NBER WORKING PAPER SERIES

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Takatoshi Ito
Yuri Nagataki Sasaki

Working Paper 6730
http://www.nber.org/papers/w6730

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
September 1998

Comments on an earlier draft by Thomas Pugel, Hugh Patrick, and other participants in the Japan Economic Seminar, New York, University of Tokyo, Bank of Japan, Kobe University, and Osaka University were very helpful. Helpful and constructive comments from Graham Elliot, Michael Gibson, Brian Hall, KIazuo Ueda, and Yuzo Honda were very much appreciated. All remaining errors are our own. The views expressed here are those of the authors and do not reflect those of the National Bureau of Economic Research or institutions the authors have been affiliated with in the past or present.

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NBER Working Paper No. 6730
September 1998
JEL No. G18, G21, G28

ABSTRACT

This paper examines how the risk based capital standards, the so-called Basle Accord, influenced 87 major Japanese banks' behavior between 1990 and 1993. As the Japanese stock prices fell, banks' latent capital gains, which are part of tier II capital, became smaller. Empirical findings are consistent with a view that banks with lower capital ratios tended to issue more subordinated debts (tier II) and to reduce lending (risk assets).

Takastoshi Ito
Institute of Economic Research
Hitotsubashi University
Kunitachi, Tokyo, 186, Japan
and NBER
CR00312@srv.cc.hit-u.ac.jp

Yuri Nagataki Sasaki
Department of Commerce
Takachiho University
Suginami, Tokyo, 168, Japan

1. Introduction

This paper examines how the risk-based capital standards, the so-called Basle Accord, influenced 87 major Japanese banks' behavior between 1990 and 1993, a critical transition period for Japanese banks in their attempt to achieve the international standard.[1] In 1988, bank regulators of major industrial countries agreed to a standardized capital requirements on banks with international activities so that banks can withstand more adverse shocks.[2] The Basle Accord requires banks to achieve a certain ratio of capitalization for risk-weighted assets. Riskless assets such as the government bonds are excluded from the risk asset base, while commercial loans are counted at its entirety as risky assets. The capital is classified into two categories. Equity capital is counted as tier I capital, while other assets close to capital are counted as tier II capital. The ratio of capital (tier I and tier II combined) to risk-weighted asset was required to exceed 8 % (of which at least 4 % in tier I).

The capital standard became effective in March 1989 and internationally active banks were required to achieve the benchmark by December 1992. (For Japanese banks, the deadline was March 1993, the end of their accounting year). Although there is no explicit penalty for not achieving the requirement, clearing the hurdle is widely viewed as a must for any major banks with an extensive international branch network, because the regulators may prevent undercapitalized banks from expanding their businesses. Between 1989 and 1992 banks with a weaker capital base in Japan, the United States, and other advanced countries took various actions in order to increase their capital ratio: to

shift from risky assets to safe assets by curtailing lending and increasing government bond holdings; and to issue new equities (tier I) or some other forms of capital, such as subordinated debts and convertible bonds which are counted as tier II.

One distinctive feature for Japanese banks, as opposed to banks in the United States and United Kingdom, is that Japanese banks own stocks of financial and nonfinancial companies as a part of long-term business relationship.[3] Since banks had acquired the stocks of corporations a long time ago, unrealized capital gains were "hidden" from the balance sheet in accordance with the Japanese accounting standard. In the negotiation of defining the risk-based capital standard, Japanese regulators successfully argued that part of latent, unrealized capital gains from long-term holdings should be counted toward tier II capital, since they are not meant to be traded for profit. The hidden capital gains increased in the second half of the 1980s, as the stock prices kept increasing, and it looked easy for Japanese banks to achieve.

