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The Deterioration of Banks' Balance Sheets in Japan: Risk-Taking and Recapitalization

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Abstract

This paper empirically investigates whether the slowdown of Japanese banks' credit supply observed in the early 1990s was caused by deterioration of their equity capital as suggested by the capital crunch hypothesis. The panel data of the major banks shows that the banks with higher capital/equity ratios tended to reduce their credit supply. Thus, the empirical analysis rejects the capital crunch hypothesis. Rather, our test supports the moral hazard hypothesis that an increase in banks' equity capital induces them to take conservative stance toward expansion of their credit supply. We also observe that, after substantial declines in their capital/asset ratios, the Japanese major banks used the subordinated debt to recover their deteriorated capital. Most of the subordinated debts were absorbed by financial and nonfinancial companies closely tied with the issuing banks. The traditional relationships with other firms helped the major banks to recapitalize in the face of increasing bad loans in the early 1990s.

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1. Introduction

Since the so-called "bubble burst" at the beginning of the 1990s, prices of stocks and real estates have remained stagnating in Japan. This stagnation of asset prices deteriorated capital bases of the banking industry in two ways. First, the sharp fall in stock prices from a record high attained at the end of 1989 decreased banks' hidden reserves which are a major component of Tier II capital. Second, the falls in real estate prices increased the amount of non performing loans in the banking system, because banks aggressively increased credit loans related to real estates in expectation of continuous hikes in real estate prices during the 1980s and the early 1990s. The deterioration of banks' equity capital rather abruptly brought fragility of the Japanese banking system to light. How to cope with the fragility is an urgent policy issue in Japan.

We are particularly concerned with an issue whether banks with deteriorated equity capital reduced credit supply, and thereby exacerbating macroeconomic depression that started in Japan immediately after the bubble burst. The prolongation of depression would increase the amount of non-performing loans, which decrease banks' equity capital furthermore. Thus, there may be a sort of vicious circle between deterioration of banks' equity capital and depression. Actually, Bernanke and Lown (1991) and Peek and Rosengren (1995) argue that the decline in banks' equity capital forced U.S. banks to decrease their credit supply and deposit liabilities in the early 1990s. According to their analyses, the BIS capital adequacy regulation was responsible for the decrease in banks' credit responding to declines in equity capital. Thus, they call this phenomenon " capital crunch".[1]

What about Japanese banks? Has the phenomenon of "capital crunch" been observed also in Japan? More generally, how have Japanese banks responded to the deterioration of their equity capital? To give answer to these queries is the purpose of this paper[2].

In section 2 of this paper, we will examine to what extent major 21 banks lost their equity capital since 1990, and how they tried to recover from under-capitalization. We find that the major banks mitigated the extent to which the increasing non performing loans and the large capital losses from securities holdings exhausted their equity capital by issuing subordinated debts. It was mainly by issuing subordinated debts that the major banks at least apparently prevented their equity capital from greatly decreasing despite substantial deterioration of their asset value[3].

According to Peek and Rosengren(1995), the U.S. situation was quite different from the Japan's case. In the United States, it was difficult for banks to increase equity capital by issuing equity related securities, because the deteriorated balance sheets worsened the agency problem associated with asymmetric information. We will investigate why the Japanese banks were able to recapitalize by issuing subordinated debts in this paper.

We will also investigate how Japanese banks adjusted their loan supply responding to changes in equity capital. According to our casual observation, the major banks seemed to slightly decrease their loan supply relative to their total assets. Our theoretical analysis regarding banks' risk-taking under the capital adequacy regulation suggests two possibilities of relation between banks' credit supply and their equity capital, *i.e.*, either credit supply is negatively influenced by the equity capital(the moral hazard hypothesis), or the capital adequacy regulation restraints banks' credit supply so that the banks' equity capital positively influence their credit supply(the capital crunch hypothesis).

In section 4, based on the panel data analysis of the major banks, we obtain the evidence supporting the moral hazard hypothesis that the banks with higher(lower) capital/asset ratios tend to be less(more) active in extending credit supply. Thus, our empirical analyses reject the capital crunch hypothesis. The Japanese banks were inactive in credit supply during the early 1990s not because the BIS capital adequacy regulation forced them to decrease their loan supply, but because increases in equity capital mainly enabled by issuing subordinated debts produced banks' conservatism following the moral hazard hypothesis.

The organization of this paper is as follows: Section 2 provides an overview of the deteriorated equity capital in the Japanese major banks since 1990. Section 3 explains the relationship between banks' risk-taking or credit supply and their equity capital by a simple theoretical model, deriving some refutable hypotheses to be utilized in our empirical analyses. Section 4 statistically examines banks' risk taking behavior and recapitalization based on primitive panel data methods. The primary aim of this section is to obtain statistical results comparable to the U.S. results provided by Bernanke and Lown (1991). Section 5 gives some concluding remarks.

2. Outline of the Deteriorated Balance Sheets of Japanese Banks

Before statistically investigating the relationship between banks' equity capital and their lending behavior (or risk-taking), we examine to what extent the Japanese banks' balance sheets deteriorated during the early 1990s and how the banks coped with the deterioration. In the following discussion, we estimate the actual market value of assets and equity capital held by banks based on officially disclosed information.

2.1 Estimation of banks' equity capital

Under the current accounting rules in Japan, most accounts in banks' balance sheets do not make sense from the theoretical viewpoint. For example, the account "loans" includes non-performing loans that have not yet been written off and the "securities" account records historical book value which substantially deviates from the market value. From the viewpoint of debt-holders, the mark-to-market value of assets relative to the total amount of liabilities is important because it would define the probability of banks' failure. In order to capture the actual situation of banks' balance sheets, we must amend the accounts by considering these discrepancies. We should note, however, that this mark-to-market value does not include the franchise value (or charter value) of the banks as going concerns, which is probably reflected in the market value of banks' stocks. As theoretical analyses assume that the franchise value will essentially affect banks' decisions, we take it into account after explaining the theoretical model in section 3.

Table 1 shows an estimated balance sheet for the integrated major 21 banks (11 city banks, 7 trust banks and 3 long-term credit banks) from March 1990 to September 1995. Data are taken from the Financial Statements of these major 21 banks published semi-annually. Although the information of non-performing loans has not been fully disclosed in Japan, these major banks' non-performing loans have been disclosed most openly, compared with other banks and financial institutions,. This is the reason why we choose them as a sample.

The equity capital of the banks is defined by subtracting their liabilities from the market value of assets. The market value of assets (row(j) in Table 1) is the "total assets account (book value of assets) plus hidden reserves minus officially reported non performing loans. Here, the figure of hidden reserves indicates the excess of market value over the book value of listed securities in banks' portfolios. Then, the market value of banks' equity capital (row(g)) is the market value of assets plus the general purpose provisions for loan losses (with the special foreign reserves), the special provisions for loan losses, the subordinated debts.

The Ministry of Finance does not permit banks to count the special provisions for loan losses as capital for the reason that it is used to cover the charge-off only of actual known losses or of specific loans on which losses have been highly expected. However, the part of the non performing loans covered by this account should be deleted from the gross amount to estimate net amount of non performing loans. Therefore, we include this special provision into the estimated equity capital.

The subordinated debts are included in banks' equity capital because, according to the BIS rules, these debts with maturity of longer than five years are counted as capital of Tier II up to 50% of Tier I capital when they are non-perpetual and up to 100% when perpetual. As will be discussed below, the subordinated debt played an important role in the process of recapitalization of the major banks.

Non performing loans are the sum of loans to bankrupted borrowers and loans past due over six months, both of which have been officially disclosed for the major 21 banks since March 1993. When calculating the estimated equity, we assume the value of non performing loans to be nil. This assumption may seem to exaggerate the true losses on loans, because banks would be able to collect a part of their book value. The official figure of non performing loans, however, exclude de facto non performing one such as rescue loans interest rates of which are reduced to below the official discount rate. Therefore, we consider that our figures do not necessarily overestimate the true value of non performing loans.[4]

The equity/asset ratio (row(k)) is defined as the estimated equity (row(g)) divided by the estimated asset (row(j)). This measure of capital/asset ratio is different from the BIS capital ratio in several points. In particular, (i) it is divided not by risk asset, but by the estimated market value of assets, (ii) 100% of hidden reserves is included in our estimated capital whereas the BIS capital contains only 45% of the hidden reserves. (iii) the special account for loan depreciation is included in our estimated capital, (iv) non performing loans are extracted from both capital and assets, and (v) some of specific restrictions forced by the BIS regulation are ignored in our estimation. The empirical analyses in section 4 will show that the capital/asset ratio estimated in this way affects banks' credit supply better than the BIS capital ratio.

2.2 Some observations on the estimated aggregate equity capital

Figure 1 compares compositions of the major 21 banks' equity capital between March 1990 and September 1995. According to this figure, while the book value of equity (row (a) of Table 1) did not greatly change, the estimated market value of equity declined by more than a third from ¥65.8 trillion in March 1990 to ¥41.2 trillion in September 1995. This decrease in market value of equity capital was caused mainly by a decrease in hidden reserves (row (b)) which fell from ¥43.9 trillion to ¥12.8 trillion (less than 30% of ¥43,9 trillion) reflecting the sharp decline in overall stock prices since the beginning of the 1990s. Another cause for the decrease in the market value of the banks' equity is the non-performing loans. The non-performing loans account for ¥12.0 trillion of the ¥24.6 trillion decline in the equity capital between March 1990 and September 1995 (row (f)). It is noteworthy that, as far as the officially disclosed figures are concerned, the non performing loans were less important for the deterioration of banks' equity capital than the decline in hidden reserves.

A substantial part of the reduction in equity capital was offset by the special provisions for loan losses (row (d)) and subordinated loans and debts (row (e)). In particular, the subordinated debts were quite important. The accumulated amount of subordinated debts was ¥12.3 trillion as of September 1995, which offset 40% of the decrease in hidden reserves. Were it not for issuing subordinated debts, the major banks' equity capital would have decreased by ¥37.2 trillion from March 1990 to September 1995. According to Table 2, which shows compositions of the aggregate capital/asset ratio, the estimated equity to asset ratio declined from 8.99% in March 1990 to 6.99% in September 1995.[5] If the major banks had not issued subordinated debts at all, the ratio would have fallen much more drastically to 5.02%. Thus, the subordinated debts mitigated the severity of under-capitalization for the major banks in the early 1990s.

