	0.50	***	(0.06)
Special Loss/asset	0.04	***	(0.01)
Interest Payments/Output	0.17	***	(0.03)
Profits/asset	-1.13	**	(0.53)
NPL ratio (96-97)	0.12	***	(0.04)
NPL ratio (98-02)	0.06	*	(0.03)
Difference of log (Stock price)	-0.08	**	(0.03)
Main bank default dummy	0.24		(0.18)
Major trading partner default dummy	0.35	***	(0.09)
Parent company default dummy	0.82	***	(0.22)
Industry dummy (Construction)	0.34	***	(0.06)
Industry dummy (Manufacture)	-0.21	***	(0.06)
Industry dummy (Communication and Transportation)	-0.59	***	(0.15)
Industry dummy (Real estate)	-0.26	***	(0.10)
Industry dummy (Service)	-0.27	***	(0.10)
Main bank unknown dummy	0.01		(0.12)
Unlisted bank dummy	0.03		(0.07)

Table 4-2 Estimation Result of the Multinomial Probit Model

	(B) Reconstruction			**(A) Liquidation**		
	Coef.		standard err.	Coef.		standard err.
Const.	0.09		(0.73)	-0.40		(0.81)
Debt/asset	0.30	***	(0.09)	0.57	***	(0.07)
Special Loss/asset	0.02		(0.02)	0.05	***	(0.02)
Interest Payments/Output	0.27	***	(0.04)	0.09	**	(0.04)
Profits/asset	-1.09	*	(0.63)	-0.97		(0.70)
NPL ratio (96-97)	0.02		(0.06)	0.17	***	(0.05)
NPL ratio (98-02)	0.09	**	(0.04)	0.03		(0.04)
Difference of log (Stock price)	-0.08	*	(0.04)	-0.06		(0.04)
Main bank default dummy	0.41	*	(0.24)	0.09		(0.23)
Major trading partner default dummy	0.42	***	(0.10)	0.22	*	(0.12)
Parent company default dummy	1.00	***	(0.24)	0.46		(0.34)
Industry dummy (Construction)	0.29	***	(0.09)	0.33	***	(0.08)
Industry dummy (Manufacture)	-0.09		(0.08)	-0.31	***	(0.08)
Industry dummy (Communication and Transportation)	-0.50	***	(0.19)	-0.64	***	(0.21)
Industry dummy (Real estate)	-0.43	***	(0.15)	-0.16		(0.12)
Industry dummy (Service)	-0.15		(0.12)	-0.41	***	(0.14)
Main bank unknown dummy	-0.01		(0.16)	0.02		(0.17)
Unlisted bank dummy	0.13		(0.09)	-0.07		(0.09)
rho (correlation coef.)	0.31		(0.49)			

Notes 1) ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

2) The number of samples is 31,000.

Table 5-1 Marginal Effects (Binomial Probit Model)

(% point)

	bankruptcy
Debt/asset	0.75
Special Loss/asset	0.06
Interest Payments/Output	0.25
Profits/asset	-1.69
NPL ratio (98-02)	0.09
Difference of log (Stock price)	-0.11
Main bank default dummy	0.49
Major trading partner default dummy	0.81
Parent company default dummy	3.58

Table 5-2 Marginal Effects (Multinomial Probit Model)

(% point)

	Reconstruction	Liquidation
Debt/asset	0.24	0.41
Special Loss/asset	0.02	0.04
Interest Payments/Output	0.22	0.06
Profits/asset	-0.88	-0.69
NPL ratio (98-02)	0.08	0.02
Difference of log (Stock price)	-0.07	-0.04
Main bank default dummy	0.59	0.07
Major trading partner default dummy	0.59	0.21
Parent company default dummy	3.36	0.58

Table 6-1 Binomial Probit Model with the Number of Bank Lenders

	Coef.		standard err.
Const.	-0.32		(0.65)
Debt/asset	0.51	***	(0.06)
Special Loss/asset	0.04	***	(0.01)
Interest Payments/Output	0.17	***	(0.03)
Profits/asset	-1.19	**	(0.54)
NPL ratio (96-97)	0.11	***	(0.04)
NPL ratio (98-02)	0.30	*	(0.17)
Coef. Dummy of NPL ratio	-0.25		(0.17)
Difference of log (Stock price)	-0.08	**	(0.03)
Dummy of the bank lenders' number	0.61	***	(0.19)
Main bank default dummy	0.23		(0.19)
Major trading partner default dummy	0.36	***	(0.09)
Parent company default dummy	0.81	***	(0.22)
Industry dummy (Construction)	0.35	***	(0.06)
Industry dummy (Manufacture)	-0.20	***	(0.06)
Industry dummy (Communication and Transportation)	-0.59	***	(0.15)
Industry dummy (Real estate)	-0.24	**	(0.10)
Industry dummy (Service)	-0.25	**	(0.10)
Main bank unknown dummy	-0.01		(0.12)
Unkisted bank dummy	0.03		(0.07)