However, the Japanese stock prices fell sharply after it peaked at the end of December 1989. The Nikkei 225 index lost more than 60 % by the summer of 1992. The sharp stock price decline had two kinds of adverse effects on Japanese banks. First, it made difficult for banks to issue new equities with attractive terms.[4] Second, as the Japanese stock prices fell, banks' latent capital gains, which is part of tier II capital, became smaller. This squeezed the Japanese banks' capital base. Even large banks were affected from the unexpected sharp decline in stock prices. In this paper, we investigate how Japanese banks responded to

the introduction of the capital standards and the shock in the stock prices. In the United States, several studies established the effect of capital standards on banking behavior: Haubrich and Wachtel (1993), Berger and Udell (1993), Rodrigues(1993), Brinkmann and Horvitz(1995) and Hall (1993), to name a few. However, there have been only a few analytical papers for the Japanese banks' behavior. Empirical findings of this paper are consistent with a view that banks with lower capital ratios tended to issue more subordinated debts (an increase in tier II capital) and to reduce lending (a decrease of risk assets).

The rest of the paper is organized as follows: Section 2 reviews the literature. Section 3 explains the capital standards and the data. It will be shown that as the Japanese stock prices fell, banks' latent capital gains, which is pat of tier II capital became smaller. Section 4 is the core of this paper, presenting regression results of Japanese banking behavior. Empirical findings are consistent with a view that banks with lower capital ratios tended to issue more subordinated debts (tier II) and to reduce lending (risk assets).

2. Survey of the literature

2.1. U.S. experiences

There are several papers examining the impact of implementing risk-based capital standard on the U.S. banking behavior. An interesting fact cited by many researchers is that in the early 1990s banks' holding of government securities increased and bank lendings decreased faster than other times. A working hypothesis is that the capital standard caused a "credit crunch," which in turn

contributed to the recession of 1991 - 92. There are two ways to examine whether the risk-based capital standard made the difference: one to compare loans behavior of this period with earlier recessions and to show the loan growth was lower even after controlling for macro variables, and another to use cross-section data on banks with the risk-based capital ratio, and to show that poorly (risk-based-) capitalized banks increased the loans less than well capitalized banks.[5] Hall (1993), and Haubrich and Wachtel (1993) find evidence for the effect of risk-based capital standards on lending growth, while Berger and Udell (1994) is skeptical whether this is really different from other recessionary times. Brian Hall (1993) focuses on effects of introducing the risk-based capital standards on the U.S. commercial banks' portfolios. He conducts both macroeconomic analysis with long time series data, and a cross-sectional analysis with micro data. First, noting that the portfolio naturally changes toward safer assets during a downturn, he compares the portfolio changes from 1988 to 1992, which corresponds to the transition period of implementing the Basle Accord, to those of the earlier five recessions. It is shown that a growth rate of bank lendings during the transition period is lower than that during earlier economic downturns. He then regresses an asset item on industrial production and personal income for the period from 1959 to 1988, and then calculated the out-of-sample predicted value (with confidence intervals) for the period from 1989 to 1992. Hall concludes that actual holdings of government securities were more and actual industrial loans were less than predicted.

Hall also examines the relationship between risk-based capital ratio and

portfolio adjustment using cross-sectional data, and shows that indeed those banks with lower risk-based capital ratio adjusted portfolio more from 1989 to 1992.[6] All of Hall's findings suggest that during the period between 1989 and 1992, banks portfolio was distorted toward safer assets compared to earlier recessionary periods, and more so for banks with lower risk-adjusted capital ratio, due to the risk-based capital requirements.

Haubrich and Wachtel (1993) also focus on whether bank portfolios changed as a result of the Basle Accord among U.S. commercial banks. They find also that banks with lower risk-based capital ratios changed portfolio compositions more in order to achieve the capital standards. On average, government bond holdings increased and commercial and industrial loans decreased. However, extremely well-capitalized banks did not even boost their holdings of government, and in each size category, the fall in the commercial and industrial loan share was larger for the poorly capitalized banks.

Rodrigues (1993) uses regressions to investigate determinants of government securities holdings (instead of bank lendings), and finds that the effect of risk-based capital standards in 1990 to be marginal in general, but important for the relatively small fraction of banks with weak capital positions.

