Forbearance Lending: The Case of Japanese Firms

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After the collapse of the asset price bubble, Japanese banks are said to refinance firms, even in cases where there is little prospect of firms repaying the loans extended. This phenomenon is known as "forbearance lending." We find the evidence which is consistent with the view that forbearance lending certainly took place, and that it suppressed the profitability of inefficient nonmanufacturing firms. First, contrary to the usual expectation, we find that outstanding loans were apt to increase to a firm whose debt-asset ratio exceeded a certain level: after the bubble burst, this nonlinear relationship between loans and debt-asset ratios became evident for nonmanufacturing firms, especially those in the construction and real estate industries. Furthermore, we also find that an increase in loans to highly indebted firms in these industries lowered their profitability.

Keywords: Forbearance lending; Nonperforming loan; Dynamic GMM
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I. Introduction

Along with credit crunch issues, forbearance lending is often referred to as a phenomenon associated with the nonperforming-loan (NPL) problems in Japan (see Corbett [1999], Kobayashi and Kato [2001], and Sekine *et al.* [2001]). For instance, Hoshi (2000) points out that even after the bursting of the bubble in Japan, bank loans to the real estate industry continued to swell until 1997, while those to the manufacturing industry declined significantly. He infers that the increase in loans to the real estate industry, whose profitability was severely hampered by the bursting of the bubble, stemmed mainly from forbearance lending, and did not induce new investment.

Little is known, however, about the extent to which Japanese banks have engaged in forbearance lending, and what effects this might have had on real activity. There have been very few empirical studies of this issue with the exception of Peek and Rosengren (1999), Tsuru (2001), and Sugihara and Fueda (2002). This paper is an attempt to fill this gap in the literature using corporate panel data.

Although there is no single definition of forbearance lending used universally among practitioners and researchers,[1] banks are said to engage in forbearance lending if they refinance all or part of loans (or even increase loans) to a borrower firm, even though they regard that firm as unlikely to be able to repay the outstanding loans.

This definition, however, encounters an empirical difficulty. The difficulty arises in that we cannot see, from observed data, whether banks had deemed borrower firms unable to repay the outstanding loans when they decided to roll them over.

This difficulty determines our choice of the following strategy in testing for the existence of forbearance lending. First, by estimating a loan supply function, we examine whether the relationship between the borrower firm's debt-asset ratio and its outstanding loans is nonlinear: i.e., whether loans tend to increase to firms whose debt-asset ratios were above a certain level.[2] Then, we examine the relationship between firms' debt-asset ratios and their returns on assets (ROA) to see whether, for a given increase in lending, the ROA tends to be lower for firms with heavier debt burdens. If these relationships are observed, we may conclude that banks continued to provide loans to firms with high debt-asset ratios, even though such borrower firms are less likely to be able to repay the loans, not only because they are at greater risk of bankruptcy, but also because their profitability tends to be lower.

Although we can show that some firms were less likely to repay their loans, we cannot claim that banks had expected this *ex ante*. In other words, the above strategy tests a necessary but not a sufficient condition for forbearance lending. Indeed, some banks may have extended additional loans to a heavily indebted firm with the

1. For practitioners, forbearance lending often refers to banks' finance to interest payments of insolvent borrowers. For researchers, it refers to banks' postponement of writing off NPLs. These two definitions of forbearance lending are not necessarily inconsistent: if banks finance interest payments of insolvent borrowers, banks effectively postpone writing off NPLs to these borrowers. However, these two definitions do not necessarily coincide: banks can postpone writing off NPLs by other means than financing interest payments.
2. The term "nonlinearity" in this paper implies the situation where "loans tend to increase to firms whose debt-asset ratios are above a certain level." In this situation, the outstanding loans might be described by a quadratic function in terms of the debt-asset ratio.

expectation that the loans would be repaid; they may claim that lower profitability, *ex post*, was due to an unexpected deterioration in macroeconomic conditions.

However, we may reasonably claim that banks *knew* that additional loans to these firms were less likely to be repaid and thus that the additional lending can be deemed forbearance lending. This is because even if we control for macroeconomic conditions, such as business cycles, it is found that additional loans to heavily indebted firms in the nonmanufacturing sector, especially in the construction and real estate industries, tend to squeeze their ROA. It is hard to imagine that banks had been unaware of this relationship for nearly a decade.

Forbearance lending is supposed to have spawned economic inefficiency in Japan, at the expense of social welfare. Forbearance lending adversely affects the economy by bailing out inefficient firms producing poor returns. Moreover, as Berglöf and Roland (1997) show, not only do inefficient firms survive, but they also tend to lower their levels of effort since they anticipate that banks will bail them out: a moral hazard problem. Furthermore, Kobayashi and Kato (2001) point out a risk of "disorganization" in the sense of Blanchard and Kremer (1997): a bank with increased exposure would effectively control a borrower firm as if it were a dominant shareholder. As a "dominant shareholder," the bank might be tempted to intervene in the firm's investment decisions, hindering the construction of the firm's specific business relationships.

Several theoretical models try to reveal why or under what conditions banks have an incentive to engage in forbearance lending.

- Kobayashi and Kato (2001) argue that a change in a bank's risk preferences renders it softer in providing additional loans. A bank becomes risk-loving once it increases its exposure to a firm and begins to control that firm as if it were a dominant shareholder. This is based on the following well-known argument from the corporate finance literature: if we assume that payoffs of a shareholder and a creditor depend on corporate profits respectively, a payoff function of the former becomes convex, while that of the latter becomes concave. Consequently, the former behaves as a risk-lover, while the latter behaves as a risk-averter.
- Sakuragawa (2002) develops a model in which a bank, under an opaque accounting system, has an incentive to disguise its true balance sheet so as to satisfy the Basel minimum capital requirement. In this case, a bank without sufficient loan-loss provisioning tries to put off disposal of NPLs to avoid decreasing its own capital in an accounting sense.
- Berglöf and Roland (1997) consider a game between a bank and a firm in which a bank continues to provide loans to a firm whose liquidation value plunges after a decrease in asset prices. Originally, they apply their game to the case of market transition economies, but it lends itself well to explain the Japanese case after the bursting of the bubble.

  In their game, they show that the forbearance lending doubly reduces economic efficiency. Not only does a bank bail out an inefficient firm, but also it induces moral hazard of the firm.
- Baba (2001), using real option theory, shows that uncertainties associated with the write-off of NPLs—the reinvestment return from freeing up funds by write-off, the

liquidation loss, and the possible implementation of a government subsidy scheme, etc.—induce a bank to delay writing off NPLs; in other words, uncertainties increase the option value of the wait-and-see strategy (including forbearance lending) compared with making aggressive write-offs.

In reality, some or all of these models are thought to hold at the same time—they are not mutually inconsistent with each other. It is quite likely that when a bank engages in forbearance lending, (1) that bank behaves as a risk-lover because it effectively becomes a dominant shareholder; (2) at the same time, it wants to put off disposal of NPLs due to insufficient loan-loss provisioning; (3) it thinks that the liquidation of the firm would not pay, since the price of land collateral has plummeted; and (4) it still harbors wishful thinking that the land price will recover in the future.

In this paper, we do not intend to test which of the above models best fits the data. We will test for some of these models later, but we hesitate to draw strong conclusions given empirical difficulties associated with the tests. In other words, the focus of the paper is placed on a test of whether or not the forbearance lending has taken place rather than why it has taken place.

The rest of the paper is organized as follows: Section II introduces an analytical framework after describing the corporate financial data used. Section III reports the estimation results of a loan supply function introduced in Section II. Section IV turns to an investigation of the relationship between bank loans, firms' debt-asset ratios, and their levels of profitability. Section V concludes the paper by discussing possible extensions of the research and policy implications, which is followed by the Data Appendix.

