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Do Firms Benefit from Multiple Banking Relationships? Evidence from Small and Medium-Sized Firms in Japan

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Abstract

This paper examines empirically the effects of multiple banking relationships on the cost and availability of credit. The analysis is based on an unbalanced panel data set for Japanese small and medium-sized firms over the period 2000-2002. The Hausman-Taylor estimator is used to allow for possible correlation between unobservable heterogeneity among firms and multiple banking relationships. The results suggest that the cost of credit is positively correlated with the number of banking relationships when the endogeneity of the banking relationships is considered. Multiple banking relationships have a positive effect on the availability of credit for financially constrained firms.

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1. Introduction

Relational banking plays an important role in overcoming credit constraints for small businesses. In the presence of informational asymmetry, adverse selection and moral hazard can lead to credit rationing – a problem that can be overcome by banking relationships, which, over time, help the bank to obtain information on the borrowing firm's unobservable qualities and thus mitigate credit rationing. A growing body of theoretical literature examines the costs and benefits of banking relationships, suggesting that long-term exclusive banking relationships can relax the credit constraints of less well-known firms. On the other hand, such relationships potentially allow banks to extract rent by exploiting the informational monopoly power they possess over a firm if the quality of the firm is good but unobservable and the firm has good investment opportunities (Sharpe 1990; Rajan 1992; von Thadden 1995). At the same time, however, informationally opaque firms with a single banking relationship are vulnerable to liquidity shocks to their first bank: unable to borrow from their preferred bank, such businesses may be unable to obtain financing from other, non-relational banks, which fear they might be dealing with a "lemon" (Detragiache, Garella, and Guiso 2000). Thus, in order to ensure stable financing, firms of both good and bad quality typically choose multiple sources, i.e. they enter multiple banking relationships.

A growing number of empirical studies, using cross-section data on small and medium-sized firms, explore the effect of multiple banking relationships on the cost and availability of credit. However, most of these studies do not consider the endogeneity of banking relationships and credit contract terms. When the information obtained through relationships is not easily transferred to outsiders and unobservable firm quality determines the number of banking relationships and the credit cost and availability, the banking relationships and the credit contract terms become endogenous. Determinants of unobservable firm quality are factors such as managerial ability, firms' reputation, or positive net investment opportunities that are often not fully captured by the observable data. The treatment of unobserved firm quality is particularly important when we use data on small and medium-sized firms since less observable and audited information is available for them than for listed companies.

This paper reexamines the costs and benefits of multiple banking relationships using a panel data set for Japanese small and medium-sized firms for the period 2000-2002. This paper differs from preceding studies in three ways. First, unobserved firm

heterogeneity (or unobserved firm effects) and the possible correlation between unobservable heterogeneous firm characteristics and banking relationships are considered. Second, financially constrained firms are singled out by estimating a disequilibrium model that allows for credit rationing, and the relationship between the nature of the banking relationship and credit availability is investigated. This approach differs from previous studies in that the latter define firms as financially constrained if they rely on other expensive external financial sources that are substitutes for bank credit. The third aspect in which this paper differs from previous studies on Japan is that it concentrates on small and medium-sized firms, while most preceding analyses have focused on bank-firm relationships among listed firms.

The remainder of the paper is organized as follows. Section 2 reviews previous theoretical and empirical studies and highlights their shortcomings. Section 3 describes the basic estimation strategy and our sample data. Section 4 presents the results of the estimation of the effect of banking relationships on the cost of credit. Section 5 presents the investigation into the effect of multiple banking relationships on the availability of credit for financially constrained firms. Section 6 concludes.

2. The effect of multiple banking relationships on credit cost and availability: theory and evidence

This section reviews what the theoretical literature has to say on the costs and benefits of multiple banking relationships, focusing on the effect of relationships on the pricing and availability of credit. It also discusses previous empirical studies on these issues relating to small and medium-sized firms.[1, 2]

2.1 The cost and availability of credit and multiple banking relationships: Theoretical considerations

From a theoretical point of view, multiple relationship banking can have both advantages and disadvantages, both of which are related to the fact that relationship

[1] A survey of more general issues regarding relationship banking is provided by Boot (2000).

[2] This paper restricts itself to a discussion of multiple banking relationships, however the strength of banking relationships are measured in various ways: the duration of a bank-firm relationship (Petersen and Rajan 1994, 1995; Cole 1998; Degryse and Van Cayseele 2000) and the number of different services the firm purchases from the bank (Degryse and Van Cayseele 2000).

banks acquire private information on the borrowing firm. The benefit of a single banking relationship over multiple ones is that it can save overall monitoring costs (Diamond 1984) and transaction costs. On the other hand, the cost of a single banking relationship is that the single relationship bank may use its monopoly information and extract future rents (the "hold-up problem") (Sharpe 1990; Rajan 1992; von Thadden 1995). In this environment, small and medium-sized firms that heavily rely on bank finance can protect themselves from such a hold-up problem by establishing a second banking relationship.

Multiple banking relationships also have conflicting implications with regard to credit availability. In the presence of information asymmetry between lenders and borrowers, adverse selection and moral hazard can lead to credit rationing (Stiglitz and Weiss 1981). Thus, firms are unable to obtain all the credit they demand at the going market interest rate. Adverse selection problems are particularly severe in the market for small business financing. In this case, exclusive and long-term banking relationships can mitigate credit rationing since relationship banks internalize the benefits of subsidizing firms over time. At the same time, however, firms with a single banking relationship are more at risk of not being able to obtain additional credit if their bank refuses to provide it, because non-relational banks are likely to suspect that the firm is a lemon (due to the adverse selection problem). Possible reasons why a firm's single bank might refuse to provide additional credit are that the firm's quality is revealed to be bad or the bank itself faces a liquidity problem of its own. Therefore, anticipating adverse selection problems, both good and bad quality firms may choose to engage in multiple banking relationships to ensure stable access to finance.

2.2 The cost and availability of credit and multiple banking relationships: Empirical evidence

The empirical literature has produced mixed results regarding the effects of intensive banking relations on the cost and availability of loans. Using U.S small firm data, Petersen and Rajan (1994, 1995) find that a higher concentration in banking relationships leads to lower borrowing costs and less credit rationing. Harhoff and Körting (1998), using survey data for small and medium-sized German firms with no more than 500 employees, find no correlation between the cost of debt and the number of relationship banks; however, firms with multiple banking relationships face more credit rationing than those with a single banking relationship. These studies provide evidence to support the hypothesis that an exclusive banking relationship provides a

good incentive for banks to supply loans to credit constrained firms since it enables banks to obtain rents in the future (von Thadden 1995). In contrast with these results, D'Auria, Foglia, and Reedtz (1999), using data on Italian firms, find a negative relationship between the interest rate of loans and the number of banking relationships. However, what all these studies have in common is that they treat multiple banking relationships as exogenously given and regress credit cost and availability on banking relationship variables. Yet, if relationship variables capture unobserved firm characteristics, such as managers' ability or firms' quality, and credit contract terms are also determined by the firms' unobservable characteristics, then the relationship variables and credit cost and availability are endogenous and the estimated coefficients are biased. For example, when firms of unobservable high quality choose multiple banking relationships to counter potential opportunistic behavior by banks, the banking relationships and cost of credit are both determined by the firm's quality and become endogenous.

