GCOE DISCUSSION PAPER SERIES
Global COE Program
Human Behavior and Socioeconomic Dynamics

Discussion Paper No.11

Credit Crunch: A Lesson from the Japanese Case

Daisuke Ishikawa and Yoshiro Tsutsui

October 2008

GCOE Secretariat
Graduate School of Economics
OSAKA UNIVERSITY
1-7 Machikaneyama, Toyonaka, Osaka, 560-0043, Japan

Credit Crunch: A Lesson from the Japanese Case*

Daisuke Ishikawa (Kyoto University)

Yoshiro Tsutsui (Osaka University)

Abstract

The purpose of this paper is to elucidate whether the supply side played a crucial role in causing the credit crunch in Japan in the 1990s. To this end, we estimate the supply and demand functions using prefectural panel data from 1990 to 2001 and calculate the shifts of those functions. The results reveal that until 1996 the supply side was not the main cause of stagnant loans, and after 1996 the contraction of the supply side at best contributed as much as the demand side to the decrease in loans. Thus, the countermeasures on the banking sector were not adequate to increase the loans.

JEL classification numbers: G21, E51, R51

Keywords: credit crunch, prefectural panel data, shift of functions, Japanese loan market

Correspondence:

Yoshiro Tsutsui

Graduate School of Economics,

Osaka University

1-7 Machikaneyama, Toyonaka, Osaka 560-0043 Japan

Phone: 06-6850-5223,

Fax: 06-6850-5274,

e-mail: tsutsui@econ.osaka-u.ac.jp

---

* An earlier version of this paper was presented at the RIETI seminar and at the Annual Meeting of Japan Society of Monetary Economics. We are grateful to Masaru Yoshitomi, Katsumi Matsuura, and the participants of the seminar and the meeting for their comments.

1. Introduction

Subprime loan problems have hit financial institutions globally since 2007. Many financial institutions have reported huge losses and had financial troubles. Among them, in the United States, Lehman Brothers filed for bankruptcy in September 2008, Bear Sterns was sold to JP Morgan Chase under Federal Reserve Bank pressure in March 2008, and there was a run on Indy Mac in July 2008. The possibility of a credit crunch has been discussed since the summer of 2007 (e.g., *The Japan Times,* Oct. 13, 2007). Indeed, bank credit and loans and leases in bank credit in the U.S. had been increasing almost monotonically for years, and started decreasing in April 2008 (Figure 1). How can we cope with this creeping crisis? The purpose of this paper is to find prescriptions by learning from the Japanese experience of sharp decline in loans in the 1990s.

The Japanese loan market was in a severe slump from 1990 to 2003; this was a significant historical event. The solid line in Figure 2 represents the amount of loans advanced by domestically licensed banks in Japan since 1944, showing that the 1990s was the first decade in postwar Japan: that the amount of loans began decreasing significantly. A closer inspection reveals that loans became stagnant around 1993, but continued to increase until around 1998, then began to decrease until 2004. The graph shows a recovery after 2005. The dotted line in Figure 2 represents the bank credit of commercial banks in the U.S. since 1973, which shows a monotonic upward trend. However, as shown in Figure 1, this trend became stagnant after April 2008, suggesting that the United States has been facing a sharp decline of outstanding loans as of July 2008. Thus, it is important for us to ask what we can learn from the nightmarish events of financial distress in Japan in the 1990s.

When Japan faced this remarkable stagnancy of loans in the 1990s, it was said that firms, especially small and medium sized firms, were in trouble because their applications for loans had been refused by banks. The general opinion, including that of the Diet, the government and the media, was that the banks were to blame, and that the problem stemmed from the banks'

reluctance to advance loans.

Some economists attributed the Japanese depression of the 1990s to the fall in stock prices, which decreased banks' assets, which, in turn, impaired their capital, so that they were compelled to compress loans in order to clear the BIS regulation. A fall in land prices may have been another cause: it decreased the values of collateral and banks suffered losses due to the bankruptcy of their borrowers. Thus, Japan fell into a vicious circle: an increase in the bankruptcy of borrowers, together with a fall of land prices, increased nonperforming loans, which in turn caused the banks to reduce their loans to firms, i.e., it led to a credit crunch. Conversely, the credit crunch increased the bankruptcy of borrowers and worsened the Japanese economy. In order to end this vicious circle, the Japanese government injected a huge amount of public funds into banks in 1998 and 1999.

However, the problem is not so simple. The decrease in the amount of loans may come from the demand side, not from the supply side. Because the Japanese economy was in a serious slump and the loan interest rate was falling throughout the 1990s, this view is highly convincing.[1] If this is the case, it is necessary to increase the demand for loans by raising the firms' effective demand to revitalize the slumped Japanese economy. A measure to support banks, such as injection of public funds, can only have a limited effect on raising the loan amount.[2]

This paper aims to elucidate which side, supply or demand, caused a decrease in loans in Japan in the 1990s. As will be explained in the next section, almost all of the previous studies on the credit crunch have focused on the effects of own capital ratios and nonperforming loans on the supply of loans, disregarding the demand side of loans. Even if the effect is found, it may still be true that raising the demand for loans is the key to recovery. This paper is unique in estimating the shifts of both the supply and demand functions to explicate which side primarily

[1] Declining loan interest rate is derived only by the left shift of the demand function or the right shift of the supply function.
[2] Still, it helps banks to amortize their bad loans and to escape from their failures.

caused the decrease in loans, and in investigating the factors that caused the shifts of those functions. Using a prefectural panel data set, this paper also tries to clarify whether the credit crunch hit the Japanese economy uniformly or whether it affected only specific regions.

The rest of the paper is organized as follows. In the next section, we survey the literature. In section 3, we explain the analytical framework, specification of our model, estimation method and data. In section 4, we present the results and discuss them. Section 5 concludes.

2. An overview of the literature

There have been many studies on the credit crunch in Japan. Most of them focus on banks' behavior, i.e., the supply side of loans. They try to explain the stagnant loans in the 1990s mainly by a fall of land prices, an increase in bad loans, and the regulation of own capital ratios.

Ogawa and Kitasaka (2000) found that nonperforming loans had a negative effect and own capital ratios had a positive effect on the loan supply in the 1990s. Namely, their study supports the existence of the credit crunch. Meanwhile, Yoshikawa et al. (1994) found that there was no significant negative correlation between nonperforming loan ratios and the loan supply in the early 1990s. Therefore, they are negative to the occurrence of the credit crunch in that period.

In many other studies, the results are mixed. For example, Woo (1999) made a cross-sectional analysis with banks' financial data from 1991 to 1997 in order to clarify the effect of banks' own capital ratios on loans, and reported that they had significant effects in 1997, but not in the other periods. Horie (2001) and Ishikawa (2005) obtained similar results. These studies suggest that the credit crunch was severe in the late 1990s, but not in the early 1990s. Ito and Sasaki (2002) tested whether the increase of banks' capital, which was financed by the subordinate debentures, affected the loan supply. They found that own capital ratios had positive effects on loan supply in larger banks, but not in smaller banks. Honda et al. (1995) obtained similar results. These studies also suggest that the credit crunch was severer in larger

banks than in smaller banks. Surprisingly, some studies reported that nonperforming loans exerted a positive effect and own capital ratios had a negative effect on loan supply for specific sectors, such as construction and real estate industry. They interpreted this result as banks' excessive forbearance: banks advanced additional loans to the slumped industries in order to postpone their failures. Sasaki (1998) and Tsuru (2001) are in line with this study.

3. Analytical Framework

3.1 Basic idea of the analysis

As we saw in section 2, most of the previous studies focused on the effects of BIS regulation and nonperforming loans on the supply of loans, paying no attention to the demand side. However, a credit crunch may become severe when the negative shift of the loan supply outweighs that of the loan demand. Thus, even if they found a negative effect of the BIS regulation on loans, they at best confirmed a necessary condition for the credit crunch. To confirm whether the credit crunch prevailed or not, it is necessary to investigate whether the effects of the supply side dominate those of the demand side. Thus, an analysis of the demand function, as well as the supply function, is indispensable, which is done in this paper.

A problem that has seldom been addressed in the previous studies is how to define the credit crunch. Different interpretations are possible. In this paper, the credit crunch is defined as a phenomenon in which the loan supply function shifts to the left more than the loan demand function. In this case, borrowers may face strict attitudes on the part of banks and may feel that banks are reluctant to advance loans, i.e., there exists a credit crunch.[3] Thus, we estimate the loan supply and demand functions assuming that the loan market is in equilibrium, evaluate the

[3] An alternative definition of the credit crunch is a phenomenon that results from banks' refusing the applications of loans by firms, that is, credit rationing. As for the equilibrium credit rationing, although much has been written in the field of banking theory (Jaffee and Russell 1976, Stiglitz and Weiss 1981), a method to estimate its magnitude has not been adequately developed. In addition, a change in magnitude of the equilibrium credit rationing should be associated with a shift in supply and demand loan functions. As for the disequilibrium credit rationing (Fair and Jaffee 1972), its magnitude is relatively small after the 1990s, as noted above.

magnitude of their shifts, and elucidate whether or not a credit crunch occurred in the Japanese loan market. The assumption of equilibrium seems reasonable because a couple of studies suggest that the Japanese loan market become increasingly competitive.[4]

3.2 Hypothesis of the segmented loan markets by prefectures

In this paper, we utilize prefectural panel data from 1990 to 2001. We use a prefectural data set because we suppose that the loan markets in Japan are segmented by prefectures: the amount of loans and the loan interest rate within a prefecture are determined by the demand and the supply of loans in the prefecture.

This assumption may be supported because regional banks, shinkin banks and credit cooperatives operate in restricted areas. Of course, the segmentation is not perfect, if it exists. First, city banks have nationwide branch networks, so that they can make arbitrage between the prefectural loan markets. Second, regional banks have 19% of their branches outside the home prefecture, so that "prefectural loan markets" actually overlap. Using cross-sectional data from 1996, Kano and Tsutsui (2003) demonstrated that loan markets of shinkin banks were segmented by prefectures, while those of regional banks were not. However, we may obtain different results based on the panel data set from 1990 to 2001. In this paper, we estimate the loan supply and demand functions, assuming that the loan markets are segmented by prefectures. If this assumption failed, the estimates of these functions would be unreasonable. In contrast, if the estimated coefficients of loan interest rate and other prefecture-specific variables show the expected signs, the assumption of market segmentation can be validated.

3.3 Specification of the loan supply function

We derive a loan supply function from an inter-temporal profit maximization problem of a bank

[4] Tsutsui (1982) reports that the excess demand for loans became smaller after 1973. Takenaka (1983) reports that the speed of adjustment became increasingly faster. Tsutsui (2005) reports that excess demand (supply) was less than 5% (2%) of the loan amount in the 1990s, while it was less than 15% (5%) before 1977.