II. Analytical Framework

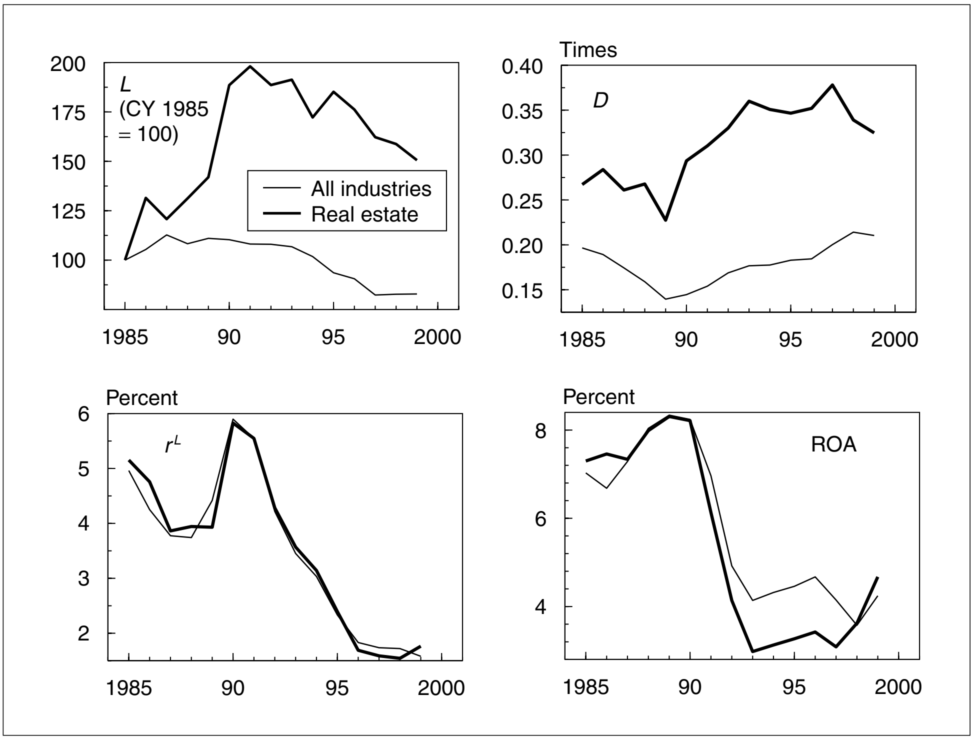
A. Data

For the remaining analyses, we exploit corporate finance data from the Corporate Finance Data Set compiled by the Development Bank of Japan, which includes balance sheets and income statements for Japanese nonfinancial firms listed on the first and second sections of the Tokyo, Osaka, and Nagoya stock exchanges or in the over-the-counter market. The database contains both consolidated and unconsolidated data. We choose the unconsolidated data, which contain more detailed time-series data than the consolidated data.

First, we check whether or not our samples in the real estate industry reveal features similar to those described in Hoshi (2000). Figure 1 uses major financial indicators to compare the real estate industry with all industries. Around 1990, outstanding loans L to the real estate industry swelled to a level almost twice as high as before the bubble period, and remained very high throughout the 1990s (upper left panel).[3]

3. In our sample, outstanding loans to the real estate industry reached their peak in 1991, whereas broader statistics such as "Loans and Discounts Outstanding by Sector" (*Financial and Economic Statistics*, Bank of Japan) peaked out in 1997. This may be due to our sample containing mainly large companies, which have alternative financial channels to bank lending.

Figure 1 Loans Outstanding to the Real Estate Industry



The debt-asset ratio[4] D soared in the 1990s for the real estate industry, the market value of whose assets plunged due to a fall in land prices (upper right panel). As for the lending interest rate r^L, there were no significant differences between the real estate industry and all industries (bottom left panel). ROA for the real estate industry was lower than that for all industries after the bubble burst (bottom right panel). In short, even after the bursting of the bubble, banks continued to provide loans to the real estate industry at interest rates that did not reflect the firms' credit risks. This finding seems to suggest that banks engaged in forbearance lending as Hoshi (2000) discusses.

These graphical comparisons give us useful insights, but we must be cautious about drawing a conclusion that the high outstanding loans and debt-asset ratios of the real estate industry are due to forbearance lending. This is because they might be explained by some industry-specific factors instead of forbearance lending. Using panel data later in this paper, we will investigate the relationship between outstanding loans and debt-asset ratios by controlling individual effects including industry-specific factors.

The following sample selection rules are applied to all the records from fiscal 1970–99: (1) exclude firms in the electricity industry, which are quasi-public enterprises

4. The debt-asset ratio is calculated as outstanding bank loans divided by total assets, of which (1) inventory, (2) land, (3) machinery, and (4) nonresidential buildings and structures are adjusted to their market values by perpetual inventory methods, so that we can take account of a fall in asset prices. See the Data Appendix for more details.

in nature; (2) select firms that continuously borrowed both short- and long-term loans over the period from fiscal 1984–99;[5] and (3) exclude outliers that are defined as firms whose interest rates belong to the upper 1 percentile, or whose ROAs belong to the upper or the lower 0.5 percentiles. These sample selection rules leave 580 firms—384 manufacturing firms and 196 nonmanufacturing firms—and hereafter, unless otherwise noted, our analyses are based on these firms.

Table 1 [1] and [2] summarizes sample properties and sample correlations among variables used for the following analyses. As evident in the statistics for means, nonmanufacturing firms have lower ROAs and higher debt-asset ratios D than manufacturing firms—an observation that is thought to reflect the influence of the real estate industry. Loans L and capital stock K are larger for nonmanufacturing firms on average. The debt-asset ratio and ROA are highly correlated with other financial indicators frequently used for credit ratings (Table 1 [3]).[6] Therefore, we may use these variables as proxy measures of safety and profitability in the credit ratings analysis.

Table 1 Sample Properties

[1] Sample Properties

	Mean			Std. dev.		
	All industries	Manufacturing	Non-manufacturing	All industries	Manufacturing	Non-manufacturing
r^L	3.65	3.53	3.90	1.90	1.89	1.90
D	0.19	0.17	0.23	0.12	0.10	0.14
ROA	5.16	5.19	5.08	3.27	3.50	2.77
$\ln L$	16.73	16.40	17.39	1.61	1.50	1.62
$\ln K$	18.07	17.88	18.43	1.49	1.49	1.41

[2] Correlation Coefficients

	r^L	D	ROA	$\ln L$	$\ln K$
r^L	1.00				
D	0.02	1.00			
ROA	0.37	–0.29	1.00		
$\ln L$	0.18	0.39	–0.12	1.00	
$\ln K$	0.20	–0.08	0.03	0.85	1.00