The MOF allowed banks to issue subordinated loans in June 1990 and to issue perpetual subordinated debt through their foreign subsidiaries in August 1992. The subsidiaries have supplied the funds raised by issuing subordinated debts to their parent banks in the form of perpetual subordinated loans. Obviously, the purpose of this policy was to help banks to clear the BIS capital adequacy requirement. As Scott and Iwahara (1994) describe in great detail, Japanese banks have not been able to take as much advantage of the Basle rules permitting the use of preferred stocks and subordinated debts as can U.S. banks. According to their estimation of capital sources (Tier I and II) for the ten largest U.S. and Japanese banks as of 1992, 14.3% of the U.S. banks' Tier I capital depended on the perpetual preferred stock and 52.1% of their Tier II capital came from the subordinated debts, whereas the Japanese banks did not issue the perpetual stock at all as of 1992, and 46.3% of their Tier II depended on the subordinated debts. Nevertheless, our investigation suggests that Japanese major banks utilized the subordinated debt to a great extent to recover their equity capital in the early 1990s. The empirical analysis in section 4 will confirm the importance of the subordinated debt in the process of Japanese banks' recapitalization.

Table 1 indicates that the major banks did not reduce their loan assets both in terms of book value (row (h)) and in terms of market value(subtracting non performing loans from the book value) during the early 1990s, while their total asset substantially decreased responding to the deterioration of equity capital. Figure 2 presents time series of both the growth rate of loans (denoted by LCH) and the ratio of loan increase to asset (LCHA) compared with the estimated equity to asset ratio (EEQR) and the BIS capital ratio (BIS). Both LCH and LCHA show mild seasonal fluctuations with faintly declining trends until March 1995, while both EEQR and BIS fluctuated without visible trends. Thus, there seems to be no significant correlation between changes in the banks' loan asset and changes in their capital-asset ratio.

As far as the aggregate data compiled in Table 1 and 2 are concerned, therefore, we cannot find strong evidence suggesting the "capital crunch" that a decrease in equity capital was accompanied with a shrinkage in banks' loan supply as was observed in the United States. However, we should refrain from deriving any definite conclusions based only on the aggregate figures. We need to investigate individual banks' behavior of credit supply more specifically based on the panel data.

3. A Theoretical Analysis

Before starting empirical analyses, we need some meaningful hypotheses about banks' credit supply or risk-taking and equity capital. Actually, there is a vast amount of literature on it. This section gives a short overview of the literature.

There are several theories about the relationship between banks' capital and their behavior. Most of them are based on the theory of corporate finance which analyzes the influence of capital structure on shareholders' or managers' incentives of risk-taking. However, banks are different from non-bank corporations in that they are under somewhat complicated safety net centered on the system of deposit insurance and the specific regulation of capital adequacy. Because of these institutional circumstances, it is rather complicated to analyze the relationship between equity capital and risk-taking in the banking sector.

The well-known moral hazard hypothesis is formally analyzed by Merton (1977, 1978), who emphasizes the influence of the uniform premium in the deposit insurance system on managers' risk-taking in the banking system. The system of uniform insurance premium confer the put option value on banks' shareholders in the sense that the greater risk a bank takes, the larger value bank's shareholders can enjoy, and the greater loss the insurance corporation will suffer.[6] Marcus(1984), Ritchken et al.(1993), Furlong and Keeley(1989), Keeley(1990), and Herring and Vankudre (1987) follow Merton's argument. [7] According to their analyses, there is a trade-off between the put option value and the charter value or franchise value for banks. While banks' expansion of risk-taking increases the option value for their shareholders at the expense of the deposit insurance system, it increases the probability of bank failures and thereby increasing the probability for shareholders to lose the charter value which is defined as the discount value of monopolistic rents they will continue to acquire so long as their banks continue to operate. In the following discussion, we slightly extend the argument of Herring and Vankudre (1987) by introducing risk-based capital restrictions to derive a meaningful hypothesis about banks' behavior of risk-taking.[8]

A bank issues the fixed amount of deposit D and the fixed amount of equity capital K. All deposits are assumed to be fully insured by the deposit insurance system whose insurance premium is given by a fixed rate p. At the end of period, the bank must pay out the amount (r+p)D unless the bank goes bankrupt, where r is a factor interest rate. When bankruptcy occurs, the insurance institution or public authority seizes control and the shareholders will receive nothing. The bank lend the amount of L to the risky borrowers and invest S in the safe assets. That is, D+K=L+S holds at the beginning of the period. At the end of period, the return from the both investments L and S realizes. In per dollar terms, the return is a random variable $\tilde{A}$ whose distribution function is denoted by $F(A;\sigma)$. Thus, total return is $(L+S)\tilde{A}$. We assume for simplicity that an increase in σ=L/(L+S), the ratio of lending to assets, makes the distribution more risky. As for the distribution function $F(A;\sigma)$, we assume the next assumptions, following Herring and Vankudre(1987)[9];

A.1. For each σ, there exists an $\hat{A}$ such that $\frac{\partial F}{\partial \sigma} > 0$ for $0 < A < \hat{A}$ and $\frac{\partial F}{\partial \sigma} < 0$ for $\hat{A} < A < \overline{A}$.

A.2. $F((r+p)D;\sigma) > 0$ for all σ.

A.3. $\sigma \in [0, \overline{\sigma}]$, $\hat{A} = \overline{A}$ at $\sigma = \overline{\sigma}$ and $\hat{A} = 0$ at $\sigma = 0$

A.4. $\dfrac{\partial^2 F}{\partial A \partial \sigma} < 0$

Furthermore, the bank has some charter value or franchise value as long as it continues business. This charter value C is defined as the present value of the net income the bank would be expected to earn on new business if it were to retain only its offices, employees, customers and charter. For example, there are monopolistic rents given by the entry regulation and the reputation produced by the long-term relationship in the banking industry. We assume this charter value is given by the fixed amount C and it is lost in the default state. Since this charter value is considered to be illiquid assets which could not be transferred into cash, the default point is invariable even if it changes. The expected value of the bank V is the sum of this charter value and the returns from lending and safe investment:

$$\begin{aligned} V &= \int_{A_0}^{\overline{A}} \left[(K+D)A - (r+p)D \right] dF(A;\sigma) + C\int_{A_0}^{\overline{A}} dF \\ &= (K+D)\overline{A} - (r+p)D - \int_{A_0}^{\overline{A}} (K+D)F(A;\sigma)dA + C\left[1 - F(A_0;\sigma)\right], \end{aligned} \quad (1)$$

where $A_0 = (r+p)D/(K+D)$ defines a default point. Note that the random variable $\widetilde{A}$ expresses the sum of returns of lending and safe investment per dollar. Figure 3 shows V as a function of σ.

The bank faces the risk-based capital adequacy constraint. The risk asset ϕ is defined as $\phi = \overline{\delta} L + \underline{\delta} S$, where $\overline{\delta}$ and $\underline{\delta}$ are risk weight ratios as for loans and safe assets, respectively. The risk-based capital adequacy ratio requires that the capital over risk asset ratio is larger than or equal to the standard ratio specified ex ante;

$$\frac{K}{\phi} \geq \alpha \tag{2}$$

This constraint equation is rewritten as

$$\sigma \leq \frac{K/\alpha - \underline{\delta}(K+D)}{(\overline{\delta} - \underline{\delta})(K+D)} \equiv \hat{\sigma}, \tag{3}$$

where $0<\alpha<1$ and $0 < \underline{\delta} < \overline{\delta} \leq 1$.[10] The risk-based capital adequacy regulation prevents banks from taking excessive risk corresponding to their equity capital positions.

Thus, bank's maximization problem is as follows:

$$\underset{\sigma}{Max} \quad V = (K+D)\overline{A} - (r+p)D - \int_{A_0}^{\overline{A}} (K+D)F(A;\sigma)dA + C\left[1 - F(A_0;\sigma)\right] \tag{4}$$

subject to $\sigma \leq \hat{\sigma}$. First, we consider the first order condition for the maximization problem above ignoring the constraint $\sigma \leq \hat{\sigma}$. That is,

$$\frac{\partial V}{\partial \sigma} = -(K+D)\int_{A_0}^{\overline{A}} \frac{\partial F}{\partial \sigma}(A;\sigma)dA - C\frac{\partial F(A_0;\sigma)}{\partial \sigma} = 0. \tag{5}$$

Denote σ satisfying this condition by σ*. After totally differentiating this first order condition, we get the following equation.

$$\frac{d\sigma^*}{dK} = \frac{\dfrac{C-(r+p)D}{K+D}\dfrac{\partial F(A_0;\sigma)}{\partial \sigma} - C\dfrac{\partial^2 F(A_0)}{\partial A \partial \sigma}\dfrac{dA_0}{dK}}{(K+D)\displaystyle\int_{A_0}^{\overline{A}} \frac{\partial^2 F(A;\sigma)}{\partial \sigma^2} + C\frac{\partial^2 F(A_0)}{\partial \sigma^2}} \tag{6}$$

The denominator is positive from the second order condition. From the assumption A.1. and equation (5), $\dfrac{\partial F(A_0)}{\partial \sigma} > 0$.[11] $\dfrac{\partial^2 F(A_0)}{\partial \sigma \partial A} < 0$ from the assumption A.4 and $\dfrac{dA_0}{dK} < 0$. Therefore, the numerator is negative when C<(r+p)D but ambiguous when

C>(r+p)D. Thus, $\frac{d\sigma^*}{dK}$ is negative when the charter value is small enough (C<(r+p)D) and the sign of this derivative is ambiguous when the charter value is sufficiently large (C>(r+p)D). We restrict our attention to the case C<(r+p)D because this case is considered to be more realistic. In practice, bank's equity capital K is much smaller than deposit D. The charter value C is produced by equity capital K so that it is reasonable to assume the charter value C to be the same magnitude as capital K. Therefore we consider that the charter value C is smaller than deposit (r+p)D and $\frac{d\sigma^*}{dK}$ is negative. A decrease in capital increases bank's risk taking when we ignore risk-based capital adequacy constraint. This comparative static result shows the usual moral hazard behavior on the side of banks' shareholders.