(see Ishikawa, 2005, Ogawa and Kitasaka, 2000, and Elyasiani et al., 1995). First, we define profit π_t^k of the k-th bank operating in prefecture i in year t as

$$\pi_t^k = r_{it}(L_{it})l_t^k + r_t^c cl_t^k - r_t^d d_t^k - C(l_t^k, fl_t^k) \tag{1}$$

where, $r_{it}(L_{it})$, l_t^k, r_t^c, cl_t^k, r_t^d, d_t^k, fl_t^k are loan interest rate, the amount of loan outstanding, the call rate, the amount of the call loan, the deposit interest rate, the amount of the deposit and the net increase in the loan ($fl_t^k \equiv l_t^k - l_{t-1}^k$). Because a few banks compete within a prefecture, we assume an imperfect loan market so that the loan interest rate $r_{it}(L_{it})$ depends on the aggregate of loans in the prefecture i, $L_{it} \equiv \sum_{k \in prefecture\ i} l_t^k$. We assume that the loan and deposit interest rates are common for banks in the same prefecture. The call rate is the same across all prefectures. $C(l_t^k, fl_t^k)$ is the operational cost function of a bank, where we assume $C_l > 0$, $C_{ll} \geq 0$, $C_{fl} > 0$, and $C_{fl,fl} \geq 0$. $C_{fl} > 0$ reflects a positive search cost to obtain new customers and a positive monitoring cost to mitigate asymmetric information between new customers and a bank.

The k-th bank aims to maximize its firm value V_t^k under the balance sheet constraint $l_t^k + cl_t^k = d_t^k + cap_t^k$.

$$\underset{\{l_t^k, cl_t^k\}}{Max} \quad V_t^k = E_t\left[\sum_{p=0}^{\infty} \gamma^p \pi_{t+p}^k\right] \quad \text{s.t.} \quad l_t^k + cl_t^k = d_t^k + cap_t^k \tag{2}$$

To simplify the model, we assume that d_t^k and cap_t^k are exogenous.[5] E_t is the operator

[5] In Japan, since the regulation on deposit interest rates was liberalized in 1993, the amount of

of conditional expectation based on the information available in year t, $\gamma(0<\gamma<1)$ is the time discount rate. The first order condition becomes

$$\gamma E_t[\frac{\partial C_{t+1}}{\partial fl_{t+1}^k}] + r_{it}(1-\frac{1}{\eta_{it}}S_{kt}\frac{\partial L_{it}}{\partial l_t^k}) - r_t^c = \frac{\partial C_t}{\partial fl_t^k} + \frac{\partial C_t}{\partial l_t^k}, \tag{3}$$

where $\eta_{it} \equiv -\frac{r_{it}}{L_{it}}\frac{dL_{it}}{dr_{it}}$ is the loan supply elasticity to the loan interest rate in prefecture *i*, and $S_{kt} \equiv \frac{l_t^k}{L_{it}}$ is the bank *k*'s market share in prefecture *i*.

Taking a linear approximation of the cost function and solving equation (3) for l_t^k yields

$$\begin{aligned} l_t^k = {} & \alpha_0 + \alpha_1 E_t[l_{t+1}^k] + \alpha_2 l_{t-1}^k + \alpha_3(r_{ir} - r_t^r) - \alpha_3 \frac{r_{it}}{\eta_{it}} S_{kt} \frac{\partial L_{it}}{\partial l_t^k} + \alpha_4 LP_{it} \\ & + \alpha_5 bad_t^k + \alpha_6 cap_t^k + \alpha_7 SP_t + \alpha_8 CITYBANKS_{it} + \alpha_9 DENSITY_{it} \end{aligned} \tag{4}$$

where we added land price LP_{it}, nonperforming loans bad_t^k, own capital cap_t^k, stock market price index SP_t, the dominance ratio of the number of branches of city banks to that of all types of banks (city, regional and second regional banks) in prefecture i $CITYBANKS_{it}$, and the population density $DENSITY_{it}$, to the explanatory variables, and $\alpha_1 \equiv \gamma(C_{fl,fl} + C_{fl,l})/\delta > 0$, $\alpha_2 \equiv (C_{fl,fl} + C_{fl,l})/\delta > 0$, $\alpha_3 \equiv 1/\delta > 0$, $\alpha_4 > 0, \alpha_5 < 0, \alpha_6 > 0, \alpha_9 > 0,$ $\delta \equiv C_{fl,fl}(1+\gamma) + 2C_{fl,l} + C_{ll} > 0$.[6,7]

---

deposits may be treated as a decision variable. Even in this case, however, the results of the following analysis are not altered in essence.

[6] The population density is included in the operational cost function and, in turn, in the loan supply function because bank staffs in higher density area can visit their customers more cheaply.

[7] If $C_{fl,l}$ was large negative value, δ became negative, thus negative α_3. However, negative

$\alpha_1 > 0$ captures a smoothing effect. When loans are expected to increase tomorrow, a bank will increase loans today to save operational costs. $\alpha_2 > 0$ captures an inertia effect. If loans increased yesterday, which can lower the monitoring costs today, a bank will increase loans today because it can take advantage of the lowered costs. We expect $\alpha_4 > 0$ because a decrease in land price lowers the value of lands held by a bank, leading to impairment of capital and therefore a decrease in loans. A decrease in land price also lowers the collateral value of land, which may increase the screening costs of loan provisions, leading to a decrease in loans. We expect $\alpha_5 < 0$, $\alpha_6 > 0$ because an increase in nonperforming loans and a decrease in own capital result in a rise in the probability of a bank's default, leading to a reduction of risky loans.[8] The sign of α_7 is not known *a priori* because a bank, faced with a blip of the stock market price index, increases investment in stocks, leading to a reduction of loans, while a rise in the index makes the value of owned stocks higher, leading to an increase in capital, with the result that there is an increase in loans. The sign of α_8 is also not known: if bank *k* is as competitive as the city banks, it can increase its loans; if not, it will be battered in the competition and will decrease its loans. We expect $\alpha_9 > 0$ because a bank, faced with high population density, can expand business easily and will increase its loans.

Loan supply function for prefecture i in year t is derived by aggregating equation (4). Denoting the number of banks in prefecture i as I, we obtain

$$L_{it}^S = \alpha_0 + \alpha_1 E_t[L_{it+1}] + \alpha_2 L_{it-1} + \alpha_3 (r_{it} - r_t^c) + \alpha_4 LP_{it} + \alpha_5 BAD_{it} + \alpha_6 CAP_{it} + \alpha_7 SP_t + \alpha_8 CITYBANKS_{it} + \alpha_9 DENSITY_{it} + \alpha_{10} HI_{it} + v_i^S + \varepsilon_{it}^S \quad (5)$$

---

sign on α_3 is embarrassing because it implies that a bank will increase its lending as the loan interest rate rises. Therefore, we postulate $C_{fl,l}$ does not take a large negative value.

[8] Some may argue $\alpha_5 > 0$: banks will advance more loans to the troubled firms in order to postpone their bankruptcy (Berglof and Roland, 1995, 1997).

where $L_{it} \equiv \sum_{k \in prefecture\ i} l_t^k$, $BAD_{it} \equiv \sum_{k \in prefecture\ i} bad_t^k$, $CAP_{it} \equiv \sum_k cap_t^k$ and we redefine $\alpha_k I$ as α_k, $k = 3, 4, 7, 8, 9$. ν_i^S is an individual effect of prefecture i, and ε_{it}^S represents an i.i.d. disturbance term with $E[\varepsilon_{it}^S] = 0$. Following Kano and Tsutsui (2003), we assume that $\frac{r_{it}}{\eta_{it}} \sum_{k \in prefecture i} (S_{kt} \frac{\partial L_{it}}{\partial l_t^k})$ is associated with the Herfindahl index, $HI_{it} \equiv \sum_{k \in prefecture i} S_{kt}^2$. If the market structure-performance hypothesis is valid, $\alpha_{10} < 0$.

3.4 Specification of the loan demand function

We assume that loan demands increase as loan interest rates decline, sales increase, retained earnings decrease, population density increases, and the costs of alternative funds, e.g., bonds and equities, increase (Me'litz and Pardue 1973, Fase 1995, Ogawa and Suzuki 2000). We also assume that land prices and the stock market price index can affect loan demands. An increase of land prices boosts the value of real estate owned by firms, lowers the probability of defaults of the firms, and helps to increase investments, which may augment loan demands. There are two ways to look at the effects of the stock market price index on loan demands. Firms, faced with a climb of the index, may increase funds by issuing stocks, leading to a reduction of loan demands. On the other hand, a rise of the index can be viewed as better profitability in the future, which may increase loan demands. The dominance ratio of small and medium sized firms in prefecture *i*, defined as (the number of employees of firms that have 4 to 99 staff members in prefecture *i*) / (the number of employees of firms that have more than 4 staff members in prefecture *i*), can be an explanatory variable in the loan demand equation. Since the small and medium sized firms have difficulty in raising funds directly in the financial markets, they are more bank-dependent: the higher the dominance ratio of the small and medium sized firms, the stronger the bank loan demands. In addition, the number of housing starts may be an important explanatory variable in the loan demand equation, because people may borrow funds in order to

buy houses.

When a firm or a household borrows funds from a new bank, they may incur additional search costs, as is the case with the loan supply. Thus, the loan demand also depends on its past and expected values. As the data of retained earnings by prefectures are not available, we specify the loan demand function as follows.

$$L_{it}^{D} = \beta_0 + \beta_1 E_t[L_{it+1}] + \beta_2 L_{it-1} + \beta_3 r_{it} + \beta_4 SALE_{it} + \beta_5 HOUSE_{it} + \beta_6 LP_{it} + \beta_7 SP_t + \beta_8 r_t^b + \beta_9 SME_{it} + \beta_{10} DENSITY_{it} + \nu_i^D + \varepsilon_{it}^D \quad (6)$$

where $SALE_{it}$ is shipment of products, $HOUSE_{it}$ is the number of housing starts, r_t^b is the interest rate of government bonds, SME_{it} is the dominance ratio of small and medium sized firms, ν_i^D is an individual effect of prefecture i, and ε_{it}^D represents an i.i.d. disturbance term with $E[\varepsilon_{it}^D] = 0$. We expect $\beta_1 > 0, \beta_2 > 0, \beta_3 < 0, \beta_4 > 0, \beta_5 > 0, \beta_6 > 0, \beta_8 > 0, \beta_9 > 0,$ and $\beta_{10} > 0$. The sign of β_7 is not known *ariori*.

3.5 Data

We use annual data from 1990 to 2001 for each prefecture.[9] However, only the data of the following items are available for each prefecture: the amount of loans outstanding, the dominance ratio of city banks, the population density, the shipment of products, the number of housing starts, and the dominance ratio of small and medium sized firms. Therefore, as for the data of loan interest rates, the amount of nonperforming loans, and the amount of bank capitals, we construct these data for each prefecture by aggregating the corresponding data of individual banks. Specifically, denoting the financial data of the k-th bank as x_{kt},

[9] Because the Japanese economy began to recover in January 2002, we chose the period up to 2001 to analyze times when the credit crunch was supposed to be most severe, if it existed.

1) for regional and second regional banks whose head offices are located in prefecture i (referred to as group A), we just add up x_{kt} .