Some studies investigate what determines a firm's choice of number of banking relationships. Detragiache, Garella, and Guiso (2000) address this question by developing a model in which a firm with a good investment opportunity establishes multiple banking relationships from the start in order to avoid the risk of financing difficulties should a single bank run into liquidity problems. Using cross-section data for small and medium-sized Italian manufacturing firms, the authors then test the model and find that the number of banking relationships is positively correlated with the fragility of banks. Berger, Klapper, and Udell (2001), using data set on Argentinean firms, find that small firms choose multiple banking relationships over a single banking relationship as a reaction to bank distress even though this increases their cost of credit. Cosci and Meliciani (2002), using data provided by a large Italian bank, find that the number of banking relationships is positively correlated with a firm's leverage and the riskiness of the sector in which the firm operates. All these studies find that firms' quality and the fragility of their primary bank determine the firms' choice of the number of banking relationships.

Credit cost and availability are affected by other factors besides multiple banking relationships. Focusing on the effect of local credit market competition on lending relationships, Petersen and Rajan (1995) argue that banks are more likely to extend credit to financially constrained firms in a concentrated credit market because they can expect future monopoly rents. The authors support their hypothesis with evidence based on U.S. small and medium-sized firm data. On the other hand, Tsuruta (2004), using panel data for Japanese small and medium-sized firms, finds that credit market

competition does not affect the loan interest rate.

3. Econometric procedure and data

3.1 Econometric procedure

Assuming that a firm chooses the number of banking relationships optimally so as to maximize profits in the presence of informational asymmetry, multiple banking relationships and the cost and availability of credit are determined by the firm's unobservable quality and become endogenous. Moreover, assuming that information on firms' quality is obtained through relationship banking, and this information is not easily transferred to or verifiable by outsiders of the relation, it is also unobservable for an econometrician. In the analysis that follows, it is therefore assumed that firms' unobservable quality and banking relationships are constant over time.

Based on previous theoretical and empirical studies it is assumed that a firm's cost of credit is determined by its observable and unobservable characteristics, credit market competition, and its banking relationships. Observable characteristics, such as firm size, firms' default risk, the industry in which they operate, their legal status and other characteristics are discussed in detail in the next section. The unobservable characteristics capture firm quality such as managerial ability, firm reputation or investment opportunities. These determinants of firm quality are usually unobservable and are not fully captured by the observable characteristics proxied by income statement and balance sheet variables. The credit market competition variable is included to control for variations in the loan rate in local credit markets.

The baseline empirical model of the determinants of the cost of credit can be written as follows:

$$\begin{aligned} Cost_{it} = {} & \beta_0 + \beta_1 \, Firm\ characteristics_{it} + \beta_2 \, Firm\ characteristics_i \\ & + \beta_3 \, Bank\ relationship\ characteristics_i + \beta_4 \, Credit\ market\ competition_{it} \\ & + \beta_5 \, Control\ variables_{it} + \alpha_i + u_{it} \ , \end{aligned}$$

where $Cost_{it}$ is the cost of credit for firm i in year t. Firms' observable characteristics consist of time-variant and time-invariant variables and their effects on the cost of credit are captured by β_1 and β_2, respectively. Firms' unobservable characteristics are captured by α_i, which is assumed to be $IID(0,\sigma_\alpha^2)$. Banking

relationships are assumed to be constant over time, while credit market competition is assumed to be changing over time. The disturbance term u_{it} is assumed to be uncorrelated with all of the explanatory variables and α_i and has zero mean and constant variance σ_u^2 conditional on all of the explanatory variables besides α_i. If α_i is correlated with some of the explanatory variables such as the bank relationship variables and firm characteristics, random effects will produce inconsistent estimators of all parameters. Although a traditional remedy for this problem is to use a fixed effects estimator, all time-invariant variables are eliminated and β_3 cannot be estimated. To estimate β_3, the Hausman and Taylor (1981) (hereafter HT) estimator is used.

For expositional simplicity, the equation above can be represented as follows:

$$Cost_{it} = \mathbf{X}_{it}\delta + \mathbf{Z}_i\gamma + \alpha_i + u_{it}, \quad (1)$$

where $\mathbf{X}_{it}$ represents time-variant firm characteristics and local credit market competition in year t. $\mathbf{Z}_i$ stands for time-invariant firm characteristics and firms' banking relationships. The unobservable firm heterogeneity α_i is $IID(0,\sigma_\alpha^2)$ and disturbance term u_{it} is assumed to be uncorrelated with the columns of $(\mathbf{X},\mathbf{Z},\alpha)$ and has zero mean and constant variance σ_u^2 conditional on $\mathbf{X}_{it}$ and $\mathbf{Z}_i$. $E(\alpha_i \mid \mathbf{X}_{it}, \mathbf{Z}_i) \neq 0$ is also assumed.

The estimation procedure of the HT estimator is as follows. $\mathbf{X}_{it}$ and $\mathbf{Z}_i$ are partitioned as $\mathbf{X}_{it} = (\mathbf{X}_{it1}, \mathbf{X}_{it2})$ and $\mathbf{Z}_i = (\mathbf{Z}_{i1}, \mathbf{Z}_{i2})$. $\mathbf{X}_{it1}$ and $\mathbf{Z}_{i1}$ are assumed to be uncorrelated with α_i, whereas $\mathbf{X}_{it2}$ and $\mathbf{Z}_{i2}$ are assumed to be correlated with α_i.

For estimation, a two-step estimation procedure is used. First, consistent estimates of δ_w are taken from the within-groups estimation of (1). Second δ_w is substituted into a between-group version of (1) to obtain

$$Cost_{i.} - \mathbf{X}_{i.}\hat{\delta}_w = \mathbf{Z}_i\gamma + \alpha_i + u_{i.} = \mathbf{Z}_i\gamma + \eta_{i.} \ ,$$

where $\eta_{i.} = \alpha_i + u_{i.}$. Since $\eta_{i.}$ is correlated with $\mathbf{Z}_{i2}$, an instrumental variable method is used to estimate γ. The instruments for $\mathbf{Z}_{i2}$ are the group means of $\mathbf{X}_{it1}$.