The upper constraint of risk $\hat{\sigma}$ given by the risk-based capital adequacy regulation (eq. (3)) is an increasing function of capital K. In other words, the risk-based capital adequacy regulation requires that banks with lower capital takes less risk. Figure 4 describes the σ^* and $\hat{\sigma}$ as a function of capital K. A decreasing function $\sigma^*(K)$ denotes the optimal σ for unconstrained maximization problem and an increasing function $\hat{\sigma}(K)$ denotes the risk-based capital adequacy constraint. The domain below the line $\hat{\sigma}(K)$ is feasible. Then, the solution for the above constrained maximization problem σ^E is $\min\left[\sigma^*, \hat{\sigma}\right]$. The solid line shows this equilibrium risk-taking σ^E. The less capitalized banks must reduce loans in order to satisfy the risk-based capital(RBC) regulation when their capital decreases. However, the well-capitalized bank can increase loans to take excessive risk when their capital decreases. In other words, lower capital/asset banks may face capital crunch, but higher capital/asset banks cause the moral hazard.

Furthermore, we derive another comparative static result using the first order condition (eq. (4)). After totally differentiating the first order condition with respect to σ* and C, we get

$$\frac{d\sigma^*}{dC} = \frac{\dfrac{\partial F(A_0)}{\partial \sigma}}{-\left[(K+D)\int_{A_0}^{\bar{A}} \dfrac{\partial^2 F(A;\sigma)}{\partial \sigma^2} + C\dfrac{\partial^2 F(A_0;\sigma)}{\partial \sigma^2}\right]} < 0 \quad (7)$$

because the numerator is positive from the assumption A.1. and the first order condition and the denominator is negative from the second order condition. An increase in charter value reduces bank's risk taking when they choose σ* as σ^E. Of course, for the bank whose equilibrium risk-taking σ^E is $\hat{\sigma}$, the change of the charter value has no effect on the equilibrium σ^E.

From the above arguments, our estimated equation is constructed as follows:

$$\sigma_{i,t}^{E} = \psi\left(\left(\frac{K}{A}\right)_{i,t-1}, C_{t-1}, \Gamma_{t-1}\right). \quad (8)$$

The equilibrium risk taking $\sigma_{i,t}^{E}$ of the i th bank at date t is a function of capital/asset ratio at date t-1, charter value at date t-1, and vector Γof some other relvant variables affecting distribution function F(A;σ, Γ). We predict explicitly the following conventional hypothesis on this estimated equation ψ from the above argument.

Hypothesis :

(I) When the risk-based capital adequacy(RBC) restriction is not binding, a decrease (an increase) in capital/asset ratio $(K/A)_{i,t-1}$ increases(decreases) the equilibrium risk $\sigma^{E}_{i,t}$ because it strengthens shareholders' incentives to expand risk-taking.

(II) When the RBC restriction is binding, a decrease(an increase) in capital/asset ratio $(K/A)_{i,t-1}$ induces a parallel decrease(increase) in the equilibrium risk $\sigma^{E}_{i,t}$.

(III) When the RBC restriction is not binding, an exogenous decline(rise) of charter value $C_{i,t-1}$ makes banks take more(less) risk (an increase(a decrease) in $\sigma^{E}_{i,t}$).

The above hypotheses emphasize that it is important whether the RBC restriction is binding or not for individual banks' behavior. The results obtained by Bernanke and Lown(1991), Berger and Udell(1994), and Peek and Rosengren(1995) as for banks in the United States correspond to the hypothesis II where the RBC restriction is binding. In the following section, we test which hypothesis I or II, applies to the Japanese major banks.

The hypothesis I and II also suggests that it may be necessary for us to differentiate the sample banks into two groups: those for which the RBC restriction is binding and those for which it is not binding. Actually, since the capital/asset ratio of every major bank in Japan has been sufficiently higher than the required minimum level 8%, the RBC restriction does not appear to be binding at all. However, it would be costly for individual banks to quickly increase their equity capital when the capital/asset ratio happens to be below the required minimum level. Thus, it may be reasonable to assume that there is a threshold equity/asset ratio higher than the required minimum level and that the RBC restriction is binding for those banks whose equity/asset ratios are lower than this threshold value. In practice, it is impossible to precisely define the threshold value for the equity/asset ratio. In the following empirical test, we divide the sample banks into the higher capital/asset ratio group and the lower ratio group in a rather ad hoc way.

The hypothesis III is tested because we are interested in how the structural changes in the financial market have influenced banks' risk taking. In Japan, the decline of their share prices as well as an increase in non-performing loans may contributes bank's risk taking behavior. These substantial decline of banks' share prices is predicted to be caused by the liberalization of financial system which undermines profitability in the banking industry that used to be protected by various regulations. Therefore, we include variables representing charter values into the estimated equation. We test this hypothesis in section 4.

4. Estimating Banks' Risk Taking Behavior

We utilize the data from balance sheets reported by the major 21 banks in Japan. They are 11 city banks, 7 trust banks and 3 long-term credit banks. Their statistics are utilized mainly because figures of their non-performing loans are most openly disclosed in Japan. As has already been explained, the disclosure of non-performing loans for these banks is not complete. However, compared with other banks and depository financial institutions, their disclosure is fairly comprehensive. Observations are semi-annual ones from March 1990 to September 1995, therefore, we have 11 periods times 21 banks observations for each variable.

4-1 The adjustment of loans by Japanese banks

Bernanke and Lown (1991) found a positive relationship between banks' loan supply and their equity capital/asset ratios in the United States. Using microeconomic panel data, we test whether the same relationship can be observed in Japan. That is, we test whether the BIS restriction was binding or not, which corresponds to hypothesis (II) or (I), respectively.

First, we linearize our estimated equation (8) and define variables completely. The linearized estimated equation is presented as follows.

$$\sigma_{i,t}^{E}=\alpha+\beta_1\left(\frac{K}{A}\right)_{i,t-1}+\beta_2 C_{i,t-1}+\sum_{j}\theta_j\gamma_j. \qquad (9)$$

We test two variables as proxy for the dependent variable σ^E(the degree of banks' risk). One is the ratio of an increment of loan over total asset (abbreviated as LCHA), and the other is the growth rate of loans (abbreviated as LCH). The former can be regarded as approximating the bank's risk as explained in theoretical analyses. The latter LCH is tested because we are interested in the issue whether the bad loan problem has actually decreased the growth rate of bank credit in Japan.

Capital K is defined as the sum of book value capital, the general and special provisions for losses, the hidden gains on the listed securities, and the subordinated debt/loans minus the amount of the non-performing loans. According to the BIS rule, banks are allowed to count their subordinated debts with maturity of longer than five years as equity capital(Tier II). The BIS rule considers that the subordinated debts will function to protect interests of banks' other debtholders(particularly depositors) in case of bankruptcy. However, in this paper, we include subordinated debts issued by banks into their capital because these debts can be regarded as an important stake held by banks' major shareholders. As will be explained in the following, most of subordinated debts issued by Japanese banks have been absorbed by insurance companies and other nonfinancial firms who have close relationships with the issuing banks. These investors are also major shareholders of the banks in the framework of so-called mutual shareholding. It is easy to show that, if the subordinated debts are totally absorbed by the current shareholders, these debts would be nothing but an extension of the shareholders' stake.

The asset A is defined as the sum of the book value of asset, and the hidden gains on the listed securities, minus the amount of non-performing loans. Hereafter, we call the estimated equity capital/asset ratio as EEQR.

The charter value is defined as CHRT=$(S-K)/A$ where S is the market value of bank's stocks. The location of branches of banks, the reputation value concerning bank's future business, and other various intangible assets produce rents to the bank, but these assets are not explicitly counted in the financial statements of banks. However, the efficient stock market would evaluated the value of these assets in banks' share prices. Therefore, we may assume that the value of the intangible assets, *i.e.*, the charter value, is represented by (S−K). We normalize it by asset A.

We include the interbank money market rate (CALL) as an explanatory variable because it is conventional to consider this interest rate as presenting the opportunity cost for banks' credit supply. Furthermore, some macroeconomic variables are included as independent variables for our estimation in order to capture their influence on the distribution function of banks' risk. Those variables are the industrial production index (IP), the exchange rate (EXR), and the stock market index (NIKK). Finally, the dummy variables as for each bank, each semi-annual period, and each type of banks(city banks, trust banks, and long-term credit banks) are included. The individual bank dummies are included to estimate the equation as the fixed effect panel model. The semi-annual time period dummies are included to absorb the macroeconomic effects which are not absorbed by the above four macroeconomic variables. And the dummy for each type of banks are included to absorb the difference of properties between each type of banks. α, β_js, and θ_js are ordinary least squares estimators for respective variables. Since the main variables are ratios over total asset, the heteroskedasticity problem can be avoided.

Table 3 shows estimated results. We estimate three models for each dependent variable; one is pooling model, another is the fixed effect model, and the other is the random effect model. Let's see the first three rows of this table. These shows the estimated coefficients, t-statistics, and R-squared when we take the ratio of loan change to estimated asset(LCHA) as dependent variable. The R-squared and the adjusted R-squared are small in each model. The estimated equity to asset ratio (EEQR) has a significantly negative coefficient in each model. Also, a short term interest rate(CALL), an industrial production index(IP), and Nikkei stock index(NIKK) have significant coefficients. When we take the change rate of loans(LCH) as dependent variable (the next three rows from the fourth), EEQR is again significantly negative. IP, CALL, and NIKK have predicted significant coefficients. A banks' charter value(CHRT) has no effect on all dependent variables.