2) for city banks, trust banks, and long-term credit banks (referred to as group B), we multiply x_{kt} with w_{kit}, a weight for prefecture i, and then add up the products. [10]

Therefore, the data for prefecture i in year t, $X_{i,t}$, is

$$X_{it} = \sum_{\substack{k \in A \text{ group and} \\ \text{head office locates} \\ \text{in prefecture } i}} x_{kt} + \sum_{k \in \mathrm{B} \text{ group}} w_{kit} x_{kt} \qquad (7)$$

w_{kit} is defined as (the number of employees of the k-th bank in year t who work at branches located in prefecture i) / (the total number of employees of k-th bank in year t). [11]

Data description is given in Table 1. What is interesting in this table is that the gaps between minimum and maximum are quite large except for the loan interest rate and the dominance ratio of small and medium sized firms. Indeed, the ratio maximum/minimum is 248 for loans, 39 for land price, 126,650 for nonperforming loans, 663 for own capital, 87 for population density, 74 for sales, and 39 for the number of housing starts. The necessity of utilizing the prefectural data stems from the fact that the economic variables are largely diversified among prefectures. The precise definitions of the data are given in Appendix.

3.6 Estimation method

Assuming that the loan markets are in equilibrium, we estimate (5) and (6) simultaneously by

[10] We omitted the Bank of Tokyo because it specialized primarily in international transactions. We also omitted the Shinsei and Aozora Banks because of data restrictions.

[11] Since the information on the number of employees for each branch was made public only until 1998, the data for 1999–2001 were replaced by the values for 1998.

the Generalized Method of Moments (GMM).[12] The endogenous variables are the loan interest rate and the amount of outstanding loans, and instrumental variables are all the variables in equations (5) and (6) except for the endogenous variables.[13] As for the expected value of the loans, we assume perfect foresight, $E_t[L_{it+1}] = L_{it+1}$.[14]

We control the fixed effects by subtracting the individual mean from the equations. We do not employ the random effects model because the distribution of the associated Hausman test statistics in this estimation is not yet well known to us.

4. Results

4.1 Estimates of the supply and demand functions

We estimated equations (5) and (6) using the data of BAD and CAP in the current and former periods. Estimation with the data in the current period suffers from the problem that $SALE$ is not significant and *J*-statistic is significant at the 10% level, which suggests misspecification of the model. Banks probably refer to BAD and CAP in the previous period because they cannot obtain their current data by the time they make decisions on advancing loans.

The results using the data of BAD and CAP in the previous period are presented in the left column of Table 2. As for the results of the supply function, the lead and lag of the loan are significantly positive as expected. Spread between the loan interest rate and the call rate,

[12] We also estimated equations (5) and (6) by the two-stage least squares (2SLS). The results are almost the same as those by GMM. Therefore, we skip reporting them.

[13] If we estimate a dynamic equation with panel data, it will also suffer from the endogeneity problem that lags of the dependent variable are not orthogonal to the error terms. In order to cope with this problem, one may take a difference of equations (5) and (6), and estimate them with instrumental variables chosen to be orthogonal to the error term (Arrelano and Bond, 1991, Anderson and Hsiao, 1981). However, we gave up using this method because the shifts of "differenced" demand and supply curves are hard to interpret.

[14] Some may argue that concomitant forecast errors will contaminate the consistency of the estimates. However, as is shown in the next subsection, the *J*-statistic is not significant at the 10% level, implying that the estimation may not be blurred by the endogeneity problem.

(*SPR*) and land price (*LP*) are significantly positive as expected. While own capital is significantly positive as expected, nonperforming loans are insignificant.[15] The Herfindahl index is insignificant, indicating the market structure-performance hypothesis is not valid. The stock market price index is significantly negative, implying that banks in the bull equity market may increase investment in stocks and may reduce the loans instead. The dominance ratio of city banks is insignificant. The population density is significantly positive as expected.

Looking at the results of the demand function, the lead and lag of the loan are significantly positive, loan interest rate is significantly negative, land price is significantly positive, sales are significantly positive, bond interest rate is significantly positive, the dominance ratio of small and medium sized firms is significantly positive, and population density is significantly positive, all of which take the expected signs. The number of housing starts is insignificant, suggesting that households borrowing to buy houses may not be a substantial part of the loans advanced by private banks. The stock market price index is significantly negative, implying that firms in the bearish equity market may decrease funds raised from stocks and may increase borrowing from banks instead. The *J*-statistic is not significant at the 10% level, supporting this specification.

We estimate the functions deleting the insignificant variables, such as nonperforming loans, the Herfindahl index, the ratio of city banks, and the number of housing starts. The results are shown in the right column of Table 2. They are almost the same as those in the left column. In sum, these results are satisfactory, and the assumption of segmented prefectural loan markets fits the reality fairly well.

4.2 Has the credit crunch occurred?

Based on the estimates shown in the right column of Table 2, we calculate the shift of the supply and demand functions for each year from 1991 to 2001. First, the average of each explanatory

[15] When we drop own capital, nonperforming loans becomes negative but remains insignificant at the 10% level.

variable across all prefectures in 1991 is substituted into the supply and demand functions, and these fitted values (*fitA_supply*, *fitA_demand*) are calculated. Then, the average of loan interest rates across all prefectures in 1991 and the averages of the other variables across all prefectures in 1992 are substituted into the supply and demand functions, and these fitted values (*fitB_supply*, *fitB_demand*) are calculated. The differences between these fitted values (*fitB_supply*－*fitA_supply*, *fitB_demand*－*fitA_demand*) are the magnitude of the supply and demand shifts from 1991 to 1992.

Figure 3, which presents the results of such calculations, reveals two facts. First, the actual value, the equilibrium value that equates loan demand and supply, the supply function, and the demand function all shifted toward the right (i.e., increasing direction) before 1996, while they shifted toward the left (decreasing direction) thereafter. Second, before 1996 the right (i.e., increasing) shifts of the supply function always exceeded those of the demand function, while after 1996 both shifts were roughly of the similar magnitude.

Let us first consider the period prior to 1996. The positive shifts of the actual and equilibrium values imply that the amount of outstanding loans increased every year. Figure 3 indicates, however, that the increase in loans in this period was induced by an increase in supply rather than an increase in demand, implying that the stagnant loan market was caused by the stagnant loan demand. Therefore, we conclude that the credit crunch did not occur in the earlier period.

In the period after 1996, the actual amount of loans decreased and the left shifts of the supply and demand functions are roughly of the same magnitude, implying that the decrease in loans depended on both supply and demand. Compared with the results before 1996, we may say that the credit crunch became more prevalent during the latter period.

In order to measure the magnitude of the credit crunch directly, let us calculate demand shift－supply shift, which we name $CC_{i,t}$. Specifically, denoting the demand and supply

functions as $L^D_{i,t} = \beta_3 r_{it} + \beta X^D_{i,t}$ and $L^S_{i,t} = \alpha_3 r_{it} + \alpha X^S_{i,t}$, the corresponding demand and supply "shifts" can be written as $\Delta L^D_{i,t} \equiv \beta\left(X^D_{i,t} - X^D_{i,t-1}\right)$ and $\Delta L^S_{i,t} \equiv \alpha\left(X^S_{i,t} - X^S_{i,t-1}\right)$ respectively, where $X^D_{i,t}$ and $X^S_{i,t}$ stand for the exogenous explanatory variables in the demand and supply functions. Then, the credit crunch measure $CC_{i,t}$ is defined as $\Delta L^D_{i,t} - \Delta L^S_{i,t} = \beta(X^D_{i,t} - X^D_{i,t-1}) - \alpha(X^S_{i,t} - X^S_{i,t-1})$.

A large and positive $CC_{i,t}$ means that the credit crunch is severer in prefecture *i* in year *t*. In addition, we calculate the factor decomposition, $FD_{i,t}$ as $FD_{i,t} \equiv \beta(X^D_{i,t} - X^D_{i,t-1})$ for each explanatory variable in the demand function and $FD_{i,t} \equiv -\alpha(X^S_{i,t} - X^S_{i,t-1})$ for that in the supply function to evaluate the cause of the credit crunch.[16]

Figure 4, which shows the degree of credit crunch (demand shift − supply shift) and its factor decomposition, reveals three facts. First, the degree of credit crunch grows consistently from 1992 to 2000, implying that the credit crunch became severer in the late 90s.[17] Second, the credit crunch was greatly eased in 1995. Third, the call rate factor explains almost the entire portion of the severity of credit crunch before 1996. However, other factors such as stock prices, bond rates, and bank capital became relatively important in the latter period.

These facts are generally consistent with our intuition. As an example, let us take a look at the Diffusion Index of lending attitudes of financial institutions, which is prepared by the Bank of Japan (Figure 5).[18] The figure reveals that the lending attitude became laxer until 1996, and turned sharply to "severer" in 1997, which is consistent with the first fact. The Figure demonstrates the fact that lending attitudes were easiest around 1995, which is consistent with

[16] If an exogenous variable *Z* is included both in the demand and supply functions, then the factor decomposition of this variable becomes $FD_{i,t} \equiv (\beta - \alpha)(Z_{i,t} - Z_{i,t-1})$.

[17] One may alternatively argue that the credit crunch was not the case at all before 1996, except for 1994, but it might have been thereafter.

[18] The Diffusion Index is defined as the ratio of the firms considering that the lending attitude becomes severer — the ratio of the firms considering that lending attitude becomes laxer.

the second fact.

Let us take a closer look at the factor decomposition. In Table 3, we present the average of the factor decomposition across all prefectures during the periods 1992–1996 and 1996–2000, in which the large and positive $CC_{i,t}$ means that the credit crunch is severer in prefecture *i* in year *t*. Among them, the call rate was the largest factor that alleviated the credit crunch. This result reflects the fact that the Bank of Japan lowered the call rate consecutively to ease money throughout the period. The effect, however, became weaker in the latter period because the call rate was lowered to near zero, so that there remained almost no room to fall further.[19] The bond rate was the second largest factor that alleviated the credit crunch by suppressing the loan demands, in which easing of the monetary policy also played a leading role. Another variable that had a large effect on easing the credit crunch was stock prices, which were declining throughout the period. This affected the credit crunch in such a way that a decrease in stock prices boosted both the supply of and the demand for loans. Since the former effect was stronger, it helped to alleviate the credit crunch.

The other variables had a relatively small effect on the credit crunch. Among them, the result of the capital factor is interesting: the negative value of the factor decomposition indicates that bank capital was augmenting throughout the periods and helped to ease the credit crunch, although the contrary is often suggested by the previous studies. The results that the mean difference between the two periods is significantly positive imply that the augmentation of bank capital contributed to easing the credit crunch more in the latter period than in the former.

4.3 The credit crunch was severer in populous and urban prefectures

In order to allow the comparisons of the degree of credit crunch between prefectures, we calculate the rate of shift, $RCC_{i,t}$, dividing $CC_{i,t}$ by the equilibrium value of the loan (the

[19] The Bank of Japan began to adopt a zero-interest-rate policy in February, 1999 and effectively lifted it in July, 2006.

demand-and-supply balancing loan amount) in the previous year. RCC_{it} is then averaged over 1992 to 1996, and 1996 to 2000.