Berger and Udell (1994) examine reasons for a credit crunch with detailed data of nearly all commercial banks' balance sheets from 1979:III to 1992:II. They try to distinguish different "supply side" factors and "demand side" factors on loan growth. The risk-based capital, leverage capital, loan examination, and voluntary risk-retrenchment hypotheses are the four supply side factors to

influence banks' loans decision, while the macro/regional and secular decline hypotheses are the two demand side explanations. They emphasize the importance of comparing the banks' behavior of 1990-1992 to the behavior in the 1980s to draw conclusions on the effect of risk-based capital standards. In general, they find that demand side explanations are relatively strong and supply side explanations are found to be not robust in timing. They conclude that the effects of the risk-based capital ratios on lending, although significant, did not get consistently stronger in the early 1990s. Instead they suggest that non-risk-related credit crunch explanations, because the credit allocation lies in the shift in constant terms.

Brinkmann and Horvitz (1995) examine the link between lending and changes in the amount of equity and subordinated debt issued between 1987 and 1991. They find that banks with larger surplus used their new capital to grow loans. Brinkmann and Horvitz (1995) differ from other papers cited above in the sense that they focus on the changes in excess capital instead of equity ratio. This paper also tests the credit crunch hypothesis using the data of the amount of subordinated debt, however, the approach is much different. This paper suppose that both operations of increasing the amount of subordinated debt and of decreasing loans are used for increasing the RBC ratio.

2.2. Japanese experiences

As mentioned earlier, the unique aspect of the Japanese experiences with the risk-based capital standards is its inclusion of 45 % of unrealized capital gains on

stocks (or 50 % of tier I capital whichever lower) into its tier II capital. Hence, a sharp decline in stock prices from 1990 to 1992 raised a concern among the Japanese banking communities. Noting this linkage, Kim and Moreno (1994) examine the effect of stock price movements on bank lending. They use a vector-autoregressions model with monthly data of industrial production, consumer price index, call money rate, in addition to bank loans, and stock price index (Nikkei 225) for the period of 1970:1 - 1993:5 (with additional subsample regressions before and after 1983:12), and they show that the response of bank loans to innovations in the stock prices became positive and significant in the latter subsample. Hence, the sharp decline in stock prices in the early 1990s contributed to the lower bank loan growth. They attribute this to deregulated environment (abolishing "window-guidance" and interest rate ceilings) and greater emphasis on capital standards. However, Kim and Moreno do not directly check the role of risk-based capital standard (the Basle Accord) in the regression analysis. Also the vector-autoregressions do not differentiate the demand and supply factors of bank loans.

Ueda (1993) analyzes with cross-section data (consisting of 21 city, long-term credit and trust banks and 129 regional banks in March 1993) the effects of the non-performing loans, latent capital gains, and the Risk-based capital (RBC) ratio, on bank lendings in Japan. He shows that the risk-based capital standards did not affect the growth rate of lending by regional banks but did affect negatively the growth rate of lending by city banks, although the sample size is admittedly small.[7]

Yoshikawa, Eto and Ike (1994) examine the cross-section data of March 1993 (consisting of 21 city, long-term credit and trust banks and 130 regional banks) for bank lending behaviors. They found that increases in bank lending are negatively correlated with banks' nonperforming loans among regional banks but not among city banks, but lending to small and medium sized firms are not correlated with nonperforming loans of any categories of banks. They conclude that it was a demand decline rather than a supply shift that explains a decline in lending. However, the RBC ratio is not used in their analysis. Baba (1995) analyzes a hypothesis of credit crunch in a disequilibrium framework, namely whichever smaller of demand and supply determines the actual size of bank lending, with a nonlinear supply curve.[8] Baba includes several variables in addition to nonperforming loans in an attempt to identify demand and supply curves. A focus of both Yoshikawa, et al (1994) and Baba (1995) is nonperforming loans rather than the RBC ratio. Peek and Rosengren(1997) examines the effects of the risk-based capital (RBC) ratios of Japanese parent banks on the lending behavior of its branches in the US. It shows that the binding RBC requirements associated with the decline in the Japanese stock market resulted in a decline in commercial lending by Japanese banks in the US.[9]

Honda, Kawahara, and Kohara (1995) is closest to our paper in its analysis. They attempt to measure the impact of capital ratio and nonperforming loans on Japanese banks' lending, and show that the RBC ratio and nonperforming loan variable affect lending behavior of major banks (city, long-term credit and trust banks), while neither variable affects lending behavior of regional banks.