Thus, the capital/asset ratio affects recent banks' risk taking negatively. This result is different from the evidence found in the U.S. by Bernanke and Lown (1991) and others. They argue that the decrease in capital/asset ratio produced lower growth rates in bank loans because of the BIS restriction. However, this does not seem to hold for the Japanese banks. Rather, Japanese banks reduced their loan supply as capital/asset ratio increased. This behavior of banks may be called "adverse moral hazard." Thus, the moral hazard hypothesis (I) in section 3.1 is supported in Japan. However, our results does not support the hypothesis (III), because the decline of charter value have no significant effect on the banks' risk taking. This result may be interpreted, for instance, as that stockholders do not enjoy their charter. Instead of them, managers and employees may enjoy the bank charter in the form of relatively high wages and some fringe benefits such as comfortable company houses and social expenses. If it is, Japanese stockholders of banks would make their decisions not taking care of the charter value.

We have also investigated how Japanese banks adjusted their loan supply responding to changes in the capital/asset ratios. The results are summarized from the fourth to sixth rows in Table 3. According to these results, banks tended to change loan supply negatively in response to variations of capital-asset ratios as suggested by the conventional moral hazard hypothesis (I). Table 1 and Figure 2 show that the growth rate in the aggregated loan has declined during our sample period. Combining this aggregate figure with the results obtained in Table 3, we conclude that recent decline of aggregate bank loans are caused by an recovery in capital/asset ratio. Banks have been able to attain a recovery of their capital/asset ratios, which induced them to be conservative in extending credit.

4.2 Results from separated samples

As we have argued in section 3, banks' behavior toward risk-taking would be different whether the capital adequacy regulation is binding or not. Specifically, under the moral hazard hypothesis I, while the banks for which the capital adequacy restriction is not binding will increase risk-taking as their equity capital decreases, those for which the restriction is binding will be forced to decrease risk-taking as their equity capital decreases. Thus, it would make sense to examine the same relationship between banks' credit supply and their equity capital as was investigated in section 4.1 by separating the sample banks into two groups by a standard of threshold capital K satisfying $\hat{\sigma}(K) = \sigma^*(K)$.[12] Since the exact value of the threshold K is not available, we take an ad hoc way of classifying the sample banks into two groups by assuming that the banks with relatively low EEQR are under the binding capital adequacy restriction and the other banks are not. Making use of both the pooling and the fixed effect models, we obtained the estimated results presented in Table 4.

The first four rows in Table 4 show the estimated results for the sample banks with low EEQR, for which we assume the capital adequacy restriction is binding. EEQRs are significantly negative only for LCHA and LCH in the pooling model. These explanatory variables are statistically insignificant in other model. The four rows from the fifth show the results for the sample banks with higher EEQR, for which we assume the capital adequacy restriction is not binding. All coefficients of EEQR are negative, but they are statistically insignificant.

Thus, the result shown in Table 4 is inconsistent with the theoretical argument regarding the influence of the binding capital adequacy regulation on banks' risk-taking. This may suggest that our method of separating the sample banks is too ad hoc to be reliable. Or, it may show that all of the Japanese major banks have sufficient amount of equity capital, so that the BIS capital regulation is not binding at all. Our result is contrary to the U.S. result obtained by Berger and Udell (1994), who find that the banks with low capital /asset ratios were bound with the BIS regulation.

4.3 Recapitalization of Japanese major banks

We have investigated how equity capital influenced major banks' risk-taking during the first half of the 1990s. Then, the next issue is how the major banks recapitalized responding to the deterioration of their balance sheets. The aggregate statistics presented in Table 1 and 2 show that, after sharply dropping from 9.0% in March 1990 to 7.2% in March 1993, the major banks' equity capital ratio (EEQR) and the BIS capital ratio mildly fluctuated with a slightly increasing trend until September 1994. Thus, these statistics suggest that those banks succeeded to some extent in keeping their equity capital from further decreasing in the face of a large amount of non performing loans.

This suggestion is confirmed by empirical investigation based on panel data. We estimate the following equation:

$$BISCG_{i,t} = \alpha + \beta_1 EEQR_{i,t-1} + \beta_2 CHRT_{i,t-1} + \sum_j \theta_j \gamma_j , \qquad (10)$$

where $BISCG_{it}$ is the growth rate of the BIS capital (Tier I and Tier II) over period t. The estimated results are summarized in Table 5. According to this table, the capital/asset ratio (EEQR) in the previous period negatively influences the growth rate of BIS capital (BISCG) in the current period. This implies that the bank was able to increase BIS capital immediately after experiencing decrease in the equity/asset ratio.

The recapitalization by the Japanese major banks is in sharp contrast with the "capital crunch" observed in the US banking industry. As Peek and Rosengren (1995) argue, it was quite difficult for US banks to quickly recapitalize in the face of increasing non performing loans, mainly because issuing stocks would be associated with substantial agency cost under asymmetric information. Thus, in the United States, banks were forced to abandon quick recapitalization and instead decrease loan supply in order to keep their BIS risk capital ratios from going down.

As we have observed, the subordinated debt was a most important instrument of recapitalization for Japanese major banks. This instrument may explain why Japanese major banks were able to recapitalize rather easily during the early 1990s. The major part of subordinated debts issued by banks was absorbed by either insurance companies or nonfinancial firms which have intimate relationships with issuing banks. It should be noted that both the insurance companies and nonfinancial firms are also major shareholders of issuing banks. Therefore, there is no difficulty of asymmetric information between issuing banks and these buyers of subordinated debts[13]. Theoretically, allotting subordinated debts to current shareholders is equivalent to issuing stocks to those shareholders. It should also be pointed out that issuing new stocks in Japan has been severely controlled by the Ministry of Finance since the early 1990s[14]. From the Japanese bankers' viewpoint, issuing subordinated debts may have been a convenient substitute for direct recapitalization through issuing new stocks.

In order to show the importance of subordinated debts, we regress the loan change /asset ratio (LCHA) on each components of equity capital(EEQR), i.e., the book value equity (EQR), the hidden reserve (HRR), the general purpose provisions for loan losses (GPR), the special provisions for loan losses (SPR), the subordinated debts (SDR), and the non performing loans (NPR). The specification of estimation is as follows.

$$LCHA_{i,t+1} = \alpha_i + \beta_1 EQR_{i,t} + \beta_2 HRR_{i,t} + \beta_3 GPR_{i,t} + \beta_4 SPR_{i,t} + \beta_5 SDR_{i,t} + \beta_6 NPR_{i,t} + \beta_7 CHRT_{i,t} + \sum_j \theta_j \gamma_{j,t} \tag{11}$$

Upper panel of Table 6 presents the estimated results. These are comparable to those presented in Table 3 where components of EEQR are integrated into one variable. All components of EEQR except for EQR have negative coefficients. This is consistent with the results of constrained estimation in Table 3. However, values of adjusted R-squared are higher in Table 6 than in Table 3. In particular, it should be noted that the subordinated debt (SDR) takes the highest t-value in each regression. The subordinated debt has influenced the major banks' credit supply most significantly among the components of EEQR.

We also examine what factors account for banks' issuance of subordinated debts by a simple method of regressing the subordinated debt ratio (SDR) on the other components of equity capital EEQR. The estimated equation is

$$SDR_{i,t} = \alpha_i + \beta_1 EQR_{i,t} + \beta_2 HRR_{i,t} + \beta_3 GPR_{i,t} + \beta_4 SPR_{i,t} + \beta_5 NPR_{i,t} + \beta_6 CHRT_{i,t} + \sum_j \theta_j \gamma_{j,t} \tag{12}$$

Lower panel of Table 6 presents the results. They show that banks with lower book value equity EQR, lower hidden reserve HRR, and lower special provisions for loan losses SPR tended to issue more subordinated debts(SDR) than otherwise. The nonperforming loans NPR, however, did not influence banks' issuance of subordinated debts. This result suggests that the major banks issued subordinated debts to compensate decrease in other elements of their equity capital.[15]

In summary, the traditional relationships between banks and insurance companies or nonfinancial firms have worked at least to some extent to mitigate the difficulty of the bad loan problem in the Japanese banking industry. However, the banking industry as a whole will have to further strengthen capital bases in order to expand business. Can Japanese banks depend on the traditional relationship or business ties with insurance companies or nonfinancial firms to recapitalize as well as during the early 1990s? There is great uncertainty about it. because the merit of the traditional relationship seems to have been exhausted in the first half of the 1990s. For example, insurance companies accepted a large amount of subordinated loans issued by banks at the early 1990s. However, they reportedly refused to absorb the subordinated debts additionally issued by banks since 1992. Accordingly, the subordinated debts were forced mostly to nonfinancial firms having intimate ties with issuing banks. According to newspaper report, the banks offered back-up credit with favorable conditions to those firms in order to motivate the firms to absorb the subordinated debt in spite of the MOF's prohibition against such a manipulation[16].

4.4 Charter value of Japanese banks

Theoretically, a bank's behavior of risk-taking should be crucially dependent on the bank's charter value (or franchise value), which presents the discounted value of rents the bank is expected to earn in the future as a going concern. Our theoretical model in section 3 predicts that an increase in charter value will reduce banks' incentives of risk-taking. It is widely believed that the reduction in charter value due to the financial deregulation during the 1980s induced banks in many countries to increase risk-taking and thereby endangering financial stability. (Keely 1990, Weisbrod, Lee, and Rojas-Suarez 1992)

However, our empirical investigation in the previous section were disappointing with respect to the charter value, because it was not significant in our regression. According to Table 3, for example, the charter value (CHRT) does not significantly influence bank' credit supply(LCHA or LCH) at all. We test the same credit supply equations by omitting the estimated equity capital EEQR, because the potential multicolinearity between EEQR and CHRT might prevent us from finding significance of CHRT. The results (from the first to the third row) in Table 7 shows, however, that the charter value remains insignificant in explaining banks' credit supply.

We also test two alternatives as a proxy for banks' charter value. One is Tobin's Q which is defined as the ratio of market value of banks' stock (S) to the book value of equity (K). Another is the ratio of S to the total assets (A). The estimated results are summarized from fourth to the last row in Table 7. Unfortunately, these two alternative Q (=S/K) and SA (=S/A) are insignificant regardless whether EEQR is included or not as an independent variable.