We present the rate of credit crunch, *RCC*, for each prefecture in Figure 6 (1992–1996) and in Figure 7 (1996–2000), which reveal the following four facts. First, *RCC* is negative for any prefecture, suggesting that an expansion in supply (a reduction in demand) outweighed an expansion in demand (a reduction in supply) in 1992–1996 (in 1996–2000) in any prefecture. Second, when we compare the two periods, *RCC* is larger (smaller in negative value) in 1996–2000 than in 1992–1996 for most of the prefectures, which is consistent with our intuition that the credit crunch was severer in the latter period. Third, the prefectures of the top five *RCC*s are Tokyo, Kanagawa, Aichi, Osaka and Fukuoka in either period, all of which have megacities. Meanwhile, the prefectures of the bottom five *RCC*s are Iwate, Tottori, Shimane, Kochi and Miyazaki in the former period (Akita, Yamanashi, Tottori, Shimane and Kochi in the latter period), all of which do not have large cities and are characterized as rural regions. In a word, the credit crunch was severer in populated areas.[20] Fourth, most of the prefectures with larger (smaller) *RCC*s in the earlier period also have larger (smaller) *RCC*s in the latter period. Indeed, the correlation between the *RCC*s in both periods is quite high.

In order to confirm the third fact, we picked up the five largest and five smallest *RCC* prefectures and examined their characteristics. In Table 4, we present the mean of population, population density, GDP, per capita GDP, sales, per capita sales, the dominance ratio of the number of branches of city banks to that of all types of banks, and the SME ratio for the top five and bottom five prefectures in 1992–1996 and in 1996–2000.

In 1992–1996 (the upper panel of Table 4), the mean of the population for the top five prefectures is 8.09×10^6 and that for the bottom five prefectures is 9.59×10^5 respectively. As is shown by the mean difference test in the rightmost column, the former is significantly larger than the latter. Similarly, the means of population density, GDP, per capita GDP, sales, per capita

[20] Actual outstanding loans also decreased in the populated prefectures like Tokyo, Aichi and Osaka.

sales, and the dominance ratio of city banks for the top five prefectures are significantly larger than those for the bottom five prefectures. The mean of the dominance ratio of small and medium sized firms, SME, is significantly smaller for the top five prefectures than that for the bottom five prefectures. In sum, the top five prefectures are characterized by larger population, GDP, sales, and city bank branches, so that we call them "populous prefectures" hereafter.[21]

4.4 Why were "populous prefectures" hit by credit crunch?

In the previous subsection, we found that the credit crunch was severer in the prefectures that have megacities than in others. Why were "populous prefectures" hit by the credit crunch? To elucidate the possible causes, we calculate the factor decompositions for the top five and bottom five prefectures, which are presented in Table 5.[22] To highlight the characteristics of the two groups, we test the difference of the mean of the factor decomposition, which are shown in the right hand columns of the table.

Let us take a look at the results of the mean difference in the table. The value of capital factors is significantly positive in the earlier period, which indicates that bank capital was an important element that intensified the credit crunch in "populous prefectures" in comparison with "the bottom five prefectures." In the earlier period, another important element were SME factors, even if it is not significant. In the latter period, SME factors became significant and were the largest element, while capital factors were the second largest. Population density affected similarly, but its effect became much smaller.

Thus, change in bank capital and dominance ratio of SME was the principal cause of the intensified credit crunch in "populous prefectures" throughout both the periods. However, its mechanism was different. The first column in the upper panel shows that the bank capital factor

[21] We also examined whether populous and urban prefectures tend to decrease the actual amount of loans. The results are just the same as those of *RCC*s.

[22] Here, we present only the results of the factor decompositions for the prefecture-specific variables, because those for the other variables, such as the call rate, are identical to every prefecture, so that their factor decompositions will become also identical.

had a significant positive sign, implying that it had decreased in “populous prefectures” during the earlier period. In the latter period, however, bank capital of “populous prefectures” became negative, which means that bank capital in the populous prefectures was augmented possibly due to the injection of public funds. That the mean difference was positive implies that the bank capital in “the bottom five prefectures” was augmented more strongly than the populous prefectures during the latter period.

As is shown in Table 2, a larger SME ratio expanded loan demand, leading to a deterioration of the credit crunch. In the latter period, SME factors took on a large negative value for “the bottom five prefectures,” which indicates that SME had decreased sharply for the bottom five prefectures during the latter period, while it was almost unchanged in “the populous prefectures.” This is the reason why the SME ratio became an important element in the latter period.

In sum, variations in the intensity of the credit crunch among prefectures came from discrepancies in the health of the local economies, which is represented by the capital of banks as well as by the SME ratio, which stands for the profitability of firms in the prefecture.

5. Conclusions

In this paper we have analyzed whether the supply side played a crucial role in causing stagnant and declining outstanding loans in Japan in the 1990s. In other words, this paper aims to make clear whether a credit crunch actually occurred in the Japanese loan market. To this end, we calculate the magnitude of the shift of the supply and demand functions, provided that the loan market was in equilibrium. If the supply function shifted towards the left more than the demand function, borrowers would have faced a strict attitude on the part of banks, which is in effect a credit crunch. Under the assumption that the Japanese loan markets are segmented by prefecture, we estimated the supply and demand functions using prefectural panel data from 1990 to 2001.

The estimation results reveal that until 1996 the supply function shifted toward the right more than the demand function, indicating that stagnant loans in this period cannot be explained by the supply side. However, after 1996, when the loan amount decreased, the loan supply shifted leftward as much as the loan demand, implying that the contraction of supply contributed partly to the decrease in loans.

Closer examination reveals the salient characteristics of those prefectures that suffered from a severer credit crunch. First, the degree of the credit crunch was severer in the urban and populous prefectures. Second, the call rate and the bond rate, which were declining because of the money easing policy, played a leading role in alleviating the credit crunch throughout the period.

These results suggest the following lessons. First, it is important to evaluate how much of the loan contraction comes from the bank side. The role of supply side is often overemphasized, as was the case in Japan. Our analysis revealed that the demand side played an equal or greater role, even in the historical financial crisis in Japan during the period 1997–2000. If the contraction is mainly due to the lack of demand, countermeasures on the banking sector may not achieve the expected recovery. For example, according to an exercise conducted in 1998 and 1999 to evaluate the effect on bank lending of the injection of public funds, the injection increased outstanding loans by only a couple of percentage points of the actual decrease of −142.31 and −173.53 billion yen respectively.[23]

Second, we demonstrated that the degree of the credit crunch was not uniform in Japan, but differed markedly among regions. This suggests that measures such as traditional monetary policy that influenced all regions uniformly were inadequate. Region-specific policies are therefore called for.

[23] The effect of the injection should be smaller than these estimates, if we consider the effect of financing the injection fund from a tax increase. Ishikawa (2004) simulated his general equilibrium model and found that the injection resulted in a decrease rather than an increase in the short run.

References

Anderson, T. W. and C. Hsiao (1981), "Estimation of Dynamic Models with Error Components," *Review of Economic Studies,* Vol. 58, pp. 277-297.

Arrelano, M. and S. R. Bond (1991), "Some Tests of Specification for Panel Data: Monte Carlo Evidence and an application to employment equations," *Journal of the American Statistical Association*, Vol. 74, pp. 427-431.

Berglof E. and G. Roland (1995), "Bank Restructuring and Soft Budget Constraints in Financial Transition," *Journal of the Japanese and International Economies*, Vol. 9, pp. 354-375.

Berglof E. and G. Roland (1997), "Soft Budget Constraints and Credit Crunches in Financial Transition," *European Economic Review*, Vol. 41, pp. 807-817.

Elyasiani, E., K. Kopecky and D. Hoose (1995), "Costs of Adjustment, Portfolio Separation, and the Dynamic Behavior of Bank Loans and Deposits," *Journal of Money, Credit and Banking,* Vol. 27(4-1), pp. 955-974.

Fair, R. C. and D. M. Jaffee (1972), "Methods of Estimation for Markets in Disequilibrium," *Econometrica*, Vol. 40, pp. 497-514.

Fase, M. M. G. (1995), "The Demand for Commercial Bank Loans and the Lending Rate," *European Economic Review*, Vol. 39, pp. 99-115.

Hausman, J. A. (1978), "Specification Tests in Econometrics," *Econometrica*, Vol. 46, pp. 1251-1272.

Honda, Y. , H. Kawara and H. Ohara (1996), "Nihon ni okeru Kashishiburi (Credit Crunch in Japan)," *Yusei Kenkyu Review* (Posts and Telecommunications Policy Review), No. 7, pp. 157-185.

Horie, Y. (2001), *Ginko Kashidashi no Keizai Bunseki* (An Economic Analysis of the Bank Lending in Japan), University of Tokyo Press.

Hsiao, C. (2003), *Analysis of Panel Data* (2nd Edition), Oxford University Press.

Ishikawa, D. (2004), "Tax-Financed Public Funds Injection into Banks and its Welfare Implications," *Osaka Economic Papers*, Vol. 54, No. 2, pp. 106-121.

Ishikawa, D. (2005), "Ginko Bumon no Zeijyakusei to Kashidashi Koudou --- Dainamikku Moderu ni yoru Bunseki (Has Damaged Balance Sheet of the Japanese Banking Sector Affected its Lending Activity? --- A Dynamic Optimization Approach)," *Gendai Finance*, No. 17, pp. 47-62.

Ito, T. and Y. N. Sasaki (2002), "Impacts of the Basle Capital Standard on Japanese Banks' Behavior," *Journal of the Japanese and International Economics*, Vol. 16, No. 3, pp.

372-397.

Jaffee, D. M. and T. Russell (1976), "Imperfect Information, Uncertainty and Credit Rationing," *Quarterly Journal of Economics*, Vol. 110, pp. 651-666.

Kano, M. and Y. Tsutsui (2003), "Geographical Segmentation in Japanese Bank Loan Markets," *Regional Science and Urban Economics*, Vol. 33, No. 2, pp. 157-154.

Me'litz, J. and M. Pardue (1973), "The Demand and Supply of Commercial Bank Loans," *Journal of Money, Credit and Banking*, Vol. 5, pp. 669-692.

Ogawa, K. and S. Kitasaka (2000), "Bank Lending in Japan: Its Determinants and Macroeconomic Implications," in Hoshi, T. and H. P. Patrick (eds.), *Crisis and Change in the Japanese Financial System* (Kluwer Academic Publishers), pp. 159-199.

Ogawa, K. and K. Suzuki (2000), "Demand for Bank Loans and Investment under Borrowing Constraints: A Panel Study of Japanese Firm Data," *Journal of the Japanese and International Economics*, Vol. 14, pp. 1-21.

Sasaki, Y. (2000), "Jiko Shihon Hiritsu Kisei to Furyo Saiken no Ginko Kashidashi e no Eikyo (Impact of the BIS Regulation and Bad Loans on Banks' Loan Provision)," in Hirofumi Uzawa and Masaharu Hanazaki, eds., *Kin'yu Shisutemu no Keizaigaku—Shakaiteki Kyotsu Shihon no Shiten kara* (Economics of Financial Systems: From the Perspective of Social Overhead Capital), University of Tokyo Press, pp. 129-148.