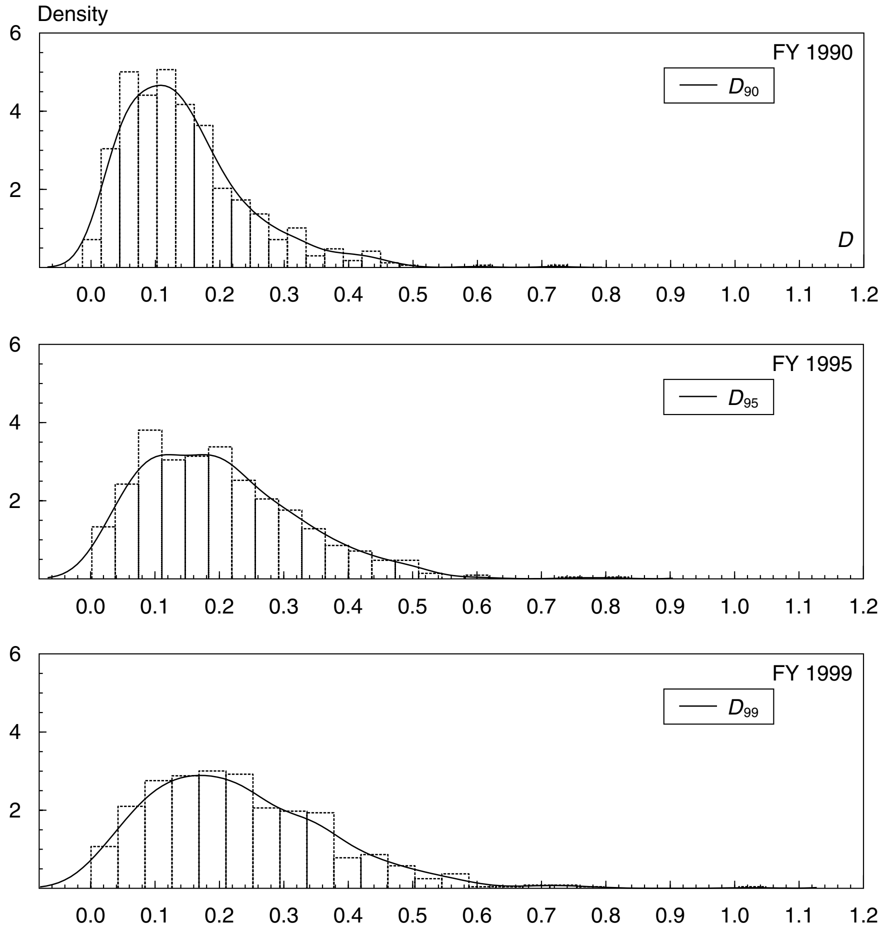
[3] Correlations with Other Financial Indicators

	D	ROA
Capital adequacy ratio	–0.58	0.19
Liquidity ratio	–0.37	0.16
Business profits to sales ratio	–0.12	0.61
Operating profits to revenue ratio	–0.32	0.74
Operating profits to capital ratio	–0.12	0.40
Interest coverage ratio	–0.34	0.38

5. Admittedly, this may cause survival biases in our analyses. Presumably, it may favor the discovery of forbearance lending, as excluded bankrupt firms may be assumed not to have received forbearance lending. This argument does not hold if these firms went bankrupt despite the forbearance lending.
6. For the recent usage of credit ratings in Japanese banks, see Bank of Japan (2001).

Turning to the distribution of firms' debt-asset ratios, we observe how the proportion of heavily indebted firms increased after the bubble burst (Figure 2). The mean (median) of the debt-asset ratio increased from 0.15 (0.13) in fiscal 1990 to 0.23 (0.21) in fiscal 1999. Its standard deviation also increased from 0.097 in fiscal 1990 to 0.141 in fiscal 1999. Thus, not only did the mean of the distribution shift to the right, but its tail also spread more widely. The NPL problem for banks and the debt-overhang problem for firms are different sides of the same coin. The change in the distribution indicates that Japanese firms suffered from an increasingly serious debt-overhang problem in that not only did average firms face higher debt-asset ratios, but also firms with high debt-asset ratios ended up with more severe debt-overhangs.

Figure 2 Histograms of Debt-Asset Ratio *D*



Note: Lines in each panel are densities estimated by Gaussian kernels (see Doornik and Hendry [2001] for details). For simplicity, we do not impose a restriction that debt-asset ratios do not take negative values.

B. Estimated Equation

To investigate whether banks engaged in forbearance lending, we estimate a loan supply function for firm i at time t as follows:[7]

$$l_{it}^{s} = \alpha_0 l_{i,t-1} + \alpha_1 r_{it} + \alpha_2 D_{i,t-1} + \alpha_3 D_{i,t-1}^2 + \alpha_4 ROA_{i,t-1} + \alpha_5 + \epsilon_{it}, \tag{1}$$

where l_{it} is a natural logarithm of outstanding loan L. r_{it} is the loan-deposit interest rate spread ($r_{it}^L - r_t^M$), and we expect to observe $\alpha_1 > 0$. D_{it} and ROA_{it} are supposed to capture the individual firm's safety and profitability, respectively, and the expected signs are $\alpha_2 < 0$ and $\alpha_4 > 0$. If banks engaged in forbearance lending, we would expect to see $\alpha_2 < 0$ and $\alpha_3 > 0$. That is, when D is small, banks squeeze loans as D increases. However, as discussed above, when D exceeds a certain level, banks squeeze loans less hard (or even increase loans, if D is sufficiently large) owing to forbearance lending.[8] ϵ_{it} represents the estimated residuals of the supply function.

Turning to the demand side, we assume that loan demand takes the following form:

$$l_{it}^{d} = \beta_0 l_{i,t-1} + \beta_1 r_{it}^L + \beta_2 k_{it} + \beta_3 + u_{it}, \tag{2}$$

where k_{it} is a natural logarithm of capital stock K. u_{it} is the estimated residual of the demand function. Expected signs are $\beta_1 < 0$ and $\beta_2 > 0$.

We further assume that the loan market is in equilibrium.[9]

$$l_{it} = l_{it}^{s} = l_{it}^{d}. \tag{3}$$

Solving equations (1)–(3) with respect to r^L, we have

$$\begin{aligned} r_{it}^L = {} & \frac{\alpha_0 - \beta_0}{\beta_1 - \alpha_1} L_{i,t-1} + \frac{\alpha_1}{\beta_1 - \alpha_1} r_t^M + \frac{\alpha_2}{\beta_1 - \alpha_1} D_{i,t-1} + \frac{\alpha_3}{\beta_1 - \alpha_1} D_{i,t-1}^2 \\ & + \frac{\alpha_4}{\beta_1 - \alpha_1} ROA_{i,t-1} - \frac{\beta_2}{\beta_1 - \alpha_1} k_{it} + \frac{\alpha_5 - \beta_3}{\beta_1 - \alpha_1} + \frac{1}{\beta_1 - \alpha_1} \epsilon_{it} - \frac{1}{\beta_1 - \alpha_1} u_{it}. \end{aligned} \tag{4}$$

From the expected signs of the parameters, $\alpha_2/(\beta_1 - \alpha_1) > 0$ and $\alpha_3/(\beta_1 - \alpha_1) < 0$. The loan interest rate starts to decline once the debt-asset ratio exceeds a certain level. That is, in the case of forbearance lending, the bank has an incentive to give the firm a discount on its interest payments as well.

A number of issues arise in estimating equation (1). First of all, we need to take into account possible biases associated with individual effects, usually considered to be contained in the estimated residuals ϵ_{it}. ϵ_{it} is supposed to be expressed as

7. Equation (1) ignores heterogeneity among banks providing loans to a firm i. We try to incorporate it later in Section III.C where, despite severe data limitations, we estimate loan supply functions for each individual bank.
8. $\partial l/\partial D = \alpha_2 + 2\alpha_3 D$. An increase in D raises the firm's outstanding loans, once D exceeds $-(\alpha_2/2\alpha_3)$.
9. Ito (1985) and Baba (1996) assume that the loan market is in disequilibrium. In this case, the equilibrium condition (3) is replaced with a short-side-principle such as

$$l_{it} = \min(l_{it}^s, l_{it}^d).$$

They estimate the above equation and equations (1)–(2) simultaneously by using a switching regression algorithm.

$$\epsilon_{it} = \eta_i + d_t + v_{it},$$

where η_i represents individual effects, d_t time-specific effects, and v_{it} idiosyncratic shocks. If η_i and the variables on the right-hand side are correlated, estimators are biased. In the case of equation (1), the auto-regressive (AR) term $l_{i,t-1}$ is certainly correlated with η_i,[10] so its estimated coefficient is biased. Furthermore, we need to take into account an endogeneity bias: since r^L_{it} depends on ϵ_{it}, (equation [4]), they are correlated, $\mathrm{Cov}(r^L_{it}, \epsilon_{it}) \neq 0$. The estimated coefficient on endogenous variables such as r^L_{it} is biased.