It is an important issue why we have not succeeded in finding significant influence of the charter value on banks' credit supply. One plausible answer to this issue may be that the Japanese stock market is not efficient enough to precisely evaluate the charter value for the banking industry. First, during our sample period, i.e., during the 1990s, the Ministry of Finance reportedly executed the so-called "price-keeping operations" in the stock market in order to alleviate downward pressures on stock prices. Although it is ambiguous whether the policy was actually effective or not, such operations were likely to distort price mechanisms of the stock market. Second, the traditional mutual shareholding between major banks and other financial institutions or nonfinancial corporations may distort the stock market pricing, because the shareholders in the framework of mutual shareholding are said to be mainly interested in warding off the capital market pressures on their own management and to be insensitive to efficiency of their share prices.

Furthermore, as suggested in section 4.1, the charter value may be consumed not by shareholders, but by banks' managers and employees in the form of higher salaries or gorgeous fringe benefits. If it is true, the share prices do not count for the charter value of banks. We should also pay some attention to the possibility that banks' management is controlled not by banks' shareholders, but by incumbent managers. If the managers controlled the banks' decision making, the charter value calculated on a basis of market value of banks' stocks would not explain their behavior of risk-taking.

At any rate, it remains to be investigated why we have not succeeded in finding significance of banks' charter value in this paper.

5. Conclusion

In the United States, the capital crunch is said to have occurred in the sense that the increase in non performing loans lowered capital/asset ratio in the banking sector, thereby forcing banks to reduce their credit supply. In Japan, a similar slowdown of bank credit was observed in the early 1990s until March 1995 (Figure 2). However, our empirical analyses based on panel data of the major banks do not support the capital crunch hypothesis. Rather, our investigation suggests that banks with higher capital/asset ratios tended to have smaller increments of credit supply. Thus, in Japan, the capital adequacy requirement seems to be effective in inducing banks' conservative behavior of risk-taking.

Why is there a significant difference between the United States and Japan with respect to the influence of equity capital on banks' credit supply? It is difficult to give a clear-cut answer to this question. However, it is noteworthy that, as Scott and Iwahara (1994: p.17) point out, U.S. banks are subject to Basle plus other capital requirements such as a 3 percent minimum leverage ratio (capital/assets, whereas Japanese banks are subject only to Basle. Therefore, it is reasonable that the restrictive effect of capital adequacy requirement is stronger in the United States than in Japan.

We emphasized the fact that the Japanese major banks mitigated the severity of undercapitalization by issuing a large amount of subordinated debts. The subordinated debt was a key factor in explaining the absence of capital crunch phenomenon in Japan. Theoretically, it would be costly for banks to quickly increase their equity capital due to the agency cost particularly when the banks are suffering from a bad loan problem (Myers and Majluf (1984) and Peek and Rosengren (1995)). In the case of Japanese major banks, they have been able to avoid this difficulty by depending on the traditional relationships with insurance companies and nonfinancial firms. Those agents who are major shareholders of the bank absorbed almost all of the subordinated debts issued by the banks.

Although there is no exact evidence, it was talked about that some major banks took measures to induce related financial and nonfinancial companies to buy the subordinated debts. This suggests a fragile aspect of Japanese banks' recapitalization, because they would not be able to extend this sort of manipulation beyond a certain limit.

It should also be pointed out that our empirical analysis is confined to the major 21 banks. For those banks outside the major bank group, it has been difficult to recover equity capital by issuing subordinated debts. However, the problem of non performing loans is reportedly more serious for outside banks such as regional banks and cooperative credit banks. Thus, according to the moral hazard hypothesis supported by our empirical test, the risk-taking of speculative credit supply may be irresistible for those banks. This is a remaining danger in the Japanese financial system that we should not ignore.

References

Berger, A.N. and Udell,G.F., 1994," Did Risk-Based Capital Allocate Bank Credit and Cause a "Credit Crunch" in the United States?", Journal of Money, Credit, and Banking,26,3:585-628.

Bernanke, B.S. and Gertler, M., 1987, "Banking and Macroeconomic Equilibrium", in New Approaches to Monetary Economics, eds. Barnett, W.A. and Singleton, K.J. Cambridge University Press.

Bernanke,B.S. and Lown,C.S., 1991,"The Credit Crunch", Brookings Papers on Economic Activity,2:205-247.

Dewatripont, M. and Tirole, J., 1993, "Efficient Governance Structure: Implications for Banking Regulation", in Capital Markets and Financial Intermediation, eds. Mayer, C. and Vives, X. Cambridge University Press.

Dewatripont, M. and Tirole, J. ,1994 , "The Prudential Regulation of Banks," MIT Press.

Furlong, F.T. and Keeley, M.C., 1989, "Capital Regulation and Bank Risk-Taking: A Note", Journal of Banking and Finance, 13, 883-891.

Herring, R.J. and Vankudre, P., 1987, "Growth Opportunities and Risk-Taking by Financial Intermediaries", Journal of Finance, XLII, 3, 583-599.

Horiuchi, A., Ohara, Y., and Paul, J.M., 1995, "Bad Loan Problem in Japan: The Present Situation and Measures to Cope with It", Unpublished mimeo, University of Tokyo.

Jensen,M. and Meckling,W.R., 1976, "Theory of the Firm, Managerial Behavior, Agency Costs and Ownership Structure", Journal of Financial Economics 3:305-360.

Keeley, M.C., 1990." Deposit Insurance, Risk, and Market Power in Banking", American Economic Review, 80, 5: 1183-1200.

Marcus, A.J.,1984, "Deregulation and Bank Financial Policy", Journal of Banking and Finance, 8, 557-565.

Merton, R.C., 1977, "An Analytical Derivation of the Cost of Deposit Insurance and Loan Guarantees", Journal of Banking and Finance, 1, 3-11.

Merton, R.C., 1978, "On the Cost of Deposit Insurance When There Are Surveillance Costs", Journal of Business, 51, 439-452.

Myers, S. and Majluf, N., 1984, "Corporate Financing and Investment Decisions When Firms Have Information That Investors Do Not", Journal of Financial Economics, 13, 187-221.

Passmore, W. and Sharpe, S.A., 1994, "Optimal Bank Portfolios and the Credit Crunch", Finance and Economics Discussion Series, FRB.

Peek, J. and Rosengren, E., 1995, "The Capital Crunch: Neither a Borrower nor a Lender Be", Journal of Money, Credit, and Banking, Vol. 27, No. 3, 625-638.

Prowse, S.D., 1990, "Institutional Investment Patterns and Corporate Financial Behavior in the United States and Japan", Journal of Financial Economics, 27, 43-66.

Ritchken, P., Thomson, J.B., DeGennaro, R.P., and Li, A., 1993," On Flexibility, Capital Structure and Investment Decisions for the Insured Bank", Journal of Banking and Finance, 17, 1133-1146.

Scott, H. S. and Iwahara, S., 1994, "In Search of a Level Playing Field: The Implementation of the Basle Capital Accord in Japan and the United States," Group of Thirty Occasional Paper 46.

Weisbrod, S. R. Lee, H. and Rojas-Suarez, L., 1992, "Bank risk and the declining franchise value of the banking systems in the United States and Japan." IMF Working Paper, 1992.

Yoshikawa, H., Etoh, M., and Ike, T.,1994,"Chuusho Kigyo ni taisuru Ginko niyoru Kashishiburi ni tsuite (On the Credit Crunch for Small Firms by Banks)" Keizai Bunseki.

Endnotes

1 We differentiate "capital crunch" from "credit crunch" in this paper. "Capital crunch" is concerned with how banks will respond to reduction in their equity capital, and we are taking up this in this paper. On the other hand, "credit crunch" is concerned with how the decline in bank credit will exert negative impact on the macroeconomy.

2 See Horiuchi et al. And Yoshikawa et al. as for other empirical evidence for Japanese bad loan problems.

3 As of September 1994, the subordinated debts of the city banks accounted for 56% of Tier II capital and 26% of total capital respectively.

4 The Ministry of Finance submitted to the Diet the comprehensive figures of non-performing loans in April 1995. The figures are comprehensive in the sense that they are constituted not only by loans to bankrupted borrowers and loans past due over six months, both of which have been officially disclosed since March 1993, but also by loans with reduced interest rates and other loans banks supplied to rescue the borrowers such as *Jusen*. According to the submitted figures, the total amount of non-performing loans is ¥23.8 trillion for major twenty-one banks as of September 1995, almost twice larger than the official figure which does not contain the loans with reduced interest rates and others. In March 1996, the Federation of Bankers Associations of Japan decided that all banks belonging to the Federation are to start disclosing the comprehensive figures of their non-performing loans.

5 The data for non performing loans is not available for the period before March 1993. Although the amount of non performing loans should have been far from negligible even before March 1993, we cannot help neglecting them in estimating

the banks' equity capital before March 1993. Therefore, the banks' equity capital is undeniably overestimated from September 1990 to September 1992.

6 In general, shareholders of corporations have moral hazard incentives of substituting assets with a view to transferring downside risk to debt-holders(see Jensen and Meckling (1976)) Thus, debt holders(depositors) of banks would require banks some compensations for this risk without the deposit insurance. However, a fixed rate premium of deposit insurance prevents this mechanism of compensation, conferring the put option value on banks' stockholders.

7 There is another theoretical literature concerning banks' loan supply behavior. For example, Bernanke and Gertler (1987) and Passmore and Sharpe (1994) considers the model where banks behave as to extract the rent from their advantage in lending rather than to enjoy the risk from limited liability.

8 Although the following theoretical argument presumes that banks' decision are made by their stockholders, we could derive the similar results even if we presume that banks' decision makings are made by banks' managers. See Dewatripont and Tirole(1993, 1994) for this argument.

9 Note that this distribution function does not obey the usual mean preserving spread.

10 We impose a regularity condition such that this risk-based capital adequacy regulation has meaningful effect on bank's decision making. The next A.5. implies that $0<\hat{\sigma}$:

A.5. $\alpha\underline{\delta} < K/(K+D)$.

Note that if we assume $\underline{\delta}=0$, we don't need this assumption and $\hat{\sigma}$ is simply $\bar{\delta}K/\{\alpha(K+D)\}$.

11 If $\partial F(A_0)/\partial\sigma < 0$, the first order condition can not hold.

12 Recall that banks with $K < \overline{K}$, *i.e.*, $\hat{\sigma}(K) < \sigma^*(K)$, choose $\hat{\sigma}(K)$ and those with $K > \overline{K}$, *i.e.*, $\hat{\sigma}(K) > \sigma^*(K)$, choose $\sigma^*(K)$.