Stiglitz, J. E. and A. Weiss (1981), "Credit Rationing in Markets with Imperfect Information," *American Economic Review*, 393-410.

Takenaka, H. (1983) "Shikin Furo no Henka to Kinrikino, (A Change in the Flow of Funds and Function of the Interest Rate), *Keizai-seminar*, March, pp. 38-45.

Tsuru, K. (2001), "The Choice of Lending Patterns by Japanese Banks during the 1980s and 1990s: The Causes and Consequences of a Real Estate Boom," IMES Discussion Paper No. 2001-E-8, the Bank of Japan.

Tsutsui, Y. (1982) "Waga Kuni no Ginko Kashidashi Shijo ha Kinko Siteiruka? (Is the Japanese Bank Loan Market in Equilibrium? An Empirical Study)," *Economic Studies Quarterly*, Vol. 33, pp. 38-54,.

Tsutsui, Y. (2005) *Kinyugyo niokeru Kyoso to Koritsusei*, (*Competition and Efficiency in the Japanese Banking Industry*), Toyokeizai-shiposha.

Woo, D. (1999), "In Search of "Credit Crunch": Supply Factors behind the Credit Slowdown in Japan," IMF Working Paper WP/99/03.

Yoshikawa, H., K. Ezaki and T. Ike (1994), "Chushou Kigyou ni taisuru Ginkou niyoru Kashishiburi ni tsuite (On the Japanese Banks' Reluctance to Lend to Small and Medium-Sized Enterprises)," *Keizai Bunseki*, pp. 1-43.

Appendix: The precise definitions of the data

Bank Loans Outstanding: "Deposits, Loans and Discounts Outstanding of Domestically Licensed Banks by Prefecture (at the end of the fiscal year)," Source: Economic Statistics by Prefecture, Bank of Japan.

Land Prices: "Land Price of Residential District (average, unit is 100 yen/m^2)," Source: Land Price Survey by Prefecture, Ministry of Land, Infrastructure and Transport.

Call Rates: "Unsecured Overnight Call Rate (monthly average balance)," Source: Financial and Economic Statistics Monthly, Bank of Japan.

Shipment of Products: "Statistics by Prefecture, Shipment of Products (employees over 4 people, all manufacturing industries, and calendar year)," Source: Industrial Statistics (Manufacturing Industry), Ministry of Economic, Trade and Industry.

Housing Starts: "The Number of Housing Starts, Classified by Funds and Purposes (houses funded by private sector, owned house)," Source: Statistical Report on Execution of Construction Work, Ministry of Land, Infrastructure and Transport.

Bond Rates: "Subscriber's Yield of 10-year Government Bond (annual average)," Source: Home Page of Bank of Japan.

Stock market price index: "Nikkei Average of 225 Selected Issues in the Tokyo Stock Exchange (at the end of the fiscal year, monthly average), Source: Home Page of Tokyo Stock Exchange.

The number of branches of city banks, regional banks, second regional banks: "The number of branches of city banks, regional banks, second regional banks," Source: Financial Journal Monthly, Extra Edition (in Japanese, *Gekkan Kin-yu Journal, Zoukan Gou*), The Japan Financial News Co., Ltd.

Dominance ratio of city banks of prefecture i at t-th year is calculated as "(the number of branches of city banks of prefecture i at t-th year) / (the number of branches of city banks, regional banks, and second regional banks of prefecture i at t-th year)."

Population: "Population by Prefectures, with intercensal adjustment (as of October 1 of each year)," Source: Population Census, Ministry of Internal Affairs and Communications.

Area of prefecture: "Area by Prefectures (as of October 1 of each year, in square kilometers)," Source: Area Survey, Geographical Survey Institute, Ministry of Land, Infrastructure and Transport.

Population Density of prefecture i at t-th year is calculated as "(population of prefecture i at t-th year) / (area of prefecture i at t-th year in square kilometers)."

The number of employees of small and medium sized firms: "Number of employees, Statistics Tables by Prefecture (establishments with 4 or more employees)," Source: Industrial Statistics (Manufacturing Industry), Ministry of Economic, Trade and Industry.

Dominance ratio of small and medium sized firms of prefecture i at t-th year is calculated as "(the total number of employees of the firms of 4 to 99 staffs in the prefecture i at t-th year) / (the total number of employees of the firms of more than 4 staffs in the prefecture i at t-th year)."

Nonperforming loans: "Allowances for Loan Losses," Source: Nikkei Needs Bank data.

Own capital: "the sum of capital stock, payment for new shares, capital reserve, earned surplus reserve, voluntary reserve, and unappropriated profit," Source: Nikkei Needs Bank data.

Loan interest rate of prefecture i at t-th year is calculated as "(loan interest revenue of prefecture i at t-th year)/ (amount of outstanding loan of prefecture i at the end of t-1-th year)," Source: Nikkei Needs Bank data.

Table 1. Descriptive Statistics

(variables)	average	standard deviation	minimum	maximum
L	9.91×10^{3}	2.90×10^{4}	8.38×10^{2}	2.09×10^{5}
SPR	2.09	0.920	−1.68	3.80
RL	4.02	1.89	1.65	8.56
RC	1.93	2.53	2.00×10^{-3}	8.28
RB	3.24	1.80	0.972	6.80
LP	8.68	9.42	2.23	8.59
SP	1.80×10^{4}	3.79×10^{3}	1.15×10^{4}	2.65×10^{4}
CITYBANKS	0.0958	0.159	0.00435	0.736
DENSITY	6.52×10^{2}	1.12×10^{3}	67.7	5.90×10^{3}
HI	0.405	0.172	0.0747	0.802
BAD	78.6	3.04×10^{2}	0.323	4.09×10^{3}
CAP	6.45×10^{2}	1.70×10^{3}	19.8	1.31×10^{4}
SALE	6.61×10^{3}	7.11×10^{3}	5.27×10^{2}	3.88×10^{4}
HOUSE	4.66×10^{3}	4.56×10^{3}	7.15×10^{2}	2.80×10^{4}
SME	0.559	0.0789	0.356	0.778

Notes : *L* is amount of outstanding loans (in billion yen), *SPR* is spread between the loan interest rate and the call rate (in percent), *RL* is the loan interest rate (in percent), *RC* is the call rate (in percent), *RB* is the bond interest rate (subscriber's yield of 10-year government bond, in percent), *LP* is the land price (per unit square meter, in ten thousand yen), *SP* is the stock market price index (in yen), *CITYBANKS* is the dominance ratio of city banks, *DENSITY* is the population density (persons in square kilometers), *HI* is the Herfindahl index, *BAD* is the amount of nonperforming loans (in billion yen), *CAP* is the amount of own capital (in billion yen), *SALE* is the amount of sales (in billion yen), *HOUSE* is the number of housing starts, and *SME* is the dominance ratio of small and medium sized firms. The sample period is from 1990 to 2001, and the number of prefectures is 47. The number of observations is 564.

Table 2. Estimation Results of the loan supply and demand functions (GMM)

L(+1)	+	0.488^{***} (15.1)	0.489^{***} (13.6)
L(−1)	+	0.476^{***} (11.6)	0.481^{***} (11.1)
SPR	+	$4.96\times10^{2**}$ (2.52)	$4.27\times10^{2**}$ (2.36)
LP	+	2.07^{**} (2.33)	1.84^{**} (2.00)
BAD(−1)	−	0.0109 (0.871)	
CAP(−1)	+	0.0520^{***} (4.27)	0.0400^{***} (3.46)
HI	−	3.76×10^{2} (0.771)	
SP	?	-0.102^{***} (−3.75)	-0.0895^{***} (−3.10)
CITY BANKS	?	9.72×10^{2} (1.28)	
DENSITY	+	22.1^{**} (2.01)	20.5^{*} (1.73)
L(+1)	+	0.486^{***} (14.6)	0.488^{***} (13.4)
L(−1)	+	0.475^{***} (11.3)	0.480^{***} (10.9)
RL	−	$-1.50\times10^{2***}$ (−2.72)	$-1.36\times10^{2**}$ (−2.50)
LP	+	2.08^{**} (2.30)	1.88^{**} (2.02)
SALE	+	$5.60\times10^{-3**}$ (2.24)	$5.53\times10^{-3**}$ (2.34)
HOUSE	+	-2.86×10^{-3} (−0.331)	
SP	?	-0.0683^{***} (−2.594)	-0.0613^{**} (−2.19)
RB	+	57.0^{**} (2.31)	56.0^{**} (2.30)
SME	+	$2.95\times10^{3*}$ (1.72)	2.42×10^{3} (1.56)
DENSITY	+	22.2^{**} (1.97)	21.1^{*} (1.72)
J-Statistics		8.04 [0.430]	6.43 [0.377]

Notes: See notes to Table 1 for definition of the variables. The dependent variable is amount of outstanding loans. *L*(+1) and *L*(−1) denote a one-year lead and lag of the amount of outstanding loans. *BAD*(−1) and *CAP*(−1) denote a one-year lag of amount of nonperforming loans and own capital. The loan demand and supply equations are estimated simultaneously by the GMM, in which we control fixed effects by subtracting individual mean from the equations. Endogenous variables are the amount of outstanding loans and loan interest rate. Instrumental variables are all of the variables in the loan demand and supply equations except for the endogenous variables. Number in parentheses ( ) are *t*-ratios. The superscripts ***, **, and * mean that the variables are significant at the 1%(***), 5%(**), and 10%(*) level. *J*-Statistics tests the null hypothesis that over-identified restriction is satisfied in the GMM estimation. *p*-values are shown in brackets [ ]. The sample period is from 1991 to 2000, and the number of prefectures is 47. The number of observations is 470.