To overcome these problems, we adopt the generalized method of moments (GMM) estimation, using instrumental variables.

- The endogeneity bias can be eliminated by applying instrumental variables obtained from the demand function in equation (2)—see, for instance, Hayashi (2000), chapter 3. k in the demand function is correlated with r^L_{it} (as shown in equation [4] $\mathrm{Cov}(r^L_{it}, k_{it}) \neq 0$), but not with ϵ_{it}, the residuals of the supply function. Thus, k can be used as an instrumental variable in estimation of the supply function (1).
- To solve the problem arising from individual effects and the AR term, we apply the dynamic GMM estimation technique. We use the system GMM estimator developed by Blundell and Bond (1998).

  A "system" consists of first-differenced and level equations. Taking for example, a simple AR(1) model, and dropping the other explanatory variables and time-specific effects from equation (1), we have the following equation in levels:

$$l_{it} = \alpha l_{i,t-1} + \eta_i + v_{it}.$$

Taking first-differences, we get

$$\Delta l_{it} = \alpha \Delta l_{i,t-1} + \Delta v_{it}.$$

As proposed by Arellano and Bond (1991), we can employ instrument variables, $l_{i,t-2}$, $l_{i,t-3}$, . . . for estimation of α in the first-differenced equation, since they are not correlated with Δv_{it}. In addition, Blundell and Bond (1998) suggest using $\Delta l_{i,t-1}$ for estimation of α in the level equation since it is not correlated with η_i or v_{it}. Thus, by estimating this system of two equations simultaneously, the Blundell-Bond system GMM estimator is exploiting more instruments than the Arellano-Bond GMM estimator. It is reported that the system GMM estimator is both more efficient and more robust.

10. Taking lags on both sides of equation (1), we have

$$l_{i,t-1} = \alpha_0 l_{i,t-2} + \alpha_1 r^L_{i,t-1} + \ldots + \eta_i + d_{t-1} + v_{i,t-1}.$$

Since $l_{i,t-1}$ depends on η_i, they are correlated: i.e., $\mathrm{Cov}(l_{i,t-1}, \eta_i) \neq 0$.

Blundell and Bond (1998) report the considerable small sample biases of standard errors for the second-step GMM estimators. However, more recently, Windmeijer (2000) shows how to correct these biases.

III. Estimation Results

A. Basic Specification

Table 2 summarizes the results of estimating equation (1) using the system GMM and the instruments discussed above.[11] We divide the sample period into two subsamples: (A) the second half, fiscal 1993–99, when NPL problems became serious; and (B) the first half, fiscal 1986–92, when asset prices rocketed and then peaked out. Various studies consider NPL problems to have started to affect real activity from around 1992–93, when the Cooperative Credit Purchasing Company (CCPC) began operation and banks began to disclose their outstanding NPLs—see, for example, Miyagawa and Ishihara (1997) and Sekine (1999). This paper broadly follows their sample division.

For the nonmanufacturing industry, the coefficient on the squared debt-asset ratio D^2_{-1} is positive and significant in the second half of the sample period. This positive coefficient is consistent with forbearance lending. However, this coefficient is insignificant in the first half of the sample period. This is partly because, during the bubble period, debt-asset ratios were so low on average that they were not likely to exceed the threshold level. It is also because banks took credit risks aggressively during the period, as evidenced by the increase in the land collateral ratio. The threshold itself was therefore likely to be higher. At that time, the euphoric sentiment prevailing in the economy led people to anticipate further rises in asset prices. By contrast, in the second half of the sample period, as firms' debt-overhang problem became serious, average debt-asset ratios increased and the threshold declined so that forbearance lending became pervasive.

Decomposing samples of the nonmanufacturing industry further into those of construction and real estate, and other nonmanufacturing, we find that in the second half of the sample period the coefficient on D^2_{-1} is positive and significant for the construction and real estate industries. The coefficient is also positive for other nonmanufacturing industries, but it is not significant. Although the estimation is based on a small sample (51 firms), it strongly supports the view that banks provided forbearance loans particularly intensively to firms in the construction and real estate sectors. This finding accords with the results of previous studies including Hoshi (2000), Sasaki (2000), and Tsuru (2001).

As for coefficients on the interest rate spread, they tend to be less significant in the second half. This implies that banks continued to make loans irrespective of their interest rate margins.

11. Hereafter, all estimations are conducted using *DPD for Ox* (Doornik *et al.* [2001]).

Table 2 Loan Supply Function: Basic Specification

Industry	All industries	Manufacturing	Nonmanufacturing	Construction and real estate	Other nonmanufacturing
Dependent	l	l	l	l	l
[1] Sample Period: 1993–99					
l_{-1}	0.97 (0.02)***	0.94 (0.02)***	1.00 (0.03)***	0.97 (0.10)***	0.97 (0.03)***
r	0.01 (0.04)	0.12 (0.05)**	0.03 (0.04)	0.14 (0.08)*	0.04 (0.03)
D_{-1}	–0.33 (0.82)	–0.12 (0.99)	–2.53 (1.15)**	–3.41 (1.76)*	–1.31 (1.12)
D^2_{-1}	0.82 (1.34)	–0.75 (2.11)	3.30 (1.66)*	3.23 (1.94)*	2.02 (1.68)
ROA_{-1}	0.02 (0.01)	0.003 (0.01)	0.02 (0.02)	0.05 (0.03)	0.001 (0.02)
Observations	4,640	3,072	1,568	408	1,160
Firms	580	384	196	51	145
SE^2	0.06	0.06	0.06	0.09	0.05
AR(2)	–0.24 [0.81]	0.46 [0.65]	–1.02 [0.31]	–1.37 [0.17]	–0.28 [0.78]
Sargan	124.0 [0.05]	112.7 [0.16]	121.6 [0.06]	37.4 [1.00]	116.3 [0.11]
[2] Sample Period: 1986–92					
l_{-1}	0.99 (0.02)***	0.98 (0.02)***	1.00 (0.03)***	0.96 (0.05)***	0.98 (0.03)***
r	0.06 (0.02)***	0.06 (0.02)***	0.05 (0.03)**	0.12 (0.03)***	0.10 (0.03)***
D_{-1}	–0.67 (0.81)	–2.44 (1.49)	–0.37 (1.15)	–3.51 (1.97)*	0.52 (1.20)
D^2_{-1}	0.53 (1.38)	4.07 (3.25)	–0.19 (1.85)	4.40 (3.60)	–1.90 (1.82)
ROA_{-1}	–0.002 (0.01)	–0.01 (0.01)	0.0004 (0.01)	0.01 (0.02)	–0.01 (0.01)
Observations	4,640	3,072	1,568	408	1,160
Firms	580	384	196	51	145
SE^2	0.06	0.07	0.05	0.07	0.05
AR(2)	–0.12 [0.91]	0.10 [0.92]	–0.59 [0.56]	–1.61 [0.11]	0.69 [0.49]
Sargan	112.7 [0.16]	125.2 [0.04]	113.4 [0.15]	36.64 [1.00]	111.2 [0.19]

Notes: 1. System GMM estimation. Coefficients on constants and time dummies are omitted.
2. Balanced panel. The number of observations equals the number of firms multiplied by the number of years (eight years including lags for estimation).
3. Estimated coefficients are obtained from two-step estimators. Figures in parentheses are standard errors from two-step estimators with the Windmeijer (2000) small sample corrections. ***, **, and * denote statistical significance at the 1 percent, 5 percent, and 10 percent level, respectively.
4. AR(2) is a test for second-order residual serial correlation, obtained from one-step estimators (the null hypothesis is no serial correlation). Sargan is a test for over-identifying restrictions (the null hypothesis is to satisfy over-identification). Figures in brackets are p-values.
5. Instruments for first-differenced equations are $l_{t-2,\ldots,t-5}$, $k_{t,\ldots,t-5}$, $D_{t-2,\ldots,t-5}$, and $ROA_{t-2,\ldots,t-5}$. Those for level equations are Δl_{t-1}, ΔD_{t-1}, and ΔROA_{t-1}.