13 We do not provide the empirical studies supporting that there does not exist asymmetric information problem. In order to do this, we should examine whether the degree of agency cost did not affect the amount of issuance of subordinated debts, in the similar way as Prowse(1990) in the context of Japanese main bank system.

14 Through the administrative guidance, the MOF prohibited public offering of stocks in April 1990 for fear of further declines in stock prices. Because of this policy, it was extremely difficult for Japanese corporation including banks to raise capital by issuing stocks.

15 The general purpose provisions GPR positively influenced banks' subordinated debt SDR. However, as table 2 shows, GPR is the least important among components of EEQR. Thus, we may neglect this factor in this paper.

16 See also Scott and Iwahara (1994)

Figure 1: Equity Capital for the Major 21 Banks

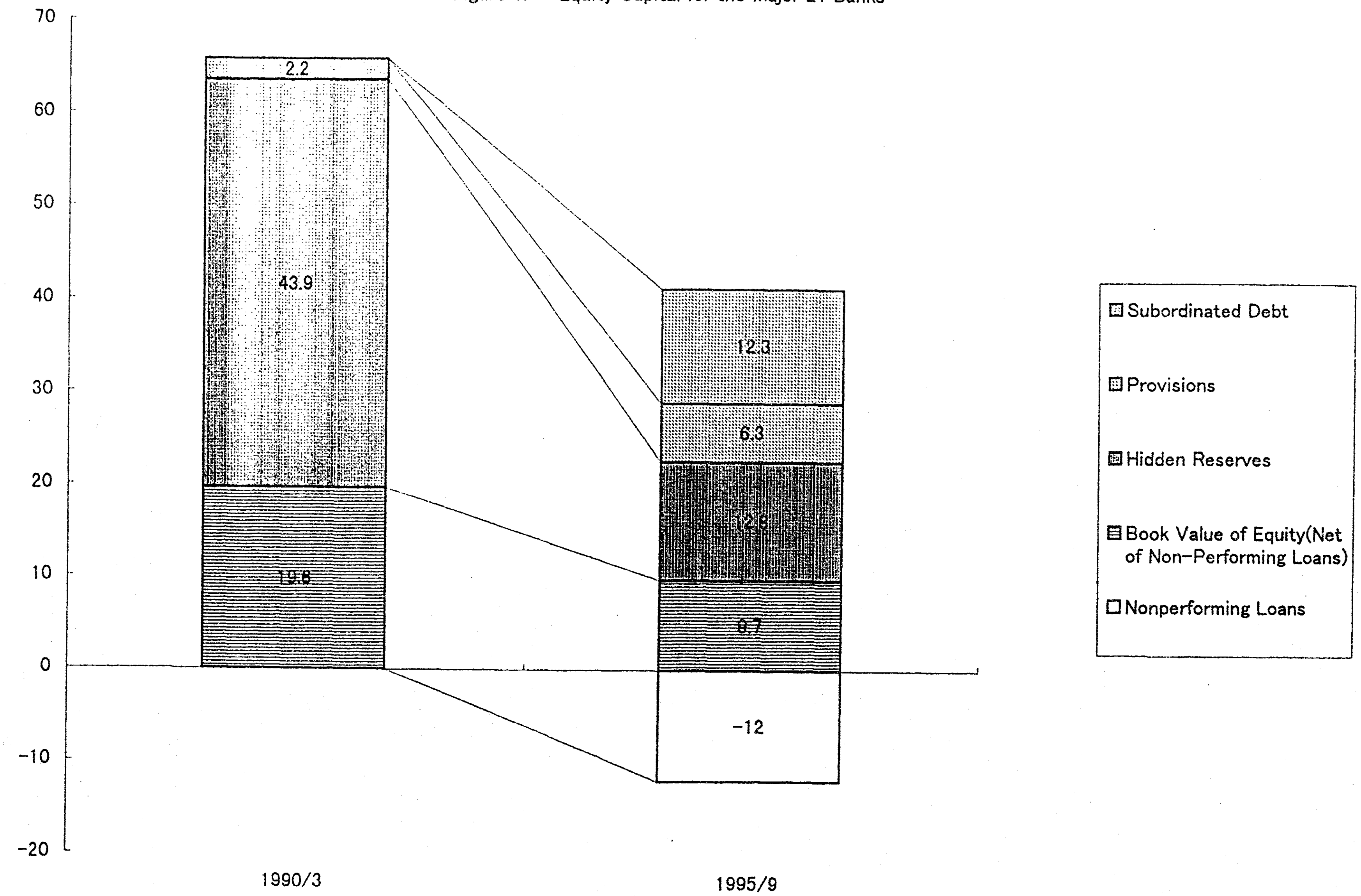

Figure 2: Recent Aggregate Trend of Loans and Capital/Asset Ratios

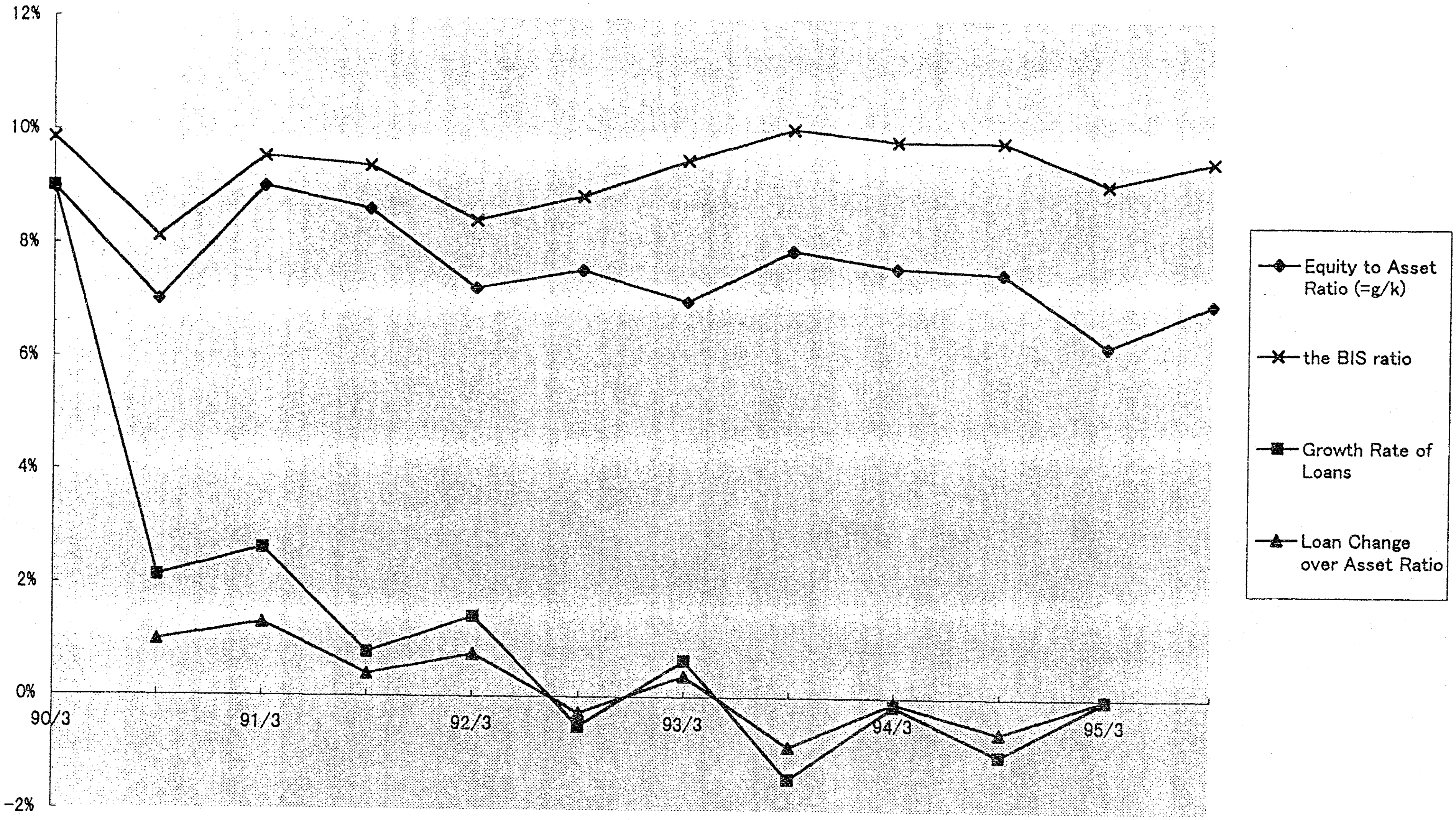

Figure 3 Bank's Value as a function of σ, given K

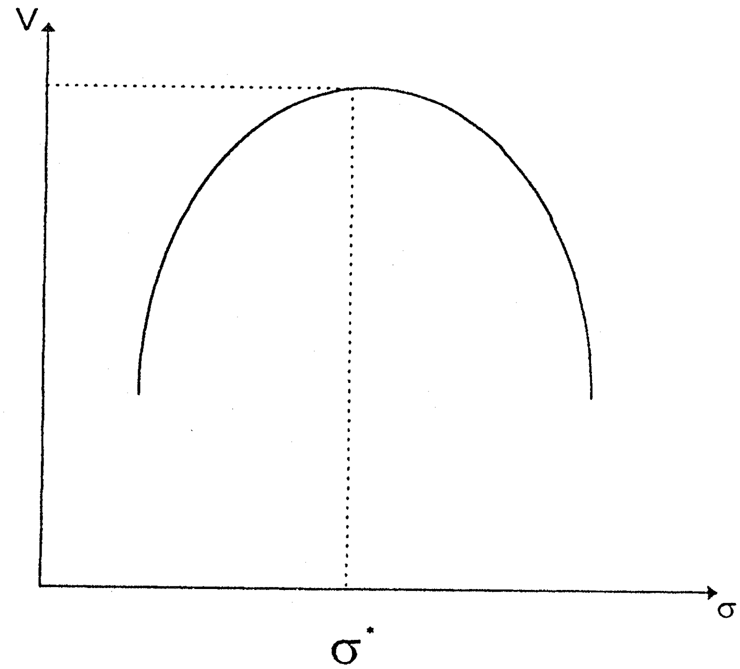

Figure 4 Equilibrium σ as a function of K

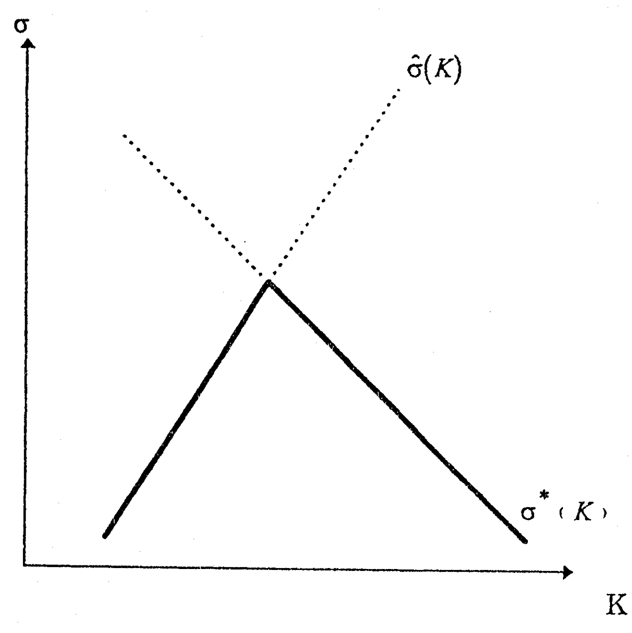

Table 1

Outline of the Recent Aggregate Balance Sheets of Japanese Major 21 Banks
Data:1990~1995

(¥Trillion)

		90/3	90/9	91/3	91/9	92/3	92/9	93/3	93/9	94/3	94/9	95/3	95/9
(a)	Equity (Book Value)	19.6	20.1	20.6	21.0	21.2	21.4	21.4	21.5	21.7	21.7	21.4	21.7
(b)	Hidden Reserves[1]	43.9	23.9	34.3	30.0	17.3	14.6	17.8	23.6	20.2	19.4	9.0	12.8
(c)	Provisions for Losses[2]	2.2	2.2	2.2	2.1	2.2	2.1	2.2	1.9	1.3	1.3	1.3	1.4
(d)	Special Provisons[3]	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	1.9	2.3	3.0	3.5	4.3	4.9
(e)	Subordinated Loans/Debts	0.2	2.6	4.6	5.4	7.2	9.7	10.6	10.3	10.3	10.4	11.3	12.3
(f)	Non-Performing Loans	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	11.7	12.7	11.5	12.2	11.6	12.0
(g)	Estimated Equity (= a + b + c + d + e − f)	65.8	48.8	61.7	58.5	47.8	47.7	42.1	46.9	45.1	44.1	35.7	41.2
(h)	Loans (Book Value)	338.4	345.6	354.7	357.4	362.5	360.6	363.0	357.8	357.3	353.7	353.6	364.9
(i)	Asset (Book Value)	688.5	671.6	650.0	649.7	644.7	617.2	596.0	581.8	583.2	579.4	575.5	587.7
(j)	Estimated Asset	732.4	695.5	684.3	679.7	662.0	631.8	602.1	592.7	592.0	586.6	572.9	588.5
(k)	Equity to Asset Ratio (=g/k)	8.99%	7.02%	9.01%	8.61%	7.23%	7.56%	7.00%	7.90%	7.62%	7.53%	6.24%	6.99%
(l)	Growth Rate of Loans	9.00%	2.14%	2.62%	0.78%	1.42%	-0.52%	0.65%	-1.43%	-0.14%	-1.01%	-0.03%	3.19%
(m)	Loan Change over Asset Ratio	4.50%	0.99%	1.30%	0.40%	0.75%	-0.28%	0.37%	-0.86%	-0.09%	-0.61%	-0.02%	1.97%
(n)	the BIS ratio	9.86%	8.13%	9.53%	9.36%	8.42%	8.85%	9.49%	10.05%	9.84%	9.83%	9.09%	9.50%
(o)	Market Value of Equity[4]	80.7	63.1	77.3	74.8	58.0	57.5	53.7	71.9	63.8	63.1	54.4	58.0

Note 1: Hidden reserves on the listed securities
2: General purpose provisions for loan losses
3: Special purpose provisions for loan losses
4:Market Value of Equity is one evaluated in the stock market.
5.Data for special provisions and non-performing loans are not available for the period before March 1993. Thus, the estimated equity is calculated by assuming both of these items are zero before March 1993.