However, all of the papers mentioned above use the published data of risk-based capital ratio. As we will argue later, the published capital ratio does not represent a real pressure on banks, since adverse impacts from the decline in stock prices on the capital ratio has been alleviated by issuing subordinated debts. The decision by banks either to issue subordinated debts or curtailing lending would not be detected when the published capital ratios are used. To our best knowledge, the present paper is the first to analyze the panel data of risk-based capital (RBC) ratios of individual banks to test how banks responded to the fluctuation of the stock prices by issuing subordinated debts and restricting the loan growth. This paper also separately estimates the effects of nonperforming loan and RBC ratio on loan growth.

3. Risk-based Capital Standards and Data

3.1 Definition

With heightened concerns among bank regulators on undercapitalized banks in industrial countries, the Basle Committee of Supervisors drafted a recommendation on capital standards for banks in December 1987. With minor changes, the recommendation was adopted by the bank supervisors of the major industrialized countries in 1988. The first set of new capital standards became effective in 1989, and after some transitional standards[10], the final set of standards was implemented by the end of December 1992 (or for the Japanese banks, by the end of March 1993, the end of their fiscal year).

The key variable in the Basle Accord is the risk-based capital ratio, the ratio

of banks' capital to the risk adjusted assets. On the capital side, Tier I capital is basically own equities and Tier II capital is near capital such as loss reserves and subordinated debts. On the asset side, safe assets such as government bonds (issued by OECD governments) have zero weights, while commercial loans are fully counted as risk-weighted assets. In equation, one can write,

$$\text{RBC ratio} = \frac{[\text{Tier I} + \text{Tier II} - \text{deduction}]}{\sum_{j=1}^{n} W_j A_j}$$

Where W_j is the risk weight of the j-th asst and A_j is the anount of the j-th asset.

The Basle Accord states that tier I capital must be at least 4 % of risk-based assets, and the sum of tier I and tier II capital must be at least 8 % of the risk-weighted assets. However, some of the details of definitions of risk-weights and some categorizations were left to discretion of the national authorities. Maximilian Hall (1992) describes the details of the difference in definitions of tier I capital, tier II capital and risk weights for US, UK, and Japanese banks. As mentioned before, a notable difference exists for Japanese banks (vis-à-vis US or UK banks) in that latent capital gains are counted toward tier II capital. Risk-weights on some tier II items also favors Japanese banks.[11]

3.2 Data

Table 1 shows the items included in tier I capital, tier II capital, and risk-weights of assets applicable to Japanese banks. The standard is of course meant

to be the same for all industrial countries, but details vary reflecting institutional differences and some details are being left to interpretation of respective monetary authorities. The Japanese banks traditionally hold a large amount of stocks of other companies and financial institutions as a part of long-term business relationship. The difference between the low book value (evaluated at the original purchase price) and the market value is latent hidden capital gains (*fukumi eki*, or simply *fukumi*, in Japanese). Some of these companies in return hold the bank's stock. This cross-holding is a hallmark of enterprise groups (horizontal *keiretsu).* Since stocks are held as a long-term strategy of banks and firms, they are part of basic assets rather than short-term portfolio investment. This consideration led the Japanese authorities to argue that part of latent capital gains should be counted toward tier II capital. In practice, this was supposed to help Japanese banks to clear the risk-based capital ratio, because they are less capitalized (in tier I capital) than their counterparts abroad. Indeed latent capital gains remained high and even increasing in 1988-1989. However, stock prices in Japan fell sharply from the beginning of 1990 to the summer of 1992. The Tokyo stock exchanges lost two-thirds of total values in two and half years. As latent capital gains were squeezed, the Japanese banks became increasingly concerned about how to maintain the crucial level of 8 %.[12]