Table 3. Factor decompositions of the credit crunch measure (average of all prefectures)

variables	average of all prefectures						
	1992–1996		1996–2000		mean difference (Welch) test		
	(a) mean	s.d.	(b) mean	s.d.	(a) - (b)	*T*	*d.f.*
credit crunch measure CC_{it}	-1.537^{***}	1.910	-0.255^{***}	0.480	-1.282^{***}	−10.00	264
call rate factors	-1.372^{***}	1.790	-0.081^{***}	0.241	-1.292^{***}	−10.96	242
land price factors	$-1.64\times10^{-3}{}^{***}$	6.12×10^{-3}	$-1.14\times10^{-3}{}^{***}$	2.32×10^{-3}	-5.00×10^{-4}	−1.18	300
sales factors	$-5.05\times10^{-3}{}^{***}$	0.026	2.16×10^{-3}	0.028	$-7.21\times10^{-3}{}^{***}$	−2.89	465
capital factors	$-2.33\times10^{-3}{}^{***}$	0.015	$-7.49\times10^{-3}{}^{***}$	0.036	$5.17\times10^{-3}{}^{**}$	2.01	317
stock price factors	-0.039^{***}	0.294	-0.122^{***}	0.344	0.083^{***}	2.81	457
bond rate factors	-0.106^{***}	0.211	-0.039^{***}	0.120	-0.067^{***}	−4.26	370
SME factors	-0.012^{***}	0.066	-0.020^{***}	0.077	8.37×10^{-3}	1.27	457
population density factors	$1.17\times10^{-3}{}^{***}$	1.93×10^{-3}	$3.80\times10^{-4}{}^{***}$	1.80×10^{-3}	$7.86\times10^{-4}{}^{***}$	4.57	466

Notes: The credit crunch measure CC_{it} is defined as "demand shift − supply shift," or $CC_{it} = \beta (X^{D}_{it} - X^{D}_{it-1}) - \alpha (X^{S}_{it} - X^{S}_{it-1})$, where X^{D}_{it} and X^{S}_{it} are the exogenous explanatory variables in the demand and supply functions, α and β are the corresponding coefficients. Large and positive CC_{it} means that the credit crunch is severer in prefecture *i* in year *t*. The factor decompositions of the the credit crunch measure, for example, correspond to $\beta (X^{D}_{it} - X^{D}_{it-1})$ or $\alpha (X^{S}_{it} - X^{S}_{it-1})$. The null hypothesis of the mean difference (Welch) test is that the mean difference (a)-(b) is zero. The statistics *T* is defined as $(\mu_A - \mu_B)\Big/\sqrt{s_A{}^2/n_A + s_B{}^2/n_B}$, where μ_A and μ_B are the sample means of group A and B, s_A and s_B are the sample standard deviations, n_A and n_B are the number of observations, respectively. Under the null, the statistics *T* follows *t*-distribution with degrees of freedom *d.f.*. Also refer to Notes in Table 2.

Table 4. Characteristics of prefectures whose credit crunch measures are top five and bottom five

[1992–1996]

variables	top 5 prefectures		bottom 5 prefectures		mean difference (Welch) test		
	(a) mean	s.d.	(b) mean	s.d.	(a) − (b)	*T*	*d.f.*
Credit crunch measures RCC_{it}	-0.164^{***}	0.224	−3.41	3.13	3.25^{***}	5.18	24
population	$8.09\times10^{6***}$	2.35×10^{6}	$9.59\times10^{5***}$	2.98×10^{5}	$7.13\times10^{6***}$	15.06	25
population density	$3.24\times10^{3***}$	1.87×10^{3}	$1.36\times10^{2***}$	33.99	$3.10\times10^{3***}$	8.27	24
GDP	$3.99\times10^{5***}$	2.20×10^{5}	$2.88\times10^{4***}$	8.84×10^{3}	$3.70\times10^{5***}$	8.42	24
per capita GDP	0.046^{***}	0.012	0.030^{***}	2.07×10^{-3}	0.016^{***}	6.67	25
Sales	$2.27\times10^{5***}$	9.34×10^{4}	$1.27\times10^{4***}$	5.27×10^{3}	$2.14\times10^{5***}$	11.43	24
per capita sales	0.029^{***}	0.014	0.013^{***}	3.36×10^{-3}	0.016^{***}	5.52	27
city banks	0.100^{***}	0.064	$1.49\times10^{-3***}$	4.59×10^{-4}	0.098^{***}	7.65	24
SME	0.519^{***}	0.102	0.621^{***}	0.075	-0.102^{***}	−4.03	44

[1996–2000]

variables	top 5 prefectures		bottom 5 prefectures		mean difference (Welch) test		
	(a) mean	s.d.	(b) mean	s.d.	(a) – (b)	*T*	*d.f.*
Credit crunch measures RCC_{it}	−0.020	0.059	−0.578	0.858	0.558^{***}	3.24	24
population	$8.17\times10^{6***}$	2.30×10^{6}	$8.58\times10^{5***}$	1.99×10^{5}	$3.71\times10^{6***}$	15.83	24
population density	$3.26\times10^{3***}$	1.86×10^{3}	$1.46\times10^{2***}$	41.34	$3.12\times10^{3***}$	8.35	24
GDP	$4.14\times10^{5***}$	2.30×10^{5}	$2.84\times10^{4***}$	6.51×10^{3}	$3.85\times10^{5***}$	8.38	24
per capita GDP	0.048^{***}	0.013	0.033^{***}	2.06×10^{-3}	0.014^{***}	5.49	25
sales	$2.11\times10^{5***}$	8.82×10^{4}	$1.41\times10^{4***}$	6.35×10^{3}	$1.97\times10^{5***}$	11.15	24
per capita sales	0.027^{***}	0.013	0.017^{***}	6.80×10^{-3}	0.010^{***}	3.46	36
city banks	0.096^{***}	0.061	$2.27\times10^{-3***}$	1.87×10^{-3}	0.094^{***}	7.71	24
SME	0.523^{***}	0.100	0.622^{***}	0.073	-0.093^{***}	−4.00	44

Notes: The credit crunch measure RCC_{it} is defined as CC_{it} divided the equilibrium value of the loan (demand-and-supply balancing loan amount) in the previous year. Also refer to the Notes to Tables 2 and 3.

Table 5. Factor decompositions of the credit crunch measures
(top five and bottom five prefectures)

[1992–1996]

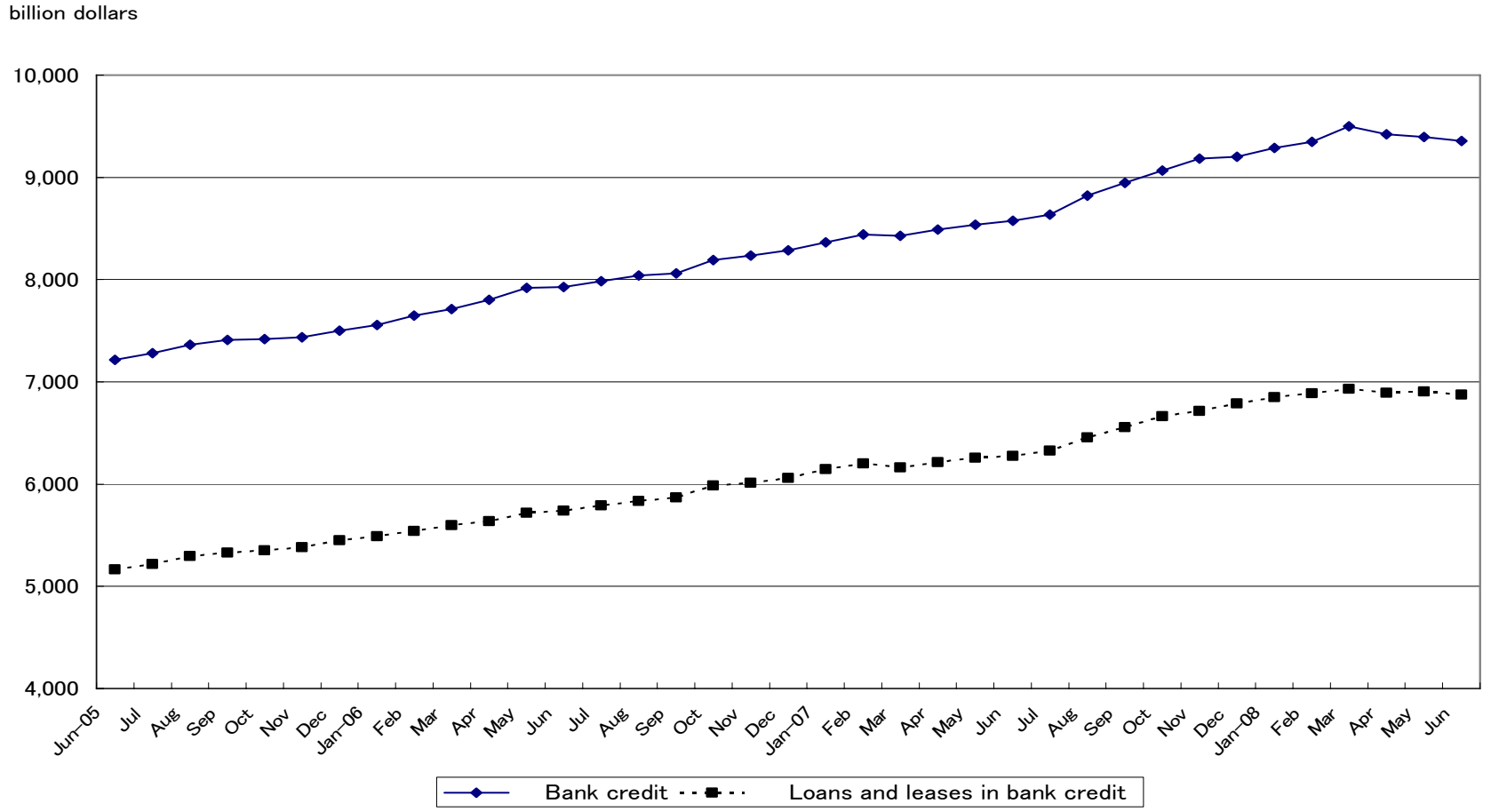
variables	top 5 prefectures		bottom 5 prefectures		mean difference (Welch) test		
	(a) mean	s.d.	(b) mean	s.d.	(a) – (b)	*T*	*d.f.*
credit crunch measures RCC_{it}	-0.164^{***}	0.224	-3.41^{***}	3.13	3.25^{***}	5.18	24
land price factors	$-1.97\times10^{-3***}$	1.99×10^{-3}	$1.40\times10^{-3***}$	2.55×10^{-3}	$-3.37\times10^{-3***}$	−5.20	45
sales factors	$-9.71\times10^{-3***}$	0.021	3.05×10^{-3}	0.014	-0.013^{***}	−2.52	41
Capital factors	6.05×10^{-3}	0.017	$-8.52\times10^{-3***}$	0.016	0.015^{***}	3.07	48
SME factors	-9.08×10^{-4}	4.71×10^{-3}	−0.020	0.124	0.019	0.78	24
population density factors	$1.47\times10^{-3***}$	1.58×10^{-3}	-1.83×10^{-4}	9.41×10^{-4}	$1.65\times10^{-3***}$	4.49	39

[1996–2000]

variables	top 5 prefectures		bottom 5 prefectures		mean difference (Welch) test		
	(a) mean	s.d.	(b) mean	s.d.	(a) – (b)	*T*	*d.f.*
credit crunch measures RCC_{it}	−0.020	0.059	-0.578^{***}	0.858	0.558^{***}	3.24	24
land price factors	$-7.37\times10^{-4***}$	5.84×10^{-4}	-6.35×10^{-4}	3.02×10^{-3}	-1.02×10^{-4}	−0.17	26
sales factors	-3.00×10^{-3}	0.022	5.81×10^{-3}	0.027	-8.81×10^{-3}	−1.27	46
Capital factors	-4.04×10^{-3}	0.044	$-1.47\times10^{-2***}$	0.024	0.011	1.07	37
SME factors	1.63×10^{-3}	6.97×10^{-3}	-0.062^{*}	0.149	0.064^{**}	2.15	24
population density factors	$1.50\times10^{-3***}$	1.51×10^{-3}	-4.09×10^{-4}	1.33×10^{-3}	$1.91\times10^{-3***}$	4.73	47