3.2 Sample data

The data used in this study are taken from JADE (Japanese Accounts and Data on Enterprises), which is a combination of the databases of Teikoku Databank and Bureau van Dijk and covers over 100,000 major Japanese firms including small and medium-sized firms. For this study, small and medium-sized firms are selected based on the definition of the Small and Medium Enterprise Basic Law, according to which small and medium-sized firms are defined as firms with capital of up to 300 million yen or up to 300 employees. In the case of the wholesale industry, small and medium-sized firms are defined as firms with capital of up to 100 million yen or up to 100 employees, and in the retail industry as enterprises with capital of up to 50 million yen or up to 50 employees. Since firms' number of employees varies over time, firms in this study are chosen on the basis of their data for 2002. Moreover, since information on firms' banks is provided only for the last period surveyed (year 2002), the sample is taken for the period 2000-2002 to minimize the effect of changes in banking relationships.

3.3 Variables

Independent variable

The cost of credit is expressed as the percentage point spread between the interest rate paid by the firm and short-term prime rate to control for changes in the underlying cost of credit. A positive spread indicates that the firm has to pay an additional risk premium. The interest rate is calculated as the interest paid divided by the total outstanding loan amount (expressed in %). Data for the short-term prime rate is taken from the *Financial and Economics Statistics Monthly* issued by the Bank of Japan.

Firm characteristics

As for time-variant firm characteristics, the logarithm of total assets and the current assets/current liabilities ratio are included as proxies for firms' default risk. The interpretation of these variables is that larger firms and firms with a high current assets/current liabilities ratio are less risky. Sales growth is included in order to control for the different investment opportunities firms face. The expected sign of this variable is negative. Log (1+firm age) and log (1+firm age)^2 are included to take account of possible non-linear firm age effects. The expected sign of log (1+firm age) is negative because younger firms tend to be relatively informationally opaque and therefore pay higher interest rates on their loans. The tangible fixed assets/total assets ratio is included as a proxy for collateral. The expected sign of this variable is negative. To mitigate the skewness of the distribution of the financial data, the lower and upper 1% tails of the distribution are trimmed. As for time-invariant firm characteristics, a dummy that takes one if a firm is incorporated and zero otherwise and a stock listing dummy that equals one if a firm's stock is traded at the stock market and zero otherwise are included as proxies for risk. Industry dummies are also included to control for variations across industries.

Banking relationship variables

The sample firms obtain credit from two different types of banks: non-government banks and government-affiliated financial institutions. It is assumed that the nature of relationships with non-government banks is different from that with government-affiliated financial institutions. Since the latter are supposed to function as the so-called "last resort", credit-rationed firms are likely to obtain finance from government-affiliated financial institutions at low interest rates that do not reflect their true default risk. To isolate the effect of non-government banking relationships on the cost of credit, the number of firms' banking relationships is calculated by including only non-government banks, of which there are several types: city banks, regional and second-tier regional banks, credit associations, and credit coops. To take account of the government-affiliated financial institutions effect, a dummy variable is included that takes one if the firm borrows from one of the government-affiliated financial institutions for small business (Shoko Chukin Bank, Japan Finance Corporation for Small Business, and National Life Finance Corporation) and zero otherwise. Also included is a dummy for city banks that takes one if the borrower's main bank is a city bank because the interest rate charged by city banks tends to be lower than that

charged by other national banks. The database does not contain information on the length of banking relationships, an issue that has been investigated in some of the previous studies.

Credit market competition

In order to control for variations in lending rates attributable to the degree of competition in the different regional loan markets, a measure of bank concentration in the local credit market is included. The measure is defined as the lending share of the three largest banks in the prefecture where the firm is headquartered. Data on the credit market share is obtained from three different sources: the *Kinyu Map* published by the Financial Journal Co., the *Kinyu* published by Japanese Bankers Associations, and the *Zenkoku Shinyokinko Zaimu Shohyo* published by Kinyu Tosho Consultant Co. Prefecture dummies are also included to control for time-constant variations across regional credit markets.

Summary statistics of the variables used in this study are presented in table 1.A. The industry distribution of observations is shown in table 1.B. The lower and upper 1% tails of the distribution of the financial variables are trimmed to eliminate outliers. After eliminating observations with incomplete or erroneous data, there are 78,695 firm-year observations (34,330 firms).

[Insert Tables 1.A and 1.B]

In order to partition explanatory variables into exogenous and endogenous ones described in the HT procedure, it is examined whether the variables are latent-choice variables or have a correlation with unobservable firm characteristics such as managerial ability. Firms' characteristics such as total assets and firm age, the current assets/current liabilities ratio, and credit market competition are considered as exogenous variables $\mathbf{X}_{it1}$, while firms' time-invariant characteristics such as firms' legal form, stock market listing status, industry dummies, and prefecture dummies are represented by $\mathbf{Z}_{i1}$. $\mathbf{X}_{it2}$ contains the tangible fixed assets ratio and other proxy variables for firms' quality. $\mathbf{Z}_{i2}$ contains the banking relationship variables, i.e. the

number of banking relationships and the dummy for government-affiliated financial institutions for small business. The city bank dummy is treated as a time-invariant exogenous variable since city banks have few branch offices in local credit markets and since whether a firm can obtain credit from a city bank is partly determined by local credit market conditions.

3.4 Specification tests

Prior to estimating equation (1) by the HT procedure, the validity of the exogeneity condition is tested using the Hausman test based on the difference between the within and the random estimator. The specification test statistics are presented in table 2. The test statistic is 1165.43 which is distributed as χ^2 (8) and is significant at the 1% level. The highly significant test statistics indicate that α_i is correlated with some of the explanatory variables and a random effects model is inappropriate.

Next, the null hypothesis of no correlation between α_i and $\mathbf{X}_{it1}$ and between α_i and $\mathbf{Z}_{i1}$ in the HT model specification is tested using the Hausman test based on the difference between the within and the HT estimator. The test statistic in the last row of table 2 (χ^2 (3) =5.51) indicates that the exogeneity assumption of some of the explanatory variables is valid and supports the HT specification.

4. Empirical evidence

4.1 The cost of credit

The estimation results are presented in table 2. Each regression includes year dummies to control for time series variation. The base line equation is labeled as Model I. The coefficient on the number of banking relationships is positive and significant at the 1% level, suggesting that multiple banking is costly. The coefficient on the dummy for borrowing from government-affiliated banks is negative and highly significant. This result is consistent with the notion that the government-affiliated financial institutions can set the interest rate at a lower level than the non-government banks and that small and medium-sized firms who can borrow from government-affiliated financial

institutions are in a better position when negotiating borrowing rates with non-government banks. The significant negative relationships (at the 1% level) between the interest rate and log (total assets) as well as the current assets/current liabilities ratio imply that larger and less risky firms can get access to cheaper credit. The coefficient on the tangible fixed assets/total assets ratio is negative and significant at the 1% level. Firms can borrow at a lower interest rate when they have more tangible assets for collateral. Contrary to expectation, the coefficient on the firm age variable is positive. The coefficient on the dummy indicating whether a firm is incorporated is negative, but statistically insignificant. Finally, the coefficient on the stock listing dummy is negative and significant at the 1% level, suggesting that firms listed on the stock market are charged a lower risk premium.