Table 6-2 Multinomial Probit Model with the Number of Bank Lenders

	(B) Reconstruction			**(A) Liquidation**		
	Coef.		standard err.	Coef.		standard err.
Const.	-0.37		(0.80)	-0.96		(0.84)
Debt/asset	0.30	***	(0.09)	0.58	***	(0.07)
Special Loss/asset	0.02		(0.02)	0.05	***	(0.02)
Interest Payments/Output	0.27	***	(0.04)	0.08	**	(0.04)
Profits/asset	-1.20	*	(0.65)	-0.98		(0.70)
NPL ratio (96-97)	0.01		(0.06)	0.17	***	(0.05)
NPL ratio (98-02)	0.15		(0.29)	0.36	*	(0.19)
Coef. Dummy of NPL ratio	-0.04		(0.09)	-0.35	*	(0.20)
Difference of log (Stock price)	-0.08	*	(0.04)	-0.06		(0.04)
Dummy of the bank lenders' number	0.62	**	(0.29)	0.56	**	(0.24)
Main bank default dummy	0.40	*	(0.24)	0.09		(0.23)
Major trading partner default dummy	0.43	***	(0.10)	0.23	*	(0.12)
Parent company default dummy	0.98	***	(0.24)	0.45		(0.34)
Industry dummy (Construction)	0.30	***	(0.09)	0.34	***	(0.08)
Industry dummy (Manufacture)	-0.09		(0.08)	-0.31	***	(0.08)
Industry dummy (Communication and Transportation)	-0.50	***	(0.19)	-0.64	***	(0.21)
Industry dummy (Real estate)	-0.43	***	(0.15)	-0.14		(0.12)
Industry dummy (Service)	-0.14		(0.12)	-0.39	***	(0.14)
Main bank unknown dummy	-0.04		(0.16)	0.00		(0.16)
Unlisted bank dummy	0.13		(0.09)	-0.07		(0.09)
rho (correlation coef.)	0.30		(0.48)			

Notes 1) ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

2) The number of samples is 31,000.