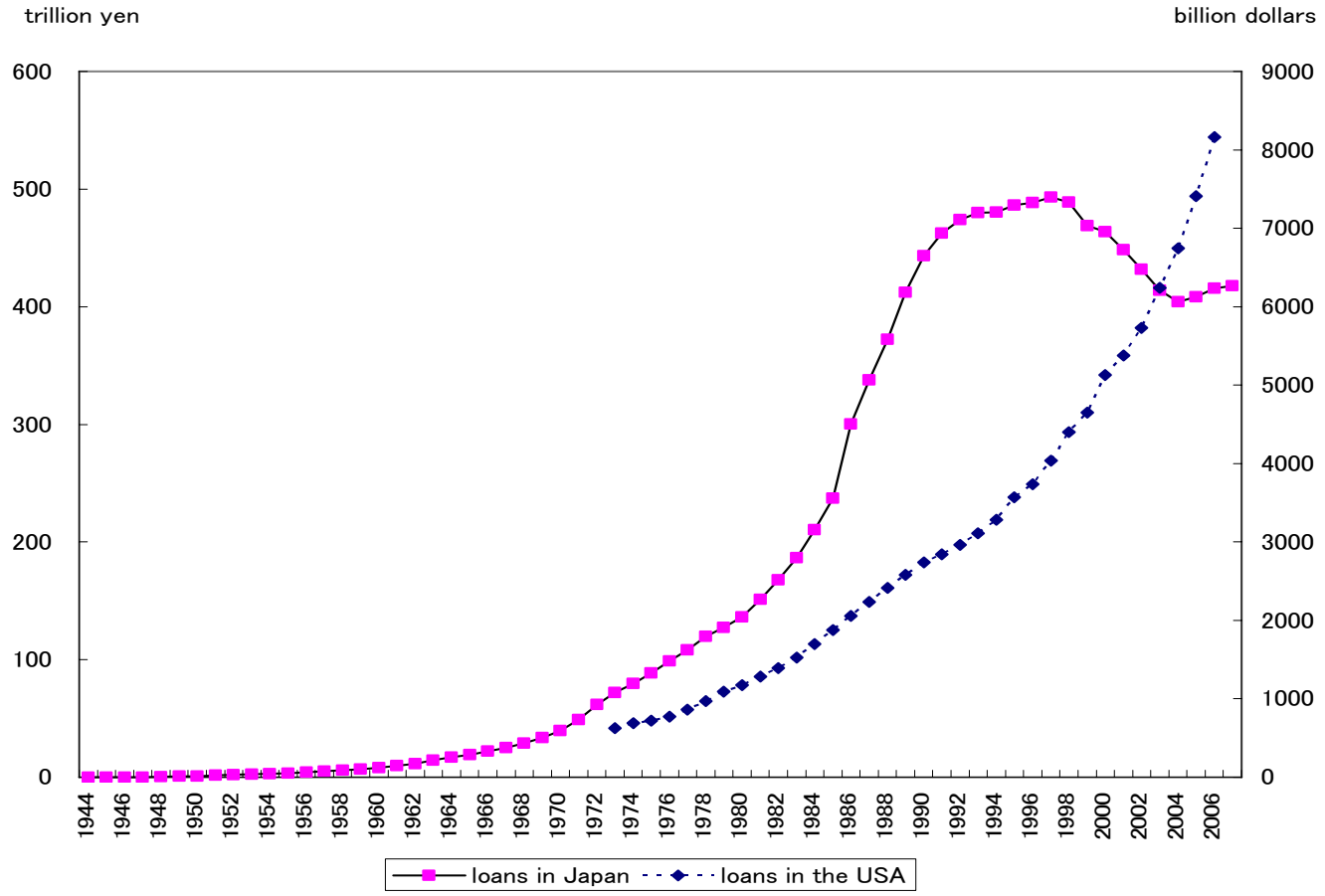
Notes: Refer to the Notes to Tables 2, 3, and 4.

Figure1. Recent decline in amount of loans in the United States due to the subprime loan problem



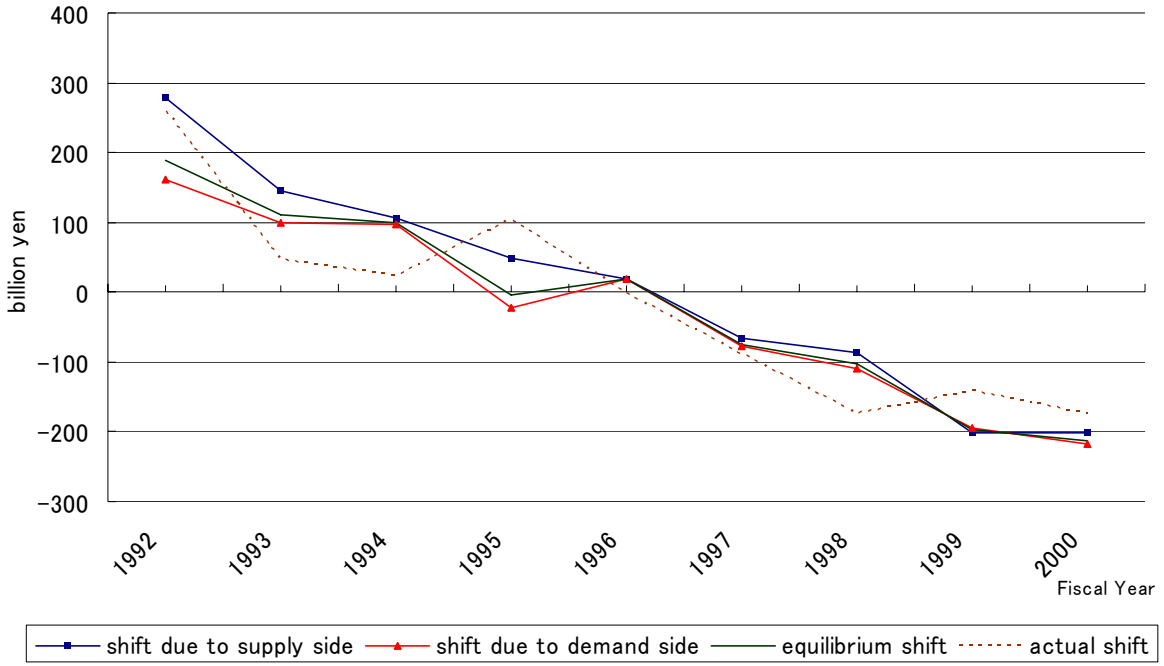
Notes: The data source is the website of The Federal Reserve Board.

Figure 2. Bank credits in Japan and in the United States



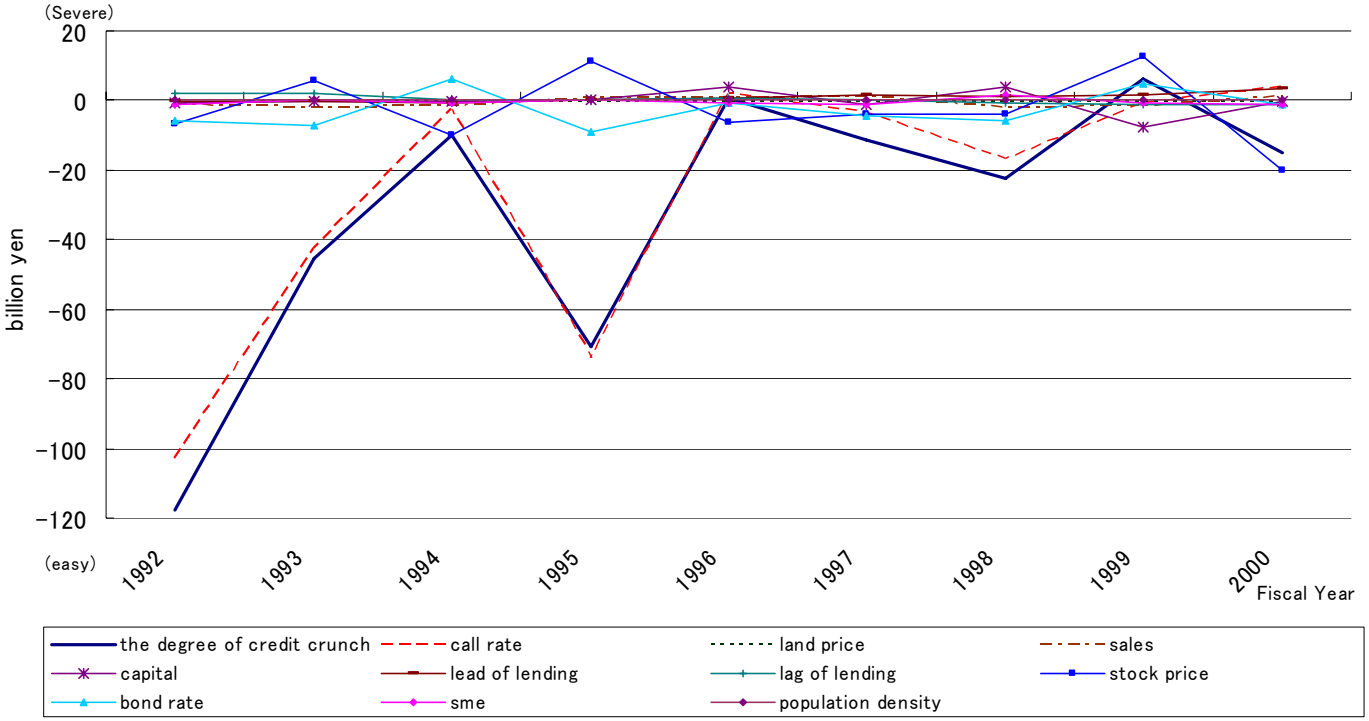
Notes: The data source of bank credit in Japan is from the Financial Statistics Annual, the Bank of Japan. The sample period is from 1944 to 2004. The data source of bank credit in the U.S. is from the Board of Governors of the Federal Reserve System. The sample period is from 1973 to 2003.