4.2 Controlling for firms' observable quality

It may be argued that the variable on the number of banking relationships captures the effect of firm quality that is uncontrolled for in the estimation above. In other words, the observed positive correlation between the cost of credit and the number of banking relationships may be due to omitted variables that are possibly correlated with the banking relationship variable. One possible scenario is that the higher cost of credit of firms engaged in multiple banking relationships is a reflection of the quality of those firms as only lower-quality firms would engage in multiple banking relationships to avoid the liquidation of an ongoing project in case the primary bank denies refinancing for the project (Petersen and Rajan 1994). To test this hypothesis, the observable time-varying quality of the firm is controlled for by including the operating profit/interest ratio (interest coverage ratio) and a financial distress dummy that takes one if a firm was in financial distress within the last three years. Lagged values of the interest coverage ratio are used to avoid simultaneity problems. The expected sign for the interest coverage ratio variable is negative, while that for the financial distress dummy is positive. This estimation is labeled Model II and the results are displayed in table 2. The coefficients on the interest coverage ratio and the financial distress dummy show the expected signs and are significant at the 1% and the 10% level, respectively. When a firm generates sufficient profits to pay the interest on its loans, the cost of credit is lower. However, firms that experienced financial distress in the preceding three years face lower credit costs. The estimation results on the banking relationship variables hold even when the quality of the firm is controlled for. The results of the other variables also remain unchanged.

4.3 Credit market competition

Petersen and Rajan (1995) argue that banks in concentrated credit markets charge lower interest rates than their counterparts in competitive credit markets because they can expect future monopoly rents. If firms in competitive credit markets have more banking relationships than those in less competitive credit markets, i.e., if firms' choice of the number of banking relationships is affected by the degree of competition in the credit market, then the positive result for the correlation between the cost of credit and the number of banking relationships found above may reflect a spurious correlation. To eliminate the possibility of such spurious correlation, the third model estimated includes the variable on the degree of competition in the credit market. The results, shown in table 2, indicate that the coefficient on the credit concentration variable is positive but not significant. The estimation results on the banking relationship variables and other variables remain unchanged. This result shows that the number of banking relationships is not a proxy for the degree of competition in local credit markets.

In sum, the estimation of Models I, II, and III suggest that multiple banking relationships are costly in terms of the interest rate borrowers need to pay and this result is robust when firms' quality and credit market competition are controlled for. Therefore, the question naturally arises as to why firms establish multiple banking relationships despite the costs?

[Insert Table 2]

5. Credit availability

In this section, the effect of multiple banking relationships on credit availability is investigated. Why do firms establish multiple banking relationships despite the costs? One way to think about this is to consider a firm with a profitable investment opportunity that requires capital in several tranches. Under these circumstances, a firm with a single banking relationship is more at risk of having to liquidate the project if the bank refuses to provide credit at a later stage. Given this risk, the cost of credit is a relatively minor consideration. Unfortunately, information on whether firms have been

refused credit by their first bank is unavailable. This section therefore analyzes the effect of multiple banking relationships on access to credit for financially constrained firms. The reason for focusing on financially constrained firms is that, all else being equal, the effect of banking relationships on credit availability is relevant only for financially constrained firms. This paper singles out constrained firms by estimating a disequilibrium model.[3] The estimation strategy in this part of the analysis is as follows. First, the sample is partitioned into credit constrained and unconstrained firms by estimating a disequilibrium model that allows for credit rationing. Next, the effect of banking relationships is estimated for credit constrained firms.

5.1 A disequilibrium model

A disequilibrium model with unknown sample separation, as described by Maddala (1983), is employed.

The disequilibrium model consists of the demand equation, supply equation and transaction equation:

$Loan_{it}^{d} = \beta_0^d + \beta_1^d Activity_{it}^{d} + \beta_2^d Size_{it} + \beta_3^d Substitutes_{it} + \beta_4^d Cost_{it} + u_{it}^{d}$ (demand function),

$Loan_{it}^{s} = \beta_0^s + \beta_1^s Collataral_{it} + \beta_2^s Default\ risk_{it} + u_{it}^{s}$ (supply function),

$Loan_{it} = Min\left(Loan_{it}^{d}, Loan_{it}^{s}\right)$ (transaction equation).

$Loan_{it}^{d}$ denotes the amount of bank credit demanded by firm i in period t, $Loan_{it}^{s}$ denotes the maximum amount of credit available to firm i in period t, and $Loan_{it}$ is the realized amount of bank credit. Following the example of Ogawa and Suzuki (2000) and Atanasova and Wilson (2004), the amount of bank credit demanded is modeled as a function of the level or the expansion of firm activity, firm size, other sources of capital that are substitutes to bank loans, and the cost of bank credit. The maximum amount of credit available to a firm is modeled as a function of the firm's collateral and default risk.

[3] Previous studies using data on small and medium-sized firms in the U.S. define firms as constrained when they fall behind in their repayment of trade credits, because trade credits become the most expensive source of capital if repaid after the due date.

In the demand equation, the level of firm activity is measured by sales, and substitutes for bank loans are proxied by cash flow and net trade credit. Net trade credit is calculated as the differences between notes payable trade plus accounts payable trade and notes receivable trade plus debtors' accounts receivable trade. The expected sign of the firm activity variable is positive because firms' demand for cash increases with the expansion of their business activities (the transaction cost motive for demanding cash). The expected signs of the variables for bank loan substitutes are negative. The cost of bank credit is expressed as the percentage point spread between the interest rate paid by the firm and short-term prime rate and is expected to have a negative effect on loan demand. Sales growth is included to control for firms' investment opportunities.

In the supply equation, firms' collateral is measured by tangible fixed assets and total assets. Firms' default risk is measured by the ability to pay interest and the ability to pay short-term debt. The former is represented by the operating profit/interest ratio, while the latter is represented by the current assets/current liabilities ratio. A high operating profit/interest ratio or a high current assets/current liabilities ratio indicates that the default risk is low. Therefore, the expected signs of collateral variable and variables indicating the ability to pay interest are all positive. All level variables are divided by total assets to reduce heteroscedasticity. Thus, the size effect of β_2^d in the demand function above is estimated as a constant term, while the constant term β_0^d is estimated as a coefficient of the reciprocal of total assets. The same logic is applied to the collateral effect of total assets and the constant term in the supply function. Both equations contain log (GDP) to control for macroeconomic conditions. To control for unobservable firm-fixed effects, first differences of the equations are estimated. In this way, banking relationships that might affect the maximum amount of credit available to firms are also eliminated. Other time-constant firm characteristics such as firms' legal status and industry specific effects that might affect the demand equation are also eliminated. To take first differences, data for the year 1999 is also used. The first-differenced variables are again truncated at the lower and upper 1% tails of the distribution and the total number of firm-year observations is 70,171. The model is estimated by the maximum likelihood method.