Figure 1 shows a parallel movement of the Nikkei 225 index (line graph) and latent capital gains (black bar). The magnitude of decline in latent capital gains from March 1990 to September 1990, and again from 1991 to 1992 is quite dramatic. By definition, this caused the declines in latent capital gains and in

risk-based capital ratio. However, impacts on balance sheets varied across banks, reflecting the difference in their capital positions and in the degree of reliance on latent capital gains. The Ministry of Finance changed the regulation in the fall of 1990 to allow banks to issue subordinated debts in order to help banks raise the capital ratio. Since both latent capital gains and subordinated debts are in the tier II capital, they are perfect substitutes for the purpose of maintaining a RBC ratio above 8 %. Figure 1 also shows that the decrease in latent capital gains (black bars) were partially matched by subordinated debt issues (white bars).

Appendix Table 1 shows the panel data of the RBC ratio for 21 largest banks (11 city banks (after two mergers), three long-term credit banks, seven trust banks and the average of internationally active regional banks.) It is obvious from the table that some banks had struggled in the transitional period (from 1988 to 1990) to achieve the critical 8 %. In particular, the ratio went down for almost all banks from March 1990 to September 1990. This reflects a sharp decline in stock prices from January to August of 1990. The ratio was below 8 % in September 1990 for more than half of the major 21 banks. The RBC ratio improved for almost all banks in 1991 and 1992, despite more declines in stock prices in 1992. The Sakura Bank (or Mitsui bank, before a merger and a change of name) was the last to clear the hurdle only in September 1992, six months before the final target date of March 1993.[13]

Appendix Table 2 shows how latent capital gains on securities holdings (near all in stocks) changed from 1990 to 1993. It is easy to observe that there were sharp declines from March 1990 to September 1990, and again from

September 1991 to September 1992. The latent capital gains movement mirrored the movement of stock price index. **Appendix Table 3** shows how banks issued the subordinated debts. Casual observations suggest that banks with low RBC ratios, like Mitsui, Fuji, and Sanwa, issued more subordinated debts than others, although Daiichi Kangyo, and Sumitomo, without apparent problem in achieving the RBC ratio also issued a substantial amount of subordinated debts.

Figure 2 shows that the changes in the sum of lending amounts from 1990 to 1993. The amount increased until March 1993 and then decreased sharply. The timing of decreases in lending seems to be inconsistent with the hypothesis that the RBC ratio was the culprit for credit crunch, at least in the aggregate time-series level. However, cross-section data may suggest otherwise. **Appendix Table 4** shows the panel data of bank loans of the 21 major banks and the average of regional banks. Indeed lending was not growing or rather declining for many banks in the 1990s. Although it is difficult to make a clear cut observation, some banks, such as Sakura, which had low RBC ratios started to cut lending before other banks.

3.3 Working Hypothesis

Data presented above suggest the following hypotheses. First, banks issued subordinated debts which counted as tier II assets, in reaction to a sharp decline in the latent capital gains (*fukumi*) in 1991 and 1992. The problem arising from the decline in stock prices is unique to Japanese banking behavior, because counting the latent capital gains in tier II were unique to Japanese banks in the RBC

standards as described in earlier sections. This figure suggests the validity of the working hypothesis.

The second working hypothesis is a credit crunch hypothesis that had been tested in the United States (as surveyed in Section II). The hypothesis is that undercapitalized banks become reluctant to extend bank loans, because of commercial lending (as opposed to holdings of safe, lower risk weight, assets) reduces the RBC ratio.