Source: Financial Statements of individual banks, and Analysis of Financial Statements of All Banks

Table 2

Decomposition of Capital to Asset Ratio
Data :Japanese Major 21 Banks (1990~1995)

(%)

		90/3	90/9	91/3	91/9	92/3	92/9	93/3	93/9	94/3	94/9	95/3	95/9
(a)	Equity (Book Value)	2.67	2.89	3.01	3.09	3.20	3.39	3.55	3.64	3.66	3.71	3.74	3.68
(b)	Hidden Reserves	5.99	3.44	5.01	4.42	2.61	2.30	2.96	3.98	3.42	3.30	1.57	2.18
(c)	Provisions for Losses	0.30	0.32	0.32	0.31	0.33	0.33	0.36	0.32	0.22	0.22	0.23	0.23
(d)	Special Provisons	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	0.31	0.38	0.51	0.60	0.75	0.83
(e)	Subordinated Debts/Loans	0.02	0.37	0.67	0.79	1.08	1.53	1.76	1.73	1.74	1.77	1.97	2.10
(f)	Non-Performing Loans	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	-1.95	-2.14	-1.94	-2.08	-2.03	-2.03
(g)	Total Equity	8.99	7.02	9.01	8.61	7.23	7.56	7.00	7.90	7.62	7.53	6.24	6.99
(h)	Stock Market Value of Equity	11.03	9.07	11.03	11.01	8.76	9.11	8.92	12.13	10.78	10.76	9.50	9.85
(i)	Q	1.23	1.38	1.30	1.34	1.42	1.47	2.08	2.07	2.31	2.65	2.41	2.26

Notes: Each component of capital is divided by the estimated asset.(rows from (a) to (h))
Non-performing loans is shown in negative sign.
(h)Stock Market Value of Equity shows the ratio of total value of stocks in the stock market to the estimated asset.
(i)Q is defined as the ratio of total value of stocks in the stock market to the total equity.((h) devided by (g))

Sources: See the footnote of Table 1.

Table 3 Regression of Loans on Capital/Asset Ratio for Major 21 Banks from March 1990 to September 1995(Semi-Annual Data)

Dependent Variable	Model	R^2	Adjusted R^2	Independent Variable C	EEQR	CHRT	CALL	IP	EXR	NIKK
LCHA	POOLING	0.171	0.101	-0.231	-0.227	-0.015	-0.005	0.002	5.7E-05	1.4E-06
				(4.295)**	(3.442)**	(0.416)	(3.018)**	(4.877)**	(0.415)	(2.953)**
LCHA	FIXED	0.193	0.033		-0.276	-0.055	-0.005	0.002	6.2E-05	1.5E-06
					(3.764)**	(0.903)	(3.081)**	(4.741)**	(0.451)	(3.178)**
LCHA	RANDOM	0.176	0.013	-0.231	-0.239	-0.020	-0.005	0.002	6.0E-05	1.4E-06
				(4.349)**	(3.572)**	(0.499)	(3.086)**	(4.951)**	(0.445)	(3.046)**
LCH	POOLING	0.142	0.070	-0.428	-0.598	-0.063	-0.011	0.004	3.5E-04	2.9E-06
				(3.487)**	(3.972)**	(0.749)	(3.053)**	(3.840)**	(1.132)	(2.729)**
LCH	FIXED	0.168	0.003		-0.725	-0.200	-0.011	0.004	3.5E-04	3.2E-06
					(4.303)**	(1.441)	(3.118)**	(3.670)**	(1.103)	(3.005)**
LCH	RANDOM	0.145	-0.024	-0.426	-0.617	-0.073	-0.011	0.004	3.6E-04	2.9E-06
				(3.505)**	(4.055)**	(0.826)	(3.092)**	(3.868)**	(1.152)	(2.785)**

Notes

Absolute values of t-statistics are in parentheses.

**(*) Coefficients are significant at the 1%(5%) level.

Each variable has 231(21 banks times 11 period) sample data.

Definition of variables are as follows;

- LCHA: The ratio of loan change to asset
- LCH: The growth rate of loans
- EEQR: The estimated capital/asset ratio
- CHRT: The ratio of the difference of value of total stocks from the estimated equity to asset
- CALL: The interest rate of interbank(call) market
- IP: Industrial production index
- EXR: Exchange rate
- NIKK: Nikkei 225 stock market index

Dummy variables are included in the estimated equation, but are not reported in the table.