The estimation results are presented in table 3. The coefficients in the supply equation show the expected sign and are highly significant. Firms with more collateral, as measured by the tangible fixed asset/total assets ratio, obtain more credit. The results for the operating profit/interest ratio and the current assets/current liabilities ratio suggest that firms' ability to pay interest and short-term debt is also an important

determining factor of loan availability besides collateral. In the demand equation, the coefficients on the cash flow/total assets ratio and on the net trade credit/total assets ratio have the expected sign and are significant at the 1% level. Firms with a larger internal cash flow and greater other outside financial resources have a lower demand for bank loans. The coefficient on the percentage point spread between the loan interest rate paid by the firm and the short-term prime rate shows the expected sign and is highly significant. Contrary to expectation, the estimated coefficient on the sales/total assets ratio has a negative sign. The negative and significant coefficient on the sales growth variable suggests that growing firms generate greater internal cash flow and therefore have a lower demand for bank loans.

[Insert Table 3]

5.2 Credit availability

Next, the investigation turns to the effect of multiple banking relationships on the availability of credit for credit-constrained firms. Based on the results obtained in the previous section, a firm is defined as financially constrained in year t if the probability that the desired amount of bank credit in year t exceeds the maximum amount of credit available in the same year is greater than 0.5. Following Gersovitz (1980), the probability that firm i will face a financial constraint in year t is derived as follows:

$$\Pr(Loan_{it}^{d} > Loan_{it}^{s}) = \Pr(\mathbf{X}_{it}^{d}\beta^{d} + u_{it}^{d} > \mathbf{X}_{it}^{s}\beta^{s} + u_{it}^{s}) = \Phi\left(\frac{\mathbf{X}_{it}^{d}\beta^{d} - \mathbf{X}_{it}^{s}\beta^{s}}{\sigma}\right),$$

where $\mathbf{X}_{it}^{d}$ and $\mathbf{X}_{it}^{s}$ denote the variables that determine firms' loan demand and the maximum amount of credit available to firms, respectively. The error terms are assumed to be distributed normally, $\sigma^2 = \text{var}(u_{it}^{s} - u_{it}^{d})$, and $\Phi(\cdot)$ is a standard normal distribution function. Since $E(Loan_{it}^{d}) = \mathbf{X}_{it}^{d}\beta^{d}$ and $E(Loan_{it}^{s}) = \mathbf{X}_{it}^{s}\beta^{s}$, $\Pr(Loan_{it}^{d} > Loan_{it}^{s}) > 0.5$ if and only if $E(Loan_{it}^{d}) > E(Loan_{it}^{s})$.

Over the whole sample period 2000-2002, the average proportion of financial constrained firms is 39.75%.

Next, using only the sample of financially constrained firms, the effect of banking

relationships on credit availability is estimated. Conditional on the demand of credit, the availability of credit is determined by firms' collateral, default risk, other firm characteristics, banking relationships, credit market competition, and firms' unobservable characteristics. Although the observed amount of bank credit should be on the supply curve since the firms are liquidity constrained and fail to obtain the desired amount of bank credit, demand factors for loans are also included to lessen the identification problems.

The estimated equation is as follows:

$$\begin{aligned} LOAN_{it} = {} & \beta_0 + \beta_1 Collateral_{it} + \beta_2 Default\ risk_{it} + \beta_3\ Firm\ characteristics_i \\ & + \beta_4 Bank\ relationship\ characteristics_i + \beta_5 Credit\ market\ competition_{it} \\ & + \beta_6 Control\ variables_{it} + \alpha_i + u_{it}. \end{aligned}$$

The equation is estimated using the Hausman-Taylor method. The dependent variable is the total outstanding loan amount/total assets *100. Firms' collateral is measured by the tangible fixed assets/total assets ratio, while the firms' default risk is measured by the current assets/current liabilities ratio, the operating profit/interest ratio, and the financial distress dummy. Log (1+firm age) and log (1+firm age)^2 are included as proxies for firms' informational opaqueness. Time-invariant firm characteristics, bank relationship characteristics, and credit market competition are represented by the same variables in table 2. The predicted value of the loan demand calculated from the previous estimation is used as a measure of the demand for loans. Log (total assets) and debt/total assets are also included to control for firms' size effect and debt capacity, respectively. Year dummies are also included. Firms' unobservable characteristics are captured by α_i, which is assumed to be $IID(0,\sigma_\alpha^2)$. The disturbance term u_{it} is assumed to be uncorrelated with all of the explanatory variables and α_i and has zero mean and constant variance σ_u^2 conditional on all of the explanatory variables besides α_i. The predicted demand, the tangible fixed assets ratio, the interest coverage ratio, and the distress dummy are assumed to be endogenous time-variant variables, while banking relationship variables such as the number of banking relationships and the dummy for government-affiliated financial institutions for small business are assumed to be endogenous time-invariant variables; the rest of the variables are assumed to be exogenous.

The results of the estimation are presented in table 4. The base line model is labeled Model IV. The coefficient on the number of banking relationships in Model IV is positive and significant at the 1% level. Among financially constrained firms, those with multiple banking relationships obtain more credit. This result implies that multiple banking relationships relax firms' credit constraints. On the other hand, the coefficient on the dummy for borrowing from government-affiliated banks, unexpectedly, is negative and significant, implying that firms which borrow from government-affiliated banks obtain less credit than those that do not. A possible explanation of this unexpected result is that the dummy for borrowing from government-affiliated banks may partly capture firms' observable quality, since it is low quality firms that tend to apply for loans from government-affiliated banks as a "last resort" and the coefficient on the measures of firms' risk of default (the operating profit/interest ratio and the distress dummy) show the predicted signs but are insignificant. The negative and significant coefficient on the dummy indicating whether the first bank is a city bank is consistent with the large-bank barriers hypothesis. This hypothesis posits that large banks have difficulties in establishing lending relationships with small and medium-sized firms because of organizational diseconomies and organizational hierarchical structures that put large banks at a disadvantage when it comes to gathering soft information (Berger and Udell 2002; Stein 2002).

The coefficient on the tangible assets ratio is highly significant and positive, as expected. This result suggests that credit constraints are lessened when firms have more collateral. The positive and significant coefficient on the current assets/current liabilities assets ratio indicates that more bank credit is available when firms' ability to repay short-term debt is higher. The coefficients on the log (1+firm age) and the log $(1+\text{firm age})^2$ are positive and negative, respectively, and both of them are statistically significant at the 1% level. There results suggest that young firms have difficulties in obtaining enough credit because of their informational opaqueness, on the other hand, old firms have also difficulties in obtaining funds since they have less good investment opportunities.