Figure 1 Bankruptcies in Japan

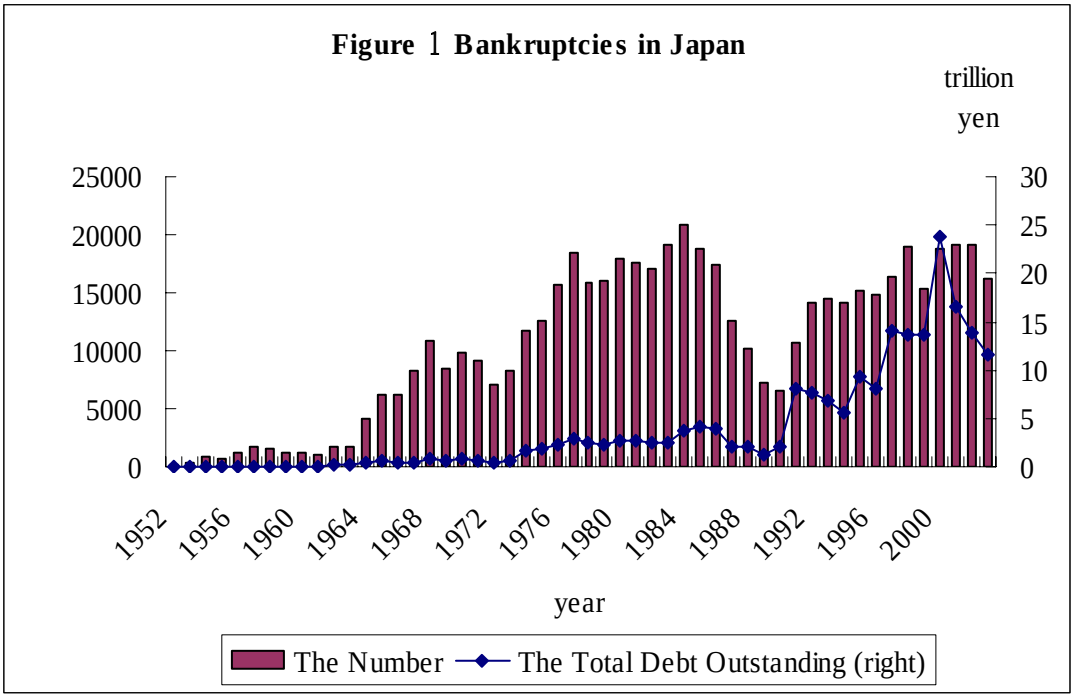

Figure 2. The "Tankan" DI: Lending Attitude

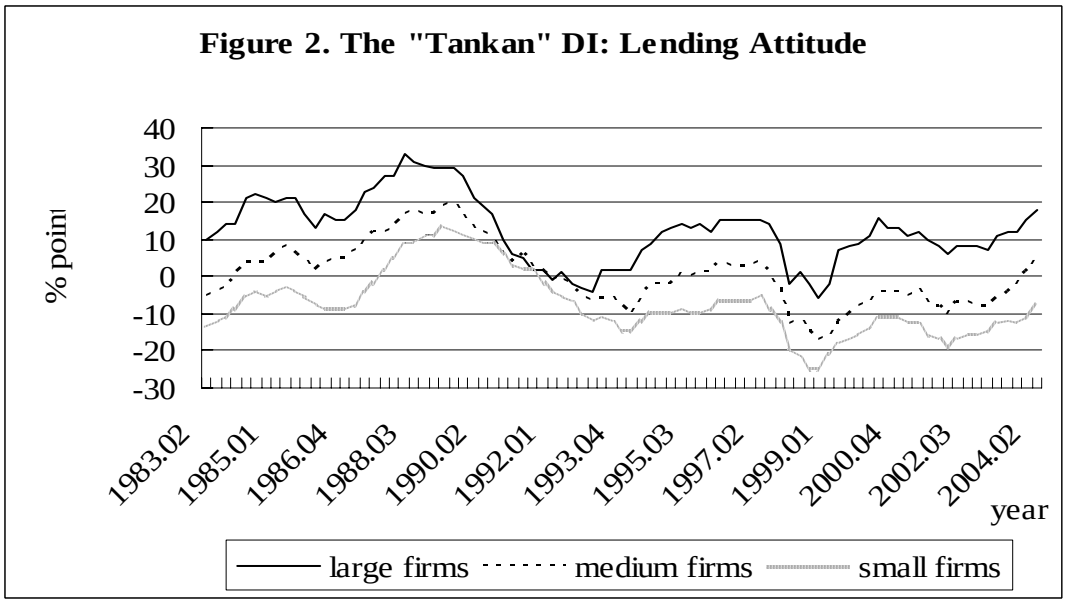

Figure 3. Percentages of Bankrupt Firms

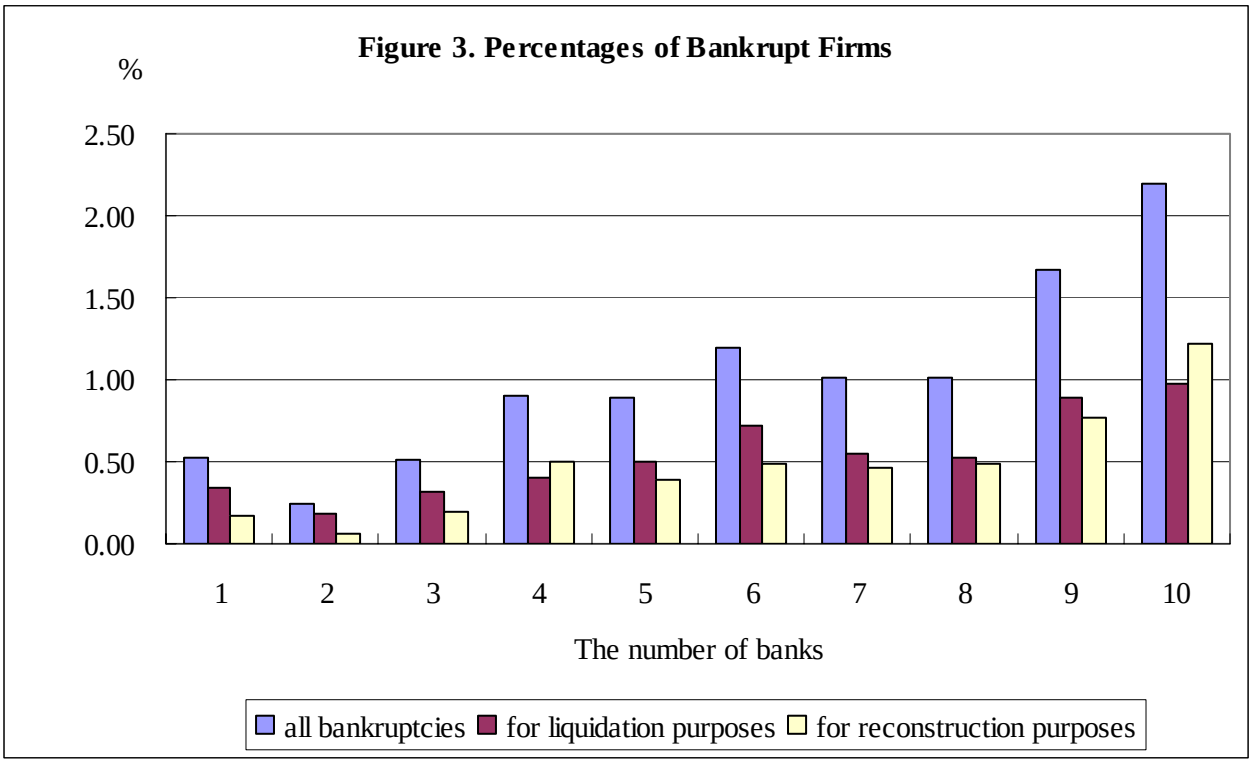

Figure 4. Histogram of Predicted Bankruptcy Probabilities