Credit crunch was a reason for low investment in the 1990s. However, others argue that it was demand that was low because of excess capacity. The same questions (as already asked in the U. S. context) arise here: whether it was the supply curve or demand curve that shifted in the bank loan market, whether the credit crunch (rationing) was taking place, and if so whether the Basle Accord was to blame. One way to check this is to use cross-section data of individual banks and to test whether the RBC ratio is correlated with a change in the lending ratio. This will be done in next section.

4. Theoretical and Empirical Analysis

4.1 Model of banks' behavior

First, a simple model of banks under capital requirements is developed. The Basle capital requirement is described here as variable costs for a bank instead of absolute constraints. The smaller the capital ratio, the higher costs the bank has to pay in terms of losing credibility for its management. Some opportunity costs may also incur due to restraints on international businesses

when the optimal ratio becomes lower than 8%. Even in the case that the capital ratio is above 8 %, a bank gain its credibility (thus diminishing the costs of raising funds and gaining businesses) by increasing its capital ratio.

Suppose that the representative bank maximizes the following profit function;

$$\max_{L,B,R} \Pi = r_L(L)\cdot L + r_B \cdot B - r_D \cdot D - r_R(R)\cdot R - C(BIS)$$

s. t. L+B = R+D+K

where, L denotes (commercial) loans; B bonds; D deposits; R subordinated debts; K capital; C(.) cost function of BIS, that is the RBC ratio; r_L interest rate for loan; r_B interest rate for bond; r_R interest rate for subordinated debts. The variable BIS is defined as

$$BIS = \left\{\frac{K+F+R}{L}\right\}.$$

where F is *fukumi.*

We assume that the cost of RBC ratio is reduced as the ratio increases while its rate of change is diminished or constant; ($C' < 0$, $C'' \geq 0$). It means that banks with a low RBC ratio can improve profit more by raising the ratio than banks with a high RBC ratio. Thus, the banks with a lower RBC ratio will try to raise the ratio more eagerly.

We also assume the following derivative conditions: $r_R' > 0$, $r_R'' > 0$, $r_L' < 0$, $r_L'' < 0$. The first two conditions imply that a bank which issues more subordinated debts has to raise the interest rate to attract more investors, and the rate of increase accelerates as more subordinated debts being issued. As for the conditions

for loan, we include total costs into interest rates. Even though the lending rate is given to this bank due to the perfectly competitive loan market, in order to increase lending, the bank has to bear the cost of additional efforts in screening borrowers.

Solving the above maximization problem using the Lagrangean Function, first order conditions are written as follows.

$$\frac{\partial \Pi}{\partial L} = r_L + r_L' \cdot L - C' \cdot \frac{\partial BIS}{\partial L} - \lambda = 0$$

$$\frac{\partial \Pi}{\partial B} = r_B - \lambda = 0$$

$$\frac{\partial \Pi}{\partial R} = -r_R - r_R' \cdot R - C' \cdot \frac{\partial BIS}{\partial R} + \lambda = 0$$

$$\frac{\partial \Pi}{\partial \lambda} = L + B - D - K - R = 0$$

Then, substituting out λ, we obtain the following three conditions.

(1) $$r_L + r_L' \cdot L - C' \cdot \frac{\partial BIS}{\partial L} = r_B$$

(2) $$r_R + r_R' \cdot R + C' \cdot \frac{\partial BIS}{\partial R} = r_B$$

(3) $$L + B - D - K - R = 0$$

Eq. (1) means that the net return of marginal loan is equal to profit of bonds. Eq.(2) states that the net return of marginal subordinated debts is equal to marginal profit of bonds.

We can obtain the reduced form of dL and dR by totally differentiating eq.(1)

and (2), and using the definition of BIS = (K+R+F)/L.

$$(4)\quad dL = \frac{\alpha_1 \cdot (dK + dF + dR) - dr_B}{\alpha_2}$$

$$(5)\quad dR = \frac{\alpha_1 \cdot dL - \alpha_3 \cdot (dK + dF) + dr_B}{\alpha_3 + \alpha_4}$$

where,

$$\alpha_1 = \frac{1}{L^2}\left(C' + BIS \cdot C''\