Controlling for credit market competition (Model V), the results for the banking relationship variables remain virtually unchanged. The coefficient on the credit market concentration variable is positive, but statistically insignificant.

Finally, in order to examine the effect that bank fragility might have on the availability of credit, a variable representing the non-performing loan (NPL) ratio of firms' first bank is included (Model VI). Data on NPL ratios are taken from the *Bank Financial Statement Data* published by Nikkei Quick data service. The results suggest

that banks' fragility, as indicated by the NPL ratio, has a significant negative effect on the availability of credit. Again, the results for the other variables remain virtually unchanged.

[Insert Table 4]

6. Conclusion

This paper reexamined the costs and benefits of multiple banking relationships using a panel data set for Japanese small and medium-sized firms over the period 2000-2002. By employing the Hausman-Taylor estimator, this paper attempted to consider the correlation between unobservable firm characteristics (unobservable firm quality) and multiple banking relationships that previous studies have ignored.

The main results can be summarized as follows. First, a positive relationship between the number of banking relationships and the cost of credit is observed even after controlling for firm quality. Second, multiple banking relationships have a positive effect on the availability of credit for financially constrained firms. These results imply that financially constrained firms forge multiple banking relationships in order to be certain of having access to credit, even if this guarantee raises the overall cost of credit. These results contradict the empirical findings of Petersen and Rajan (1994) and Harhoff and Körting (1998) that a concentration of banking relationships leads to less credit rationing, suggesting that the hold-up problem does not to apply to small business financing in Japan. Third, less credit is available when firms' first bank is fragile. Fourth, less credit is extended to financially constrained firms when firms' first bank is a city bank, indicating larger banks are reluctant to supply credit to smaller, riskier firms. These findings imply that small and medium-sized firms are vulnerable to liquidity shocks to their banks and the consolidation of large Japanese banks may have a further negative impact on small business financing.

This paper could be extended in several directions. One area that could be examined is the link between banks' characteristics and firms' choice of single over multiple banking relationships. Another possible extension would be to try to measure the closeness of a firm to its bank by some other means, such as the length of the relationship or the physical distance between the firm and the bank. These issues are left for future research.

References:

Atanasova, Christina V., and Nicholas Wilson (2004) "Disequilibrium in the UK Corporate Loan Market", *Journal of Banking and Finance*, Vol. 28, No. 3, 595-614.

Berger, Allen N., Leora F. Klapper, and Gregory F. Udell (2001) "The Ability of Banks to Lend to Informationally Opaque Small Businesses", *Journal of Banking and Finance*, Vol. 25, 2127-2167.

–––, and Gregory F. Udell (2002) "Small Business Credit Availability and Relationship Lending: The Importance of Bank Organizational Structure", *The Economic Journal* , Vol. 112, 32-53.

Boot, Arnoud W. A. (2000) "Relationship Banking: What Do We Know?", *Journal of Financial Intermediation* , Vol. 9, No. 1, 7-25.

Cosci, Stefania, and Valentina Meliciani (2002) "Multiple Banking Relationships: Evidence from the Italian Experience", *The Manchester School*, Vol.70 (Supplement 1463-6786), 37-54.

Cole, Rabel A. (1998) "The Importance of Relationships to the Availability of Credit", *Journal of Banking and Finance*, Vol. 22, No. 6-8, 959-77.

D'Auria, Claudio, Antonella Foglia, and Paolo Marullo Reedtz (1999) "Bank Interest Rates and Credit Relationships in Italy", *Journal of Banking and Finance,* Vol. 23, No. 7, 1067-1093.

Degryse, Hans and Patrick Van Cayseele (2000) "Relationship Lending within a Bank-Based System: Evidence from European Small Business Data", *Journal of Financial Intermediation,* Vol. 9, No. 1, 90-109.

Detragiache, Enrica, Paolo Garella, and Luigi Guiso (2000) "Multiple versus Single Banking Relationships: Theory and Evidence", *Journal of Finance*, Vol. 55, No. 3, 1133-1161.

Diamond, Douglas W. (1984) "Financial Intermediation and Delegated Monitoring", *Review of Economic Studies* ,Vol. 51, No. 3, 393-414.

Gersovitz, Mark (1980) "Classification Probabilities for the Disequilibrium Model", *Journal of Econometrics,* Vol.14, No. 2, 239-246.

Hausman, Jerry A. and William E. Taylor (1981) "Panel Data and Unobservable Individual Effects", *Econometrica*, Vol. 49, No. 6, 1377-1398.

Harhoff, Dietmar and Timm Körting (1998) "Lending Relationships in Germany – Empirical Evidence from Survey Data", *Journal of Banking and Finance*, Vol. 22, No. 10-11, 1317-1353.

Houston, Joel, and Christopher James (1996) "Bank Information Monopolies and the

Mix of Private and Public Debt Claims", *Journal of Finance*, Vol. 51, No. 5, 1863-1889.

Maddala, G. S. (1983) *Limited-Dependent and Qualitative Variables in Econometrics*, Cambridge: Cambridge University Press.

Ogawa, Kazuo and Kazuyuki Suzuki (2000) "Demand for Bank Loans and Investment under Borrowing Constraints: A Panel Study of Japanese Firm Data", *Journal of the Japanese and International Economies*, Vol. 14, No. 3, 1-21.

Rajan, Raghuram G. (1992) "Insiders and Outsiders: The Choice between Informed and Arm's-Length Debt", *Journal of Finance*, Vol. 47, No. 4, 1367-1400.

Petersen, Mitchell A. and Raghuram G. Rajan (1994) "The Benefits of Lending Relationships: Evidence from Small Business Data", *Journal of Finance*, Vol. 49, No. 1, 3-37.

———, and ——— (1995) "The Effect of Credit Market Competition on Lending Relationships", *The Quarterly Journal of Economics*, Vol. 110, No. 2, 407-443.

Sharpe, Steven A. (1990) "Asymmetric Information, Bank Lending, and Implicit Contract: A Stylized Model of Customer Relationships", *Journal of Finance*, Vol. 45, No. 4, 1069-1087.

Stein, Jeremy C. (2002) "Information Production and Capital Allocation: Decentralized versus Hierarchical Firms", *Journal of Finance*, Vol.57, No. 5, 1891-1921.

Stiglitz, Joseph, and Andrew Wise (1981), "Credit Rationing in Markets with Imperfect Information", *American Economic Review*, Vol. 71, No. 3, 393-410.

Thadden, Ernst-Ludwig von (1995), "Long-term Contracts, Short-term Investment and Monitoring", *Review of Economic Studies*, Vol. 62, No. 4, 557-575.

Tsuruta, Daisuke (2004), "Credit Availability for Young Small Business: Does Banking Market Stracture Matter? - Evidence from Panel Data in Japan", paper presented at the annual spring conference of the Japanese Economic Association, held at Meiji Gakuin University, Tokyo, Japan , June 12 to 13.