Table 4 Regression of Loans and BIS Ratios on Capital/Asset Ratio
Classified Data: March 1990~September 1995, semi annual)

Dependent Variable	Sample	Model	R^2	Adjusted R^2	C	EEQR	CHRT	CALL	IP	EXR	NIKK
LCHA	LOW EEQR	POOLING	0.267	0.130	-0.199	-0.359	0.029	-0.001	0.003	-2.8E-04	9.1E-07
					(2.383)*	(2.375)*	(0.455)	(0.369)	(3.381)**	(1.279)	(1.201)
LCHA	LOW EEQR	FIXED	0.593	0.382	-0.205	-0.151	-0.078	2.0E-04	0.003	-3.4E-04	5.1E-07
					(2.676)**	(0.835)	(0.757)	(0.094)	(3.716)**	(1.670)	(0.772)
LCH	LOW EEQR	POOLING	0.223	0.077	-0.308	-0.855	0.060	-0.002	0.004	-3.9E-04	2.2E-06
					(1.732)	(2.653)**	(0.438)	(0.430)	(2.488)*	(0.850)	(1.340)
LCH	LOW EEQR	FIXED	0.604	0.398	-0.324	-0.299	-0.217	4.8E-04	0.004	-6.1E-04	1.3E-06
					(2.071)*	(0.811)	(1.038)	(0.108)	(2.901)**	(1.489)	(0.980)
LCHA	HIGH EEQR	POOLING	0.201	0.053	-0.274	-0.153	-0.076	-0.009	0.003	4.0E-04	1.1E-06
					(3.271)**	(1.307)	(1.621)	(3.666)**	(3.281)**	(2.252)*	(1.681)
LCHA	HIGH EEQR	FIXED	0.326	-0.019	-0.258	-0.026	-0.088	-0.008	0.003	3.6E-04	7.9E-07
					(2.756)**	(0.187)	(1.014)	(3.103)**	(2.769)**	(1.882)	(1.020)
LCH	HIGH EEQR	POOLING	0.208	0.061	-0.613	-0.502	-0.208	-0.021	0.006	0.001	2.5E-06
					(2.961)**	(1.744)	(1.806)	(3.672)**	(2.938)**	(2.634)**	(1.460)
LCH	HIGH EEQR	FIXED	0.330	-0.014	-0.543	-0.143	-0.358	-0.019	0.005	0.001	1.3E-06
					(2.346)*	(0.411)	(1.672)	(2.964)**	(2.300)*	(2.200)*	(0.686)

Notes
Absolute values of t-statistics are in parentheses.
**(*) Coefficients are significant at the 1%(5%) level.
There are 115 sample data for low EEQR group and 116 for high EEQR group.
See the footnotes of Table 2 for the definition of variables.
Dummy variables are included in the estimated equation, but are not reported in the table.

Table 5 **Regression of BIS ratio on Capital/Asset Ratio for Major 21 Banks from March 1990 to September 1995(Semi-Annual Data)**

Dependent Variable	Model	R^2	Adjusted R^2	Independent Variable C	EEQR	CHRT	CALL	IP	EXR	NIKK
BISCG	POOLING	0.543	0.504	1.685	-2.545	0.093	0.072	-0.010	-0.003	-2.3E-05
				(5.926)**	(7.292)**	(0.475)	(8.663)**	(3.646)**	(4.469)**	(9.446)**
BISCG	FIXED	0.568	0.482		-3.174	0.197	0.071	-0.009	-0.003	-2.2E-05
					(7.918)**	(0.597)	(8.287)**	(3.408)**	(3.855)**	(8.847)**
BISCG	RANDOM	0.552	0.463	1.675	-2.777	0.112	0.072	-0.010	-0.003	-2.3E-05
				(6.329)**	(8.179)**	(0.531)	(9.266)**	(3.892)**	(4.622)**	(10.011)**

Notes

Absolute values of t-statistics are in parentheses.
**(*) Coefficients are significant at the 1%(5%) level.
Each variable has 231(21 banks times 11 period) sample data.
BISCG is the growth rate of BIS capital(Tier I and II).
See the footnotes of Table 2 for the definition of other variables.
Dummy variables are included in the estimated equation, but are not reported in the table.

Table 6

Analysis of Subordinated Debt
Semi Annual Data from March 1990 to September 1995

Dependent Variable	Model	R^2	Independent Variable Adjusted R^2	C	EQR	HRR	GPR	SPR	SDR	NPR	CALL	IP	EXR	NIKK	CHRT
LCHA	Pooling	0.312	0.236	-0.227	0.521	-0.213	-2.504	-0.225	-0.754	0.127	-0.005	0.002	8.4E-05	1.3E-06	-0.052
				(4.215)**	(2.530)*	(2.544)*	(2.848)**	(0.425)	(3.267)**	(1.025)	(3.317)**	(4.685)**	(0.568)	(2.448)*	(1.457)
LCHA	Fixed	0.305	0.145		1.196	-0.169	-3.130	0.093	-0.729	0.185	-0.004	0.002	2.5E-04	1.0E-06	-0.095
					(3.457)**	(1.630)	(1.918)	(0.158)	(2.595)*	(1.339)	(2.777)**	(4.611)**	(1.474)	(1.637)	(1.606)
LCHA	Random	0.298	0.137	-0.239	0.659	-0.203	-2.561	-0.136	-0.744	0.155	-0.005	0.002	1.3E-04	1.2E-06	-0.061
				(4.816)**	(2.969)**	(2.493)*	(2.585)**	(0.273)	(3.304)**	(1.338)	(3.540)**	(5.241)**	(0.926)	(2.420)*	(1.600)
SDR	Pooling	0.820	0.801	0.058	-0.258	-0.119	1.006	-0.485		0.039	-0.002	-1.1E-04	-2.1E-04	3.8E-07	-0.007
				(3.718)**	(4.368)**	(5.024)**	(3.952)**	(3.112)**		(1.050)	(3.624)**	(0.737)	(5.057)**	(2.390)*	(0.632)
SDR	Fixed	0.808	0.765		-0.238	-0.001	0.776	-0.387		0.014	-0.001	-7.6E-05	-2.3E-04	-1.0E-08	-0.014
					(2.703)**	(0.055)	(1.850)	(2.587)*		(0.394)	(3.729)**	(0.570)	(5.765)**	(0.062)	(0.937)
SDR	Random	0.806	0.763	0.060	-0.236	-0.041	0.973	-0.424		0.017	-0.002	-8.7E-05	-2.3E-04	1.4E-07	-0.008
				(4.266)**	(3.281)**	(1.648)	(2.930)**	(2.943)**		(0.486)	(3.901)**	(0.665)	(6.012)**	(0.937)	(0.653)

Notes

Absolute values of t-statistics are in parentheses.
**(*) Coefficients are significant at the 1%(5%) level.
Each variable has 231(21 banks times 11 period) sample data.
Definition of independent variables is as follows:
- EQR: The ratio of book value of equity capital to asset
- HRR: The ratio of hidden reserves on the listed securities to asset
- GPR: The ratio of general purpose provisions to asset
- SPR: The ratio of special purpose provisions to asset
- SDR: The ratio of subordinated debts to asset
- NPR: The ratio of non-performing loans to asset

See the footnotes of Table 2 for the definition of other variables.
Dummy variables are included in the estimated equation, but are not reported in the table.

Table 7 Regression of Bank Loans on Charter Value (Semi Annual Data from March 1990 to September 1995)

Dependent Variable	Model	R^2	Adjusted R^2	C	EEQR	CHRT	Q	SA	CALL	IP	EXR	NIKK
				Independent Variable								
LCHA	POOLING	0.125	0.055	-0.225 (4.087)**		-0.011 (0.302)			-0.004 (2.625)**	0.002 (4.655)**	-4.6E-05 (0.337)	1.0E-06 (2.204)*
LCHA	FIXED	0.134	-0.032			-0.055 (0.872)			-0.004 (2.579)*	0.002 (4.434)**	-6.4E-05 (0.470)	1.0E-06 (2.259)*
LCHA	RANDOM	0.126	-0.042	-0.225 (4.110)**		-0.014 (0.355)			-0.004 (2.648)**	0.002 (4.689)**	-4.7E-05 (0.349)	1.0E-06 (2.229)*
LCHA	POOLING	0.171	0.101	-0.232 (4.309)**	-0.236 (3.365)**		-3.4E-04 (0.401)		-0.005 (3.031)**	0.002 (4.903)**	5.8E-05 (0.428)	1.4E-06 (2.956)**
LCHA	FIXED	0.191	0.031		-0.287 (3.764)**		-4.8E-04 (0.543)		-0.005 (3.112)**	0.002 (4.890)**	7.8E-05 (0.582)	1.5E-06 (3.147)**
LCHA	RANDOM	0.175	0.012	-0.232 (4.376)**	-0.248 (3.502)**		-3.7E-04 (0.437)		-0.005 (3.096)**	0.002 (4.983)**	6.3E-05 (0.467)	1.4E-06 (3.041)**
LCHA	POOLING	0.127	0.057	-0.232 (4.223)**			0.001 (0.762)		-0.004 (2.636)**	0.002 (4.738)**	-2.3E-05 (0.169)	9.8E-07 (2.118)*
LCHA	FIXED	0.131	-0.035				4.3E-04 (0.483)		-0.004 (2.617)**	0.002 (4.658)**	-2.8E-05 (0.202)	9.8E-07 (2.131)*
LCHA	RANDOM	0.127	-0.040	-0.232 (4.248)**			0.001 (0.738)		-0.004 (2.654)**	0.002 (4.768)**	-2.4E-05 (0.173)	9.8E-07 (2.134)*
LCHA	POOLING	0.171	0.100	-0.236 (4.395)**	-0.238 (3.233)**			0.013 (0.355)	-0.005 (3.030)**	0.002 (4.941)**	6.7E-05 (0.496)	1.3E-06 (2.884)**
LCHA	FIXED	0.190	0.030		-0.259 (2.869)**			-0.018 (0.315)	-0.005 (3.079)**	0.002 (4.850)**	8.1E-05 (0.600)	1.4E-06 (3.113)**
LCHA	RANDOM	0.175	0.012	-0.236 (4.455)**	-0.246 (3.257)**			0.009 (0.244)	-0.005 (3.090)**	0.002 (5.012)**	7.1E-05 (0.532)	1.4E-06 (2.967)**
LCHA	POOLING	0.130	0.061	-0.223 (4.084)**				-0.039 (1.174)	-0.004 (2.655)**	0.002 (4.645)**	-3.7E-05 (0.272)	1.1E-06 (2.371)*
LCHA	FIXED	0.155	-0.007					-0.115 (2.400)*	-0.004 (2.676)**	0.002 (4.459)**	-2.7E-05 (0.201)	1.3E-06 (2.750)**
LCHA	RANDOM	0.134	-0.032	-0.222 (4.132)**				-0.051 (1.436)	-0.004 (2.711)**	0.002 (4.710)**	-3.5E-05 (0.267)	1.1E-06 (2.475)*

Notes: Absolute values of t-statistics are in parentheses.
**(*) Coefficients are significant at the 1%(5%) level.
Each variable has 231(21 banks times 11 period) sample data.
Q is the ratio of market value of banks' stock to the book value of equity, and SA is the ratio of market value of stock to asset.
See the footnotes of Table 2 for the definition of other variables.
Dummy variables are included in the estimated equation, but are not reported in the table.