Nonlinearity with respect to the debt-asset ratio is also found for the share of short-term loans L^{short}/L: i.e., banks relied more on short-term lending once debt-asset ratios exceeded a certain level (Table 3).[12] This suggests that forbearance loans were mainly provided by rolling over short-term loans, since banks hesitated to provide long-term loans to heavily indebted firms. Lack of long-term finance may have

12. To derive this conclusion, it would be helpful if we could estimate the loan supply function by maturities. However, we cannot estimate short- and long-term loan supply functions separately owing to a lack of the relevant interest rate data.

Table 3 Share of Short-Term Loans Outstanding

Industry	All industries	Manufacturing	Nonmanufacturing
Dependent	L^{short}/L	L^{short}/L	L^{short}/L
D_{-1}	–0.88 (0.09)***	–1.01 (0.13)***	–0.66 (0.16)***
D^2_{-1}	1.43 (0.15)***	1.63 (0.24)***	1.25 (0.22)***
Sample period	1993–99	1993–99	1993–99
Observations	4,640	3,072	1,568
Firms	580	384	196
SE^2	0.01	0.01	0.01
R^2	0.05	0.05	0.07

Notes: 1. Within-group estimation. Coefficients on time dummies are omitted.
2. Figures in parentheses are standard errors.
3. *** denotes statistical significance at the 1 percent level.

prevented these firms from investing in facilities that would enhance their long-run productivity. In this way, the profitability of these borrowers might have dropped still further, in turn contributing to an accumulating debt-overhang.

B. Robustness Check

In Table 2, the coefficients on l_{-1} are close to unity. This might be due to a normalization problem. Since l on the left-hand side and l_{-1} on the right-hand side are not normalized by any scaling factor, they are thought to depend on a common scaling factor such as the size of the firms.[13]

We reestimate the equation, imposing a restriction $\alpha_0 = 1$ in equation (1) to check whether our findings of the coefficients on D_{-1} and D^2_{-1} are robust against the normalization problem. We transpose $l_{i,t-1}$ to the left-hand side as

$$\Delta l_{it} = \alpha_1 r_{it} + \alpha_2 D_{i,t-1} + \alpha_3 D^2_{i,t-1} + \alpha_4 ROA_{i,t-1} + \alpha_5 + \epsilon_{it}.$$

In this case, the dependent variable becomes a change in outstanding loans and none of the variables in the equation are likely to depend on firm sizes.

Estimation of this equation for the nonmanufacturing industry gives us coefficients almost identical to those in Table 2, as indicated in the first column of Table 4.

In addition, to check if estimation results differ with the estimation procedure adopted, we estimate the equation using the within-group method. In this equation, problems associated with dynamic GMM are eliminated since the AR term is excluded from the right-hand side. (Note that within-group estimation, which does not incorporate instrument variables, still leaves us with an endogeneity bias problem.) The results are shown in the second column of Table 4. The signs of the coefficients on D_{-1} and D^2_{-1} remain the same (at a higher significance level).

Instead of normalizing the dependent variable by l_{-1} (i.e., imposing a restriction of $\alpha_0 = 1$), we can normalize it by capital stock K as

13. We owe this point to an anonymous referee.

Table 4 Loan Supply Function: Robustness Check (1)

Industry	Nonmanufacturing	Nonmanufacturing	Nonmanufacturing
Dependent	ΔI	ΔI	L/K
Estimation	GMM	Within-group	Within-group
r	0.03 (0.04)	0.10 (0.02)***	0.03 (0.02)*
D_{-1}	–2.60 (1.07)**	–4.07 (0.43)***	0.24 (0.77)
D^2_{-1}	3.41 (1.67)**	3.61 (0.57)***	2.27 (1.30)*
ROA_{-1}	0.02 (0.02)	0.001 (0.01)	0.002 (0.01)
Sample period	1993–99	1993–99	1993–99
Observations	1,568	1,568	1,568
Firms	196	196	196
SE^2	0.06	0.04	0.06
AR(2)	–1.03 [0.31]		
Sargan	121.4 [0.07]		

Note: See notes for Table 2.

$$\left(\frac{L}{K}\right)_{it} = \alpha'_1 r_{it} + \alpha'_2 D_{i,t-1} + \alpha'_3 D^2_{i,t-1} + \alpha'_4 ROA_{i,t-1} + \alpha'_5 + \epsilon_{it}.$$

Estimating this equation using the within-group method, we confirm nonlinearity between outstanding loans and the debt-asset ratio: while the coefficient on D_{-1} becomes insignificant, D^2_{-1} remains positive and significant as shown in the third column of Table 4.[14]

The nonlinear relationship with respect to D can be confirmed by splitting the sample. The change in loans outstanding, $\Delta \ln L_{it}$, is regressed on $D_{i,t-1}$, r_{it}, and $ROA_{i,t-1}$ using within-group estimation,[15] where the sample is divided into those having a "high" debt-asset ratio ($D_{i,t-1} > 0.4$) and those with a "low" ratio ($D_{i,t-1} < 0.4$). As evident in Table 5, coefficients on $D_{i,t-1}$ are much smaller in the "high" category than in the "low." Shortening the sample period to fiscal 1997, we discover a larger difference between the coefficients in the "high" and "low" categories.

C. Impact of the BIS Regulations

We would like to see, in our sample, how various measures of bank health, including the Bank for International Settlements (BIS) capital adequacy ratio, affected bank loan provision. As Sakuragawa (2002) emphasizes, banks might put off disposing of NPLs to satisfy the Basel minimum capital requirement. Under an opaque accounting system, bank managers, aiming to maximize their private profits, have an incentive to postpone writing off NPLs to disguise the true state of their balance sheet.

14. If a firm reduces its capital stock as D_{-1} increases, the coefficient on D_{-1} in the above specification is not necessarily negative.
15. Dynamic GMM tends to create unstable estimation results, presumably because of the very short sample period. Note that dividing the sample according to D leaves us with an unbalanced panel, in which some samples have only one data period, because they may switch categories from time to time if their debt-asset ratios are just around 0.4.

Table 5 Loan Supply Function: Robustness Check (2)

	$D < 0.4$	$D > 0.4$	$D < 0.4$	$D > 0.4$
Dependent	Δl	Δl	Δl	Δl
r	0.10 (0.01)***	0.04 (0.02)**	0.09 (0.01)***	0.06 (0.03)**
D_{-1}	–2.31 (0.10)***	–0.52 (0.19)***	–2.92 (0.13)***	0.02 (0.29)
ROA_{-1}	–0.01 (0.002)***	0.001 (0.01)	–0.01 (0.002)***	–0.003 (0.01)
Sample period	1993–99	1993–99	1993–97	1993–97
Observations	4,325	285	3,283	177
Firms	568	63	563	45
SE^2	0.05	0.02	0.05	0.02
R^2	0.22	0.11	0.23	0.14

Note: See notes for Table 3.

Sasaki (2000) points to a possible case of forbearance lending based on her finding that in the 1990s, for the construction industry, there was a positive relationship between bank loans and the share of NPLs in overall outstanding loans. The finding is in contrast with the results of Miyagawa *et al.* (1995) and Woo (1999), who claim that impaired bank health leads to a contraction in bank loans extended (i.e., a credit crunch).

We can estimate loan supply functions for individual banks to each firm, since the Corporate Finance Data Set contains data on loans outstanding to each firm from individual banks.

Estimated loan supply functions take the form of

$$\Delta l_{ijt} = \alpha_1'' r_{it} + \alpha_2'' D_{i,t-1} + \alpha_3'' D_{i,t-1}^2 + \alpha_4'' ROA_{i,t-1} + \alpha_5'' BIS_{j,t-1} + \alpha_6'' + \epsilon_{ijt},$$

where i, j, and t denote firms, banks, and time, respectively. If the BIS capital adequacy ratio, *BIS*, had some impact on forbearance lending, we expect $\alpha_5'' < 0$ since banks would increase their lending when *BIS* deteriorated. The sample period is fiscal 1998–99, because data on the short-term loans of individual banks are not available before fiscal 1997.[16] The short sample period does not allow us to apply the dynamic GMM procedure; we estimate the equation using GMM, but without employing the first-differenced equation.[17]

The results are shown in Table 6. Although the short sample period results in some loss of reliability—coefficients on r turn out to be negative and coefficients on D_{-1} and D_{-1}^2 differ significantly from the above results—the positive signs of the coefficients on BIS_{-1} indicate that banks tend to increase loans as their capital adequacy ratios improve. This is inconsistent with the hypothesis that banks increase loans to avoid making write-offs and so satisfy their Basel minimum capital requirement.[18]

16. We choose firms which have $l_{ijt} > 0$ for more than two periods from fiscal 1997 to fiscal 1999. Banks j are city banks and long-term credit banks, which are supposed to perform the role of main banks in Japan.
17. We assume $\mathrm{Cov}(\epsilon_{ijt}, \epsilon_{ikt}) = 0$ for $j \neq k$. See Doornik *et al.* (2001) for instrument variables in unbalanced panel regressions.
18. We further test whether α_5'' varies depending on D, but we fail to find a robust estimation result.

Table 6 Loan Supply Function: Impacts of the BIS Regulation

Industry	All industries	Manufacturing	Nonmanufacturing
Dependent	Δl	Δl	Δl
r	–0.35 (0.14)***	–0.11 (0.08)	–0.16 (0.10)
D_{-1}	–5.16 (2.65)*	2.38 (2.03)	–6.00 (2.39)**
D^2_{-1}	9.34 (5.07)*	–5.60 (4.28)	9.61 (4.10)**
ROA_{-1}	0.01 (0.004)***	0.01 (0.003)**	0.01 (0.01)
BIS_{-1}	0.01 (0.01)	0.01 (0.01)	0.02 (0.01)***
Sample period	1998–99	1998–99	1998–99
Observations	9,317	4,887	4,430
SE[2]	0.40	0.26	0.34
Sargan	6.30 [0.71]	18.83 [0.03]	9.06 [0.43]

Notes: 1. See notes for Table 2.
2. Unbalanced panel. AR(2) test is not calculated due to the short sample period.
3. Instrumental variables are k_t, k_{t-1}, and BIS_{t-1}.

We further explore the possibility that bank health and forbearance lending are connected by replacing the BIS capital adequacy ratio with other bank health indicators. These include (1) *Default*: the likelihood of default for each bank, calculated from its balance sheet and share price using option pricing theory (see Oda [1999] and Fukao *et al*. [2000] for details of the calculation); (2) *Cap*: the adjusted capital adequacy ratio, which takes into account NPLs and capital gains/losses;[19] and (3) *A*2, . . . , *Baa*3: banks' rating dummies obtained from Moody's.

The results are similar to those estimated using the BIS capital adequacy ratio (Table 7) in that impaired bank health tends to induce a squeeze in lending. The negative coefficient on $Default_{-1}$ implies that banks decrease their loans to firms as their own default risk increases. The positive coefficient on Cap_{-1} suggests that when banks are financially distressed through a decline in the value of their own capital, they decrease their lending. The larger negative coefficients on inferior ratings indicate that banks with such ratings typically reduce lending.

Over the course of the financial crisis that began at the end of 1997, the Financial Services Agency strengthened its monitoring of banks through implementation of the Financial Inspection Manual after the passage of the Financial Reconstruction Law through the Diet in 1998. As a result, it might be the case that banks were left with less maneuvering room with which to disguise their true balance sheets. Also, there seemed to be only weaker incentives for banks to manipulate their BIS capital adequacy ratios, which improved considerably after a series of public money injections in 1998. We should note that the estimation by Sasaki (2000) is based on pre-1997 data (from fiscal 1989–96), and that a connection between bank health and forbearance lending is more likely to be observed before 1997.

19. (Shareholders' equity + capital gains/losses from securities + loan-loss provisioning – risk management assets – deferred tax assets)/assets. See Fukao *et al.* (2000) for more details.

Table 7 Loan Supply Function: Impacts of Bank Health

Industry	Nonmanufacturing	Nonmanufacturing	Nonmanufacturing
Dependent	Δl	Δl	Δl
r	–0.13 (0.10)	–0.13 (0.11)	–0.09 (0.10)
D_{-1}	–5.33 (2.58)**	–6.18 (2.71)**	–5.01 (2.54)**
D^2_{-1}	8.49 (4.42)*	9.90 (4.66)**	7.90 (4.35)*
ROA_{-1}	0.01 (0.01)	0.01 (0.01)	0.003 (0.01)
$Default_{-1}$	–0.43 (0.07)***		
Cap_{-1}		0.02 (0.01)***	
$A2_{-1}$			0.01 (0.02)
$A3_{-1}$			–0.04 (0.03)
$Baa1_{-1}$			–0.15 (0.03)***
$Baa3_{-1}$			–0.13 (0.04)***
Sample period	1998–99	1998–99	1998–99
Observations	4,457	4,457	4,457
SE[2]	0.31	0.33	0.29
Sargan	11.96 [0.22]	7.35 [0.60]	23.28 [0.08]

Notes: 1. See the notes for Table 6.
2. Instrumental variables are k_t, k_{t-1}, $Default_{t-1}$ or Cap_{t-1} or $A2_{t-1}$, . . . , $Baa3_{t-1}$.
3. The rating dummies are normalized so that $Baa2 = 0$.

D. Effect of Uncertainty

To see the effect of uncertainty on loans outstanding pointed out by Baba (2001), we add the volatilities of the debt-asset ratio and ROA to the basic specification. The volatility of variable x_{it} is calculated as follows.

$$Vol(x)_{it} = \frac{1}{4}\sum_{j=t-1}^{t-4} (\Delta x_{ij} - 0.25\Delta_4 x_{ij})^2,$$

where Δ and Δ_4 are the first- and fourth-difference operators, respectively, $\Delta_4 x_{it} = \sum_{j=t}^{t-3} \Delta x_{ij}$.

The estimation results are reported in Table 8. The coefficient on the volatility of ROA is negative and significant for the nonmanufacturing industry, whereas the sign should be positive if a bank engaged in forbearance lending in response to increased uncertainty.

The reason why we cannot find clear evidence regarding the impact of uncertainty on forbearance lending might lie in its theoretical ambiguity. Just as the impact of uncertainty on the firm's investment decision is theoretically ambiguous, so too its impact on bank loan provision may not be simple. While uncertainty regarding a firm's future profits may induce banks to engage in forbearance lending, it may also prompt them to cut loans. Consequently, a hike in uncertainty may exert both upward and downward pressures on banks' loan provision. It seems to us that more work is needed before it is possible to derive any conclusion regarding the relationship between uncertainty and forbearance lending. Such work should also give

Table 8 Loan Supply Function: Effect of Uncertainty

Industry	All industries	Manufacturing	Nonmanufacturing
Dependent	l	l	l
l_{-1}	0.96 (0.02)***	0.93 (0.03)***	0.99 (0.04)***
r	–0.01 (0.04)	0.12 (0.05)**	0.04 (0.05)
D_{-1}	–0.34 (0.94)	–0.65 (1.16)	–2.78 (1.26)**
D^2_{-1}	0.98 (1.48)	0.16 (2.47)	3.84 (1.79)**
ROA_{-1}	0.02 (0.01)*	0.01 (0.01)	0.01 (0.02)
$Vol(D)_{-1}$	–2.61 (25.31)	–8.60 (23.10)	–9.92 (19.41)
$Vol(ROA)_{-1}$	–0.002 (0.004)	0.01 (0.01)	–0.02 (0.01)**
Sample period	1993–99	1993–99	1993–99
Observations	4,632	3,067	1,565
Firms	580	384	196
SE^2	0.06	0.07	0.06
AR(2)	–0.26 [0.80]	0.56 [0.58]	–1.55 [0.12]
Sargan	117.1 [0.08]	103.6 [0.30]	117.5 [0.08]

Note: See notes for Table 2.

more thought to whether there is some more appropriate measure for capturing uncertainty than volatilities.[20]

IV. Firm Profitability

How does firm profitability relates to the debt-asset ratio and additional lending? As discussed at the beginning of this paper, one of the key conditions for distinguishing forbearance lending from other lending is whether or not banks deem firms capable of repaying their debts, and this in turn depends on their profitability. Furthermore, the model developed by Berglöf and Roland (1997) predicts the emergence of a moral hazard problem in which profitability may deteriorate at the time of forbearance lending, because firms rationally choose "no effort." In fact, correlation coefficients show that both debt-asset ratios and loans outstanding are negatively correlated with ROA (Table 1 [2]). The negative correlations are also evident in Figure 3. Thus, firms with higher debt-asset ratios or faster loan growth are likely to have lower ROA.

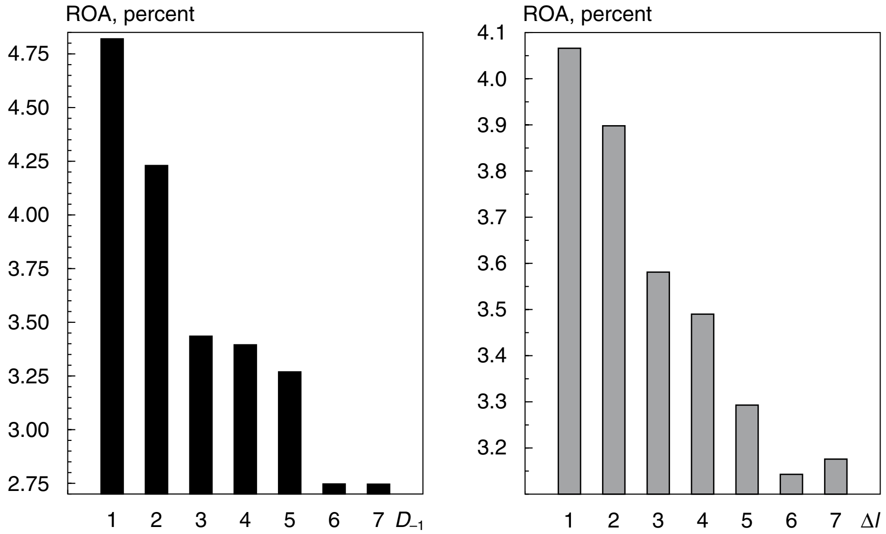
20. We find some evidence consistent with the hypothesis discussed by Kobayashi and Kato (2001) that banks effectively become dominant shareholders and act as "risk-lovers." Banks' loan shares tend to become more concentrated along with a hike in firms' debt-asset ratios.

$$\Delta H_{it} = \underset{(0.04)^{***}}{0.19} D_{i,t-1},$$

$T = 1993–99$, obs. = 9,672, $R^2 = 0.01$, $SE^2 = 0.02$

where H_{it} is the Herfindahl index ($H_{it} = \sum_j (L_{ijt}/\sum_j L_{ijt})^2$), a measure of loan share concentration for firm i. The loan share is based only on long-term loans (of city banks and long-term credit banks) due to data availability. Within-group estimation is applied.

Figure 3 Debt-Asset Ratio, Loans, and ROA



Note: Firms are ordered in accordance with their debt-asset ratios in the previous period (D_{-1}) and changes in loans outstanding in the current period (Δl), and are divided into seven equal-sized groups for each year from fiscal 1993–99. Then, period averages are taken for each group. Higher-numbered groups have larger debt-asset ratios and faster loan growth, respectively.

Regressing ROA on a cross term of the loan growth Δl and the debt-asset ratio D as below, we find that the term becomes negative and significant for the construction and real estate industries, to which banks provided forbearance loans in the 1990s (Table 9).

$$ROA_{it} = \gamma_1 ROA_{i,t-1} + \gamma_2 \Delta l \cdot D_{i,t-1} + \gamma_3 \Delta Share_{it} + \gamma_4 + \epsilon_{it}.$$

In our regressions, we control for the share of sales in the corresponding industry ($Share_{it}$), which is found to be significant in Kitamura (2001) and Weinstein and Yafeh (1998). Time dummies are added to control for macroeconomic effects such as business cycles and changes in asset prices.[21]

In place of the cross term, if we add the loan growth and the debt-asset ratio separately as

$$ROA_{it} = \gamma_1' ROA_{i,t-1} + \gamma_2' \Delta l_{i,t-1} + \gamma_3' D_{i,t-1} + \gamma_4' \Delta Share_{it} + \gamma_5' + \epsilon_{it},$$

21. Time dummies are added to the other regressions in this paper.

Table 9 Firm Profitability (1)

Industry	All industries	Manufacturing	Nonmanufacturing	Construction and real estate	Other nonmanufacturing
Dependent	*ROA*	*ROA*	*ROA*	*ROA*	*ROA*
ROA_{-1}	0.52 (0.11)***	0.54 (0.12)***	0.84 (0.17)***	0.73 (0.16)***	0.83 (0.15)***
$\Delta I \cdot D_{-1}$	–1.04 (0.80)	–0.88 (1.23)	–0.37 (0.77)	–2.56 (1.10)**	0.33 (0.92)
Share	2.44 (1.22)**	3.49 (1.61)**	0.26 (0.49)	–3.37 (1.91)*	0.70 (0.57)
Sample period	1993–99	1993–99	1993–99	1993–99	1993–99
Observations	4,640	3,072	1,568	408	1,160
Firms	580	384	196	51	145
SE[2]	3.47	4.18	1.66	1.45	1.67
AR(2)	0.41 [0.68]	0.68 [0.50]	0.33 [0.75]	1.19 [0.23]	–0.32 [0.75]
Sargan	30.2 [0.03]	26.2 [0.07]	24.8 [0.10]	19.2 [0.32]	22.0 [0.19]

Notes: 1. System GMM estimation.
2. See the notes for Table 2.
3. Instruments for first-differenced equations are ROA_{t-2}, ROA_{t-3}, ΔI_{t-1}, ΔI_{t-2}, D_{t-1}, D_{t-2}, and $Share_t$. Those for level equations are ΔROA_{t-1}, ΔI_{t-1}, ΔI_{t-2}, D_{t-1}, D_{t-2}, and $Share_t$.

Table 10 Firm Profitability (2)

Industry	All industries	Manufacturing	Nonmanufacturing	Construction and real estate	Other nonmanufacturing
Dependent	*ROA*	*ROA*	*ROA*	*ROA*	*ROA*
ROA_{-1}	0.31 (0.12)**	0.39 (0.13)***	0.64 (0.21)***	0.54 (0.19)***	0.73 (0.16)***
ΔI_{-1}	–0.15 (0.11)	–0.17 (0.15)	–0.02 (0.12)	–0.39 (0.24)*	0.06 (0.12)
D_{-1}	–1.90 (0.76)**	–1.31 (1.04)	–1.12 (0.77)	–1.37 (0.82)*	–0.82 (0.66)
Share	3.19 (1.45)**	4.13 (1.78)**	0.41 (0.58)	–3.39 (2.11)	0.87 (0.60)
Sample period	1993–99	1993–99	1993–99	1993–99	1993–99
Observations	4,640	3,072	1,568	408	1,160
Firms	580	384	196	51	145
SE[2]	4.14	4.65	1.63	1.39	1.64
AR(2)	–0.72 [0.47]	0.02 [0.99]	0.11 [0.91]	1.08 [0.28]	–0.40 [0.69]
Sargan	33.2 [0.02]	28.9 [0.05]	27.4 [0.07]	17.5 [0.49]	22.6 [0.21]

Note: See notes for Table 9.

we find that the coefficients on these terms are again negative and significant for the construction and real estate industries (Table 10).[22]

From these findings, we are able to observe that even taking into account macroeconomic effects, additional loans to heavily indebted firms tend further to reduce their ROA.

22. Although we do not report the details of the estimation results to conserve space, we find that the added term is negative and significant for the construction and real estate industries, when we add the loan growth or the debt-asset ratio individually.

V. Conclusion

In this paper, we find evidence consistent with the view that forbearance lending certainly took place in Japan, and that it suppressed the profitability of inefficient nonmanufacturing firms. First, contrary to the usual expectation, we find that outstanding loans were apt to increase to a firm whose debt-asset ratio exceeded a certain level: after the bubble burst, this nonlinear relationship between loans and debt-asset ratios became evident for nonmanufacturing firms, especially those in the construction and real estate industries. Furthermore, we also find that an increase in loans to highly indebted firms in these industries lowered their profitability.

The paper presents clear evidence of a link between debt-asset ratios and forbearance lending, but the results of our investigation into the effects of the BIS regulation and uncertainty are less conclusive. These effects are worthy of further investigation in the future.

There is no doubt that the NPL problem hampered real activity through a sharp credit contraction during the 1997–98 financial crisis. However, this paper shows in addition that, even in the absence of this crisis, the NPL problem was stifling Japanese economic growth through the practice of forbearance lending. Forbearance lending not only props up inefficient firms, it also encourages inefficient firms to avoid making the efforts necessary to raise their profitability. Maeda *et al.* (2001) point out that the stagnation of Japan's economy in the 1990s was rooted in a wide range of "structural" deficiencies including lack of flexibility in corporate management and inefficient use of fiscal spending, among others. In our view, forbearance lending should be added to this list of structural deficiencies in the Japanese economy. Similarly, Saita and Sekine (2001) show how weakened financial intermediation, manifesting itself in the form of a credit crunch and the practice of forbearance lending, caused Japanese economic growth to stagnate through declining sectoral credit shifts in the 1990s.

Since this paper focuses on firms' debt-asset ratios (bank loans outstanding/the market value of assets), our findings are also relevant to the debt-overhang problem. After all, the NPL problem for banks and the debt-overhang problem for firms are different sides of the same coin. To overcome these problems, firms must reduce their debt-asset ratios to an appropriate level by cutting their debts outstanding or increasing their market values.

DATA APPENDIX

Figures starting with "K" are code numbers corresponding to the relevant items in the Corporate Finance Data Set.

A. Outstanding Loans

Outstanding loans L = short-term bank loans (K1960) + long-term bank loans (K2350). The amount of newly contracted loans is not available in the data set.

B. Interest Rates

The interest rates on bank loans r^L are supposed to be the same as the interest rates paid by firms.

$$\text{Paid interest rate} = \frac{\text{interest payments and fees for discount (K3160)}}{\text{interest-bearing debt outstanding in the previous period}},$$

where interest-bearing debt outstanding (excluding CP and bonds) is the sum of items K1910, K1950, K2000, K2010, K2100, K2120, K2210, K2340, K2380, K2440, K2450, K2460, K5500, and K5440.

The deposit interest rates r^M are derived as a weighted average of interest rates on demand deposits, time deposits, and CDs (new issues, three-month), where the weights are from the flow-of-funds statistics.

C. Debt-Asset Ratio

Debt-asset ratio D is

$$\frac{\text{Short-term bank loans (K1960) + long-term bank loans (K2350)}}{\text{market value of assets}},$$

where the market value of assets is obtained by substituting the market value of capital stock K with the corresponding items in total assets (K1880).

D. Capital Stock

Capital stock K consists of inventory, land, machinery, and nonresidential buildings and structures. Their market values are calculated by perpetual inventory methods, which are often used for calculating average q for investment functions (see, *inter alia*, Hoshi and Kashyap [1990] and Hayashi and Inoue [1991]).

The perpetual inventory method can be expressed as

$$K_{it} = \frac{P_t^K}{P_{t-1}^K} K_{i,t-1}(1-\delta) + I_{it}. \tag{A.1}$$

The first term on the right-hand-side is the capital stock remaining from the previous period (δ is the depreciation rate), which is reevaluated at current prices by multiplying it by the change in capital stock prices, P_t^K/P_{t-1}^K. The current capital stock is obtained by adding the newly invested capital stock I_{it} to the existing capital stock.

As for the initial market value, it is assumed to be same as the book value in 1970 or the earliest available book value after 1970.[23]

Based on equation (A.1), we conduct the following calculation for each capital stock (see Sekine [1999] for more details).

(1) **Inventory**: The book value of inventory stock is obtained from the sum of items K1030, K1040, K1050, K1060, K1070, K1080, K1090, K1100, K1110, and K1120. If a firm uses the Last-In-First-Out (LIFO) method, the market value is calculated using the perpetual inventory method. Otherwise, the market value is set equal to the book value. For equation (A.1), we assume $\delta = 0$ and I_{it} is the change in the book value of stocks. P_t^K is obtained from the Wholesale Price Index (WPI), the Input-Output Price Index, and the System of National Accounts (SNA).

(2) **Land**: The book value is K1390. The Land Price Index (all purposes, six major cities) is used for P_t^K. We assume $\delta = 0$ and I_{it} is the change in the book value of stocks. When I_{it} becomes negative, we multiply by (P_t^K/P_{t*}^K) where P_{t*}^K is the price at which land was last purchased (i.e., when the book value of land stock increased).

(3) **Depreciable assets (machinery, nonresidential buildings and structures)**: The book value is the sum of items K1300, K1310, K1320, K1330, K1340, K1350, K1360, K1370, and K1380. P_t^K is chosen from appropriate items from the WPI. Following Hayashi and Inoue (1991), we set the depreciation rate δ as 4.7 percent (nonresidential buildings), 5.64 percent (structures), 9.489 percent (machinery), 14.70 percent (transportation equipment), and 8.838 percent (instruments and tools). I_{it} is the sum of changes in the book value of stock and depreciation in the current period (K6630–K6700). Since the current period depreciations for each item are only available from 1977, for the pre-1977 data we calculate them as

$$\frac{\text{Accumulated depreciation for each item}}{\text{total accumulated depreciation (K6520)}} \times \text{total current depreciation (K6610)},$$

where accumulated depreciation for each item corresponds to K6530–K6600.

E. ROA

$$ROA = \frac{\text{operating profits (K2980) + non-operating income (K2990)}}{\text{total assets (K1880) in the previous period}}.$$

23. For land stock, since its market value differs considerably from the book value, we adjust the initial market value by multiplying it by the market-to-book ratio obtained from the System of National Accounts (SNA) and the Corporate Statistics.

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