Table 1.A Summary statistics

	Obs.	Mean	Std. Dev.	25th percentile	Median	75th percentile
Firm characteristics						
Loan interest rate paid by the firm minus short-term prime rate (%)[a]	78695	1.183	(1.201)	0.491	0.974	1.580
Sales growth (ΔSales)/total assets (t-1)	78695	-0.011	(0.300)	-0.135	-0.010	0.110
Debt/total assets	78695	0.759	(0.164)	0.663	0.796	0.885
Tangible fixed assets/total assets	78695	0.274	(0.184)	0.125	0.252	0.398
Operating profit/interest (t-1)	78695	3.931	(7.769)	0.580	1.700	4.670
Total assets (¥ million)	78695	2145.22	(2970.35)	560	1129	2415
Distress dummy[b]	78695	0.244	(0.429)	0.000	0.000	0.000
Current assets/current liabilities	78695	1.487	(0.839)	1.020	1.260	1.660
Total outstanding loans amount/total assets	78695	0.413	(0.203)	0.258	0.415	0.564
Cash flow/total assets	78695	0.054	(0.092)	0.009	0.025	0.071
Sales/total assets	78695	1.518	(0.814)	0.964	1.344	1.867
(Notes payable trade+accounts payable trade)/total assets	78695	0.212	(0.175)	0.077	0.171	0.306
(Notes receivable trade+debtors' accounts receivable trade)/total assets	78695	0.220	(0.178)	0.060	0.200	0.336
Firm age (in years)	78695	35.674	(14.603)	25	35	47
Firm is incorporated[c]	78695	0.984	(0.125)	1	1	1
Stock listing dummy[d]	78695	0.017	(0.128)	0	0	0
Bank relationship characteristics						
Number of banking relationships[e]	78695	3.987	(1.835)	3	4	5
Government affiliated financial institutions for small business[f]	78695	0.529	(0.499)	0	1	1
The first bank is a city bank[g]	78695	0.408	(0.491)	0	0	1
Credit market competition						
Credit market concentration (%)[h]	75877	44.20	(12.60)	35.40	45.10	52.61
Bank fragility						
The first bank's non- performing loan ratio (%)	78694	9.56	(3.45)	7.410	9.266	10.674

[a] The interest rate is calculated as the interest paid divided by the total outstanding amount of loans (measured in %). The short-term prime rate is also measured in %.

[b] The dummy takes one if the firm was in financial distress within the last three years.

[c] The dummy takes one if the firm is incorporated and zero otherwise.

[d] The dummy takes one if the firm's stock is traded on the stock market.

[e] The number of banking relationships with non-government banks, i.e. banking relationships with government-affiliated banks are excluded.

[f] The dummy takes one if the firm borrows from one of the government-affiliated financial institutions for small business.

[g] The dummy takes one if the borrower's main bank is a city bank.

[h] Credit market concentration (%) is defined as the lending share of the three largest banks in the prefecture where the firm is headquartered.

Table 1.B Industry distribution

Industry	Number of observations
Manufacturing	21522
Agriculture, forestry, and fishery	102
Mining	200
Construction	22766
Electricity, gas, and water	107
Transportation and communication	2045
Wholesale trade	25102
Retail trade	1656
Other financial institutions	38
Real estate	1567
Services	3590

Number of observations are firm-year observations.

Table 2. Determinants of firms' cost of credit

		Model (I)			Model (II)			Model (III)		
		Coef.	Std. Err.	z	Coef.	Std. Err.	z	Coef.	Std. Err.	z
Firm characteristics										
Tangible fixed assets/total assets	(X_2)	-0.648	(0.071)	-9.12 ***	-0.641	(0.071)	-9.05 ***	-0.647	(0.073)	-8.89 ***
Sales growth	(X_1)	-0.052	(0.009)	-5.9 ***	-0.028	(0.009)	-3.03 ***	-0.027	(0.009)	-2.91 ***
Current assets/current liabilities	(X_1)	-0.085	(0.007)	-11.3 ***	-0.080	(0.007)	-10.74 ***	-0.083	(0.008)	-10.79 ***
log(total assets)	(X_1)	-1.178	(0.023)	-51.71 ***	-1.175	(0.023)	-51.74 ***	-1.171	(0.023)	-50.29 ***
log(1+firm age)	(X_1)	0.708	(0.268)	2.64 ***	0.671	(0.269)	2.49 **	0.753	(0.267)	2.83 ***
log(1+firm age)^2	(X_1)	-0.055	(0.050)	-1.11	-0.049	(0.051)	-0.98	-0.063	(0.050)	-1.27
Firm is incorporated	(Z_1)	-0.054	(0.403)	-0.13	-0.051	(0.422)	-0.12	0.094	(0.395)	0.24
Stock listing dummy	(Z_1)	-2.456	(0.565)	-4.34 ***	-2.492	(0.592)	-4.21 ***	-2.465	(0.568)	-4.34 ***
Operating profit/interest (t-1)	(X_2)				-0.007	(0.001)	-11.69 ***	-0.007	(0.001)	-10.73 ***
Distress dummy	(X_2)				0.019	(0.012)	1.66 *	0.021	(0.012)	1.75 *
Bank relationship characteristics										
The first bank is a city bank	(Z_1)	-0.335	(0.141)	-2.38 **	-0.330	(0.147)	-2.24 **	-0.318	(0.143)	-2.22 **
Number of banking relationships	(Z_2)	1.868	(0.137)	13.62 ***	1.884	(0.143)	13.19 ***	1.908	(0.140)	13.65 ***
Government-affiliated financial institutions for small business	(Z_2)	-5.941	(1.207)	-4.92 ***	-6.130	(1.264)	-4.85 ***	-6.256	(1.229)	-5.09 ***
Credit market competition variable										
Credit market concentration	(X_1)							0.001	(0.001)	1.24
Constant		5.352	(0.805)	6.65 ***	5.478	(0.833)	6.58 ***	5.087	(0.771)	6.6 ***
Industry dummy		Yes			Yes			Yes		
Prefecture dummy		Yes			Yes			Yes		
Year dummy		Yes			Yes			Yes		
Number of observations		78695			78695			75877		
Number of groups		34330			34330			33088		
Wald chi2		2830.32			2992.11			2823.64		
Test statistics										
Hausman specification test of random effects [a]		$\chi^2(8)=1165.43$ ***			$\chi^2(10)=1200.98$ ***			$\chi^2(11)=1147.14$ ***		
Hausman specification test of HT model [b]		$\chi^2(3)=5.51$			$\chi^2(3)=6.1$			$\chi^2(4)=6.65$		

The dependent variable is the percentage point spread between the loan interest rate paid by firms and the short-term prime rate. The coefficients are estimated by the Hausman and Taylor estimator. The vectors X_1, X_2, Z_1, and Z_2 contain time-varying exogenous, time-varying endogenous, time-invarying exogenous, and time-invarying endogenous variables, respectively. The lower and upper 1% tails of the distribution of the financial variables, such as total assets, the tangible fixed assets/total assets ratio, the current assets/current liabilities ratio, sales growth, and the operating profit/interest ratio, are trimmed. Each regression includes industry dummies, prefecture dummies, and year dummies.