Figure 3. Shifts of the loan supply and demand functions



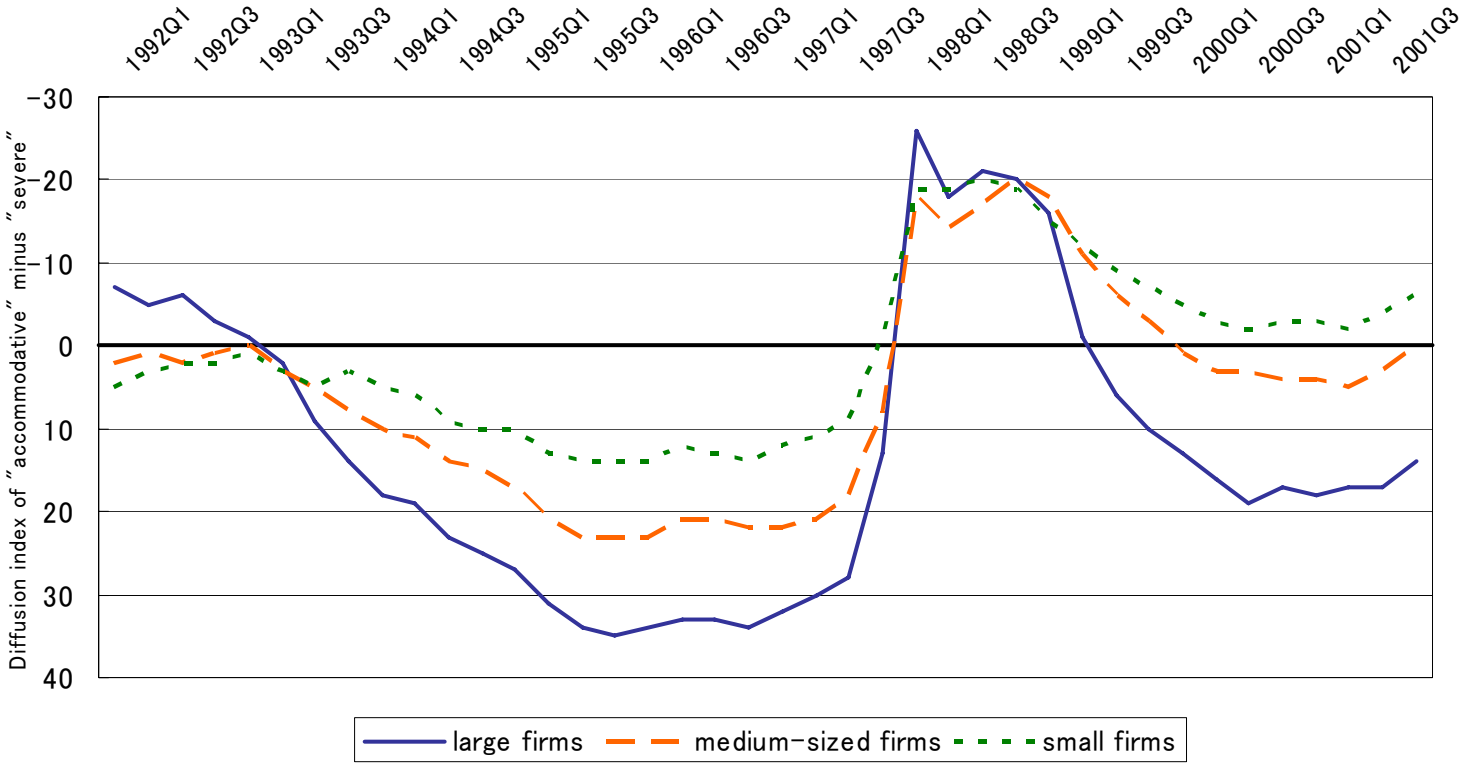
Notes: The shift due to supply and demand side for year *t* is calculated as follows: first, we substitute the prefectural average of each explanatory variable in year *t*-1 and calculate the fitted value of supply of and demand for loans in year *t-1*. Then, substituting the mean of loan interest rate in year *t*-1 and the mean of the other variables in year *t*, we calculate the fitted value in year *t*. The difference between these fitted values is the magnitude of the shifts from year *t*-1 to *t*. The equilibrium shift for year *t* is the difference between the prefectural average of equilibrium loans (supply-demand balancing loans) in year *t* and that in year *t*-1. The actual shift for year *t* is the difference between the prefectural average of outstanding loans in year *t* and that in year *t*-1.

Figure 4. The degree of credit cruch and its factor decompostion



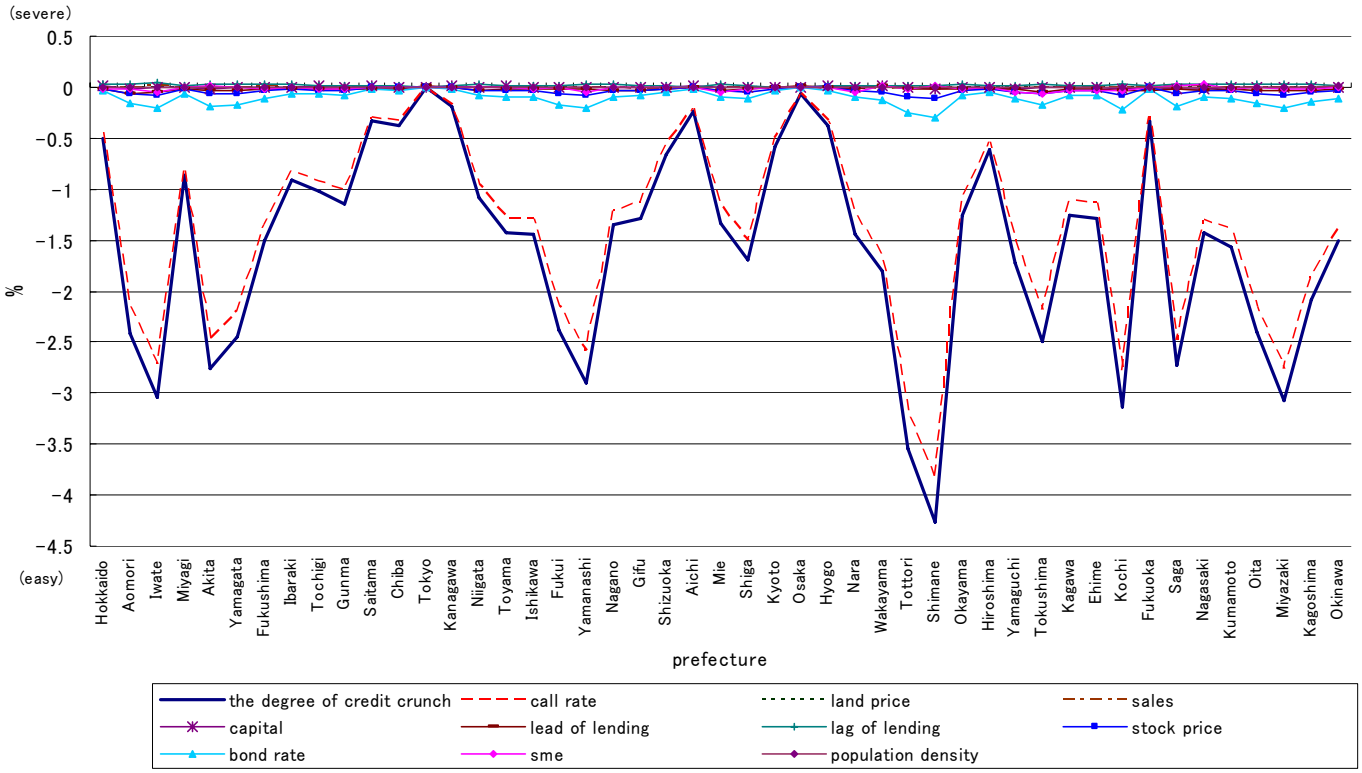
Notes: Refer to Notes to Table 3.

Figure 5. Lending attitude of financial Institutions in Japan



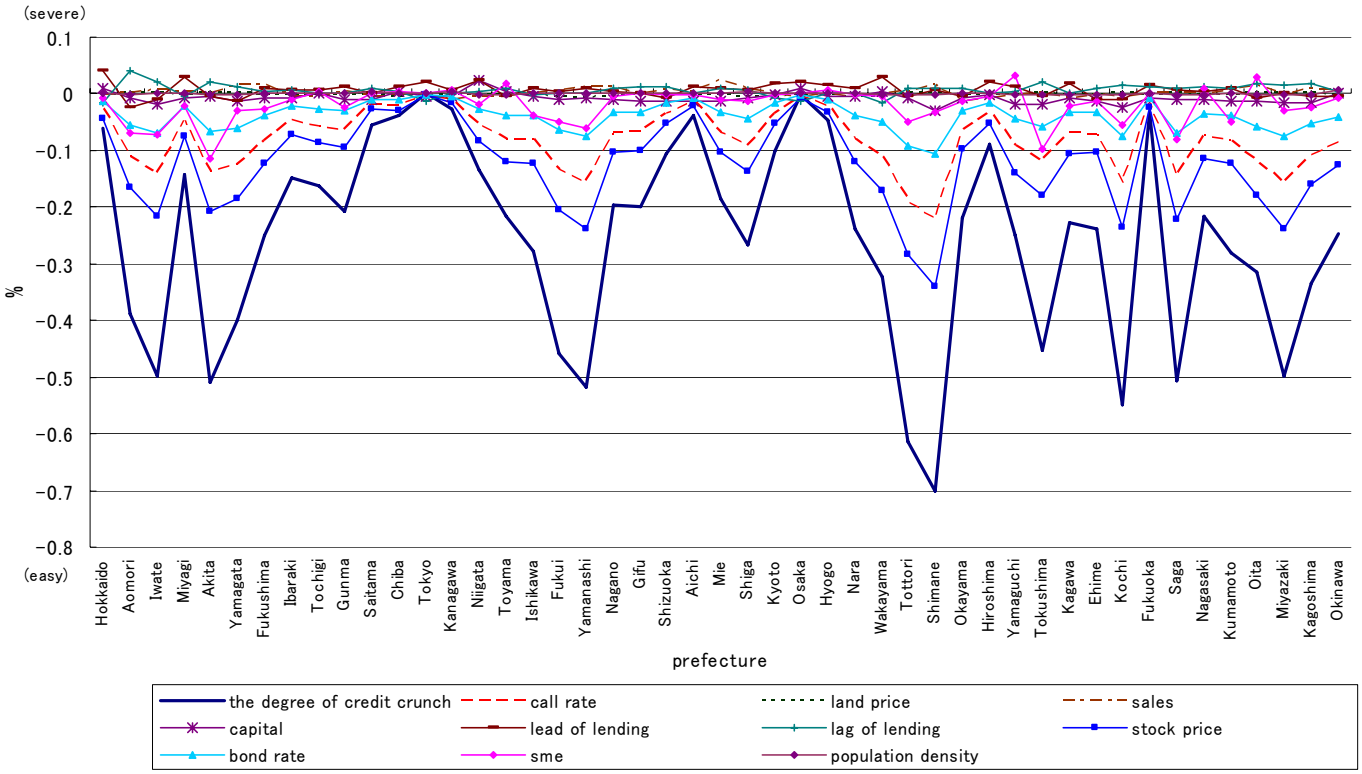
Notes: Data are of all enterprises, all industries, and evaluation of current situation. The data source is the Tankan (Short-term Economic Survey in Japan), the Bank of Japan. The diffusion index is defined as the ratio of the firms considering that lending attitude becomes severer — the ratio of the firms considering that lending attitude becomes laxer. The sample period is from fourth quarter in 1990 to second quarter in 2002.

Figure 6. The degree of credit crunch and its factor decompostion (by prefecture, 92–96 mean)



Notes: Refer to Notes in Tables 3 and 4.

Figure 7. The degree of credit cruch and its factor decompostion (by prefecture, 96–00 mean)



Notes: Refer to the Notes to Tables 3 and 4.