[a] The test statistics is χ^2 with the test of the null hypothesis: unobservable firm effects are uncorrelated with regressors.
[b] The test statistics is χ^2 with the test of the null hypothesis: X_1 and Z_1 are uncorrelated with unobservable firm effects.
*** Significant at the 1% level.
** Significant at the 5% level.
* Significant at the 10% level.

Table 3. Estimation results of the disequilibrium model

	Coef.	Std. Err.	t
Supply equation			
Tangible fixed assets/total assets	0.3286	(0.0065)	50.42 ***
Operating profit/interest (t-1)	0.0004	(0.0001)	5.65 ***
Reciprocal of total assets	6762.50	(1643.38)	4.11 ***
Current assets/current liabilities	0.0468	(0.0011)	41.89 ***
log (GDP)	1.0027	(0.0370)	27.10 ***
Demand equation			
Sales/total assets	-0.1320	(0.0044)	-30.03 ***
Cash flow/total assets	-0.4050	(0.0101)	-39.90 ***
Net trade credit/total assets	-0.3021	(0.0044)	-68.70 ***
Reciprocal of total assets	38658.70	(1159.34)	33.35 ***
Loan interest rate paid by the firm minus short- term prime rate	-0.0285	(0.0003)	-84.22 ***
(ΔSales)/total assets	-0.0162	(0.0005)	-32.46 ***
log (GDP)	-0.2237	(0.0159)	-14.11 ***
S. D. of supply equation	0.0590	(0.0002)	282.57 ***
S. D. of demand equation	0.0519	(0.0001)	376.28 ***
ρ	0.9862	(0.0036)	275.07 ***
Number of observations	70171		
Log likelihood	104390		

The dependent variable is the first-differenced value of the total outstanding loan amount/total assets. All variables in this table are first-differenced. The loan interest rate paid by the firm minus the short-term prime rate is measured in %. ρ is the correlation coefficient between supply and demand errors. The estimation method is maximum likelihood estimation.

*** Significant at the 1% level.

Table 4. Credit availability

		Model (IV)			Model (V)			Model (VI)		
		Coef.	Std. Err.	z	Coef.	Std. Err.	z	Coef.	Std. Err.	z
Firm characteristics										
Predicted demand for total outstanding loan amount/total assets	(X_2)	37.482	(1.369)	27.38 ***	37.211	(1.405)	26.49 ***	37.210	(1.404)	26.5 ***
Debt/total assets	(X_1)	68.048	(1.979)	34.38 ***	68.269	(2.061)	33.13 ***	68.203	(2.057)	33.16 ***
Current assets/current liabilities	(X_1)	2.212	(0.116)	19.08 ***	2.168	(0.120)	18.11 ***	2.176	(0.120)	18.17 ***
log(total assets)	(X_1)	-11.177	(0.535)	-20.9 ***	-11.421	(0.555)	-20.58 ***	-11.401	(0.553)	-20.61 ***
log(1+firm age)	(X_1)	21.672	(5.214)	4.16 ***	19.365	(4.698)	4.12 ***	19.458	(4.689)	4.15 ***
log(1+firm age)^2	(X_1)	-2.889	(0.793)	-3.64 ***	-2.528	(0.715)	-3.53 ***	-2.557	(0.714)	-3.58 ***
Tangible fixed assets/total assets	(X_2)	33.691	(1.626)	20.73 ***	34.077	(1.701)	20.04 ***	34.081	(1.700)	20.05 ***
Operating profit/interest (t-1)	(X_2)	-0.002	(0.013)	-0.15	-0.002	(0.013)	-0.17	-0.002	(0.013)	-0.17
Distress dummy	(X_2)	-0.058	(0.190)	-0.3	-0.088	(0.195)	-0.45	-0.089	(0.195)	-0.46
Firm is incorporated	(Z_1)	-1.512	(1.765)	-0.86	-1.905	(1.804)	-1.06	-2.004	(1.791)	-1.12
Stock listing dummy	(Z_1)	-19.483	(2.917)	-6.68 ***	-19.892	(2.957)	-6.73 ***	-19.721	(2.933)	-6.72 ***
Bank relationship characteristics										
Number of banking relationships	(Z_2)	18.040	(1.252)	14.41 ***	18.502	(1.286)	14.38 ***	18.405	(1.277)	14.42 ***
Government-affiliated financial institutions for small business	(Z_2)	-23.053	(7.394)	-3.12 ***	-25.138	(7.477)	-3.36 ***	-24.315	(7.409)	-3.28 ***
The first bank is a city bank	(Z_1)	-2.355	(0.617)	-3.82 ***	-2.178	(0.651)	-3.35 ***	-1.838	(0.656)	-2.8 ***
Credit market competition										
Credit market concentration	(X_1)				0.003	(0.012)	0.27	0.003	(0.012)	0.26
Bank fragility										
The first bank's non- performing loan ratio	(Z_1)							-0.220	(0.080)	-2.74 ***
Constant		83.382	(11.174)	7.46 ***	87.712	(10.098)	8.69 ***	89.181	(10.124)	8.81 ***
Industry dummy		Yes			Yes			Yes		
Prefecture dummy		Yes			Yes			Yes		
Year dummy		Yes			Yes			Yes		
Number of observations		29733			28635			28622		
Number of groups		23613			22762			22750		
Wald chi2		6439.03			5951.38			6006.94		
Test statistics										
Hausman specification test of random effects [a]		$\chi^2(11)=1125.33$ ***			$\chi^2(12)=1110.01$ ***			$\chi^2(12)=1109.02$ ***		
Hausman specification test of HT model [b]		$\chi^2(3)=0.59$			$\chi^2(4)=0.95$			$\chi^2(4)=0.97$		

The dependent variable is firms' total outstanding loan amount/total assets*100. The coefficients are estimated by the Hausman and Taylor estimator. The vectors X1, X2, Z1, and Z2 contain time-varying exogenous, time-varying endogenous, time-invarying exogenous, and time-invarying endogenous variables, respectively. The lower and upper 1% tails of the distribution of the financial variables, such as total assets, the tangible fixed assets/total assets ratio, the current assets/current liabilities ratio, and the operating profit/interest ratio, are trimmed. Each regression includes industry dummies, prefecture dummies, and year dummies.

[a] The test statistics is χ^2 with the test of the null hypothesis: unobservable firm effects are uncorrelated with regressors.

[b] The test statistics is χ^2 with the test of the null hypothesis: X_1 and Z_1 are uncorrelated with unobservable firm effects.

*** Significant at the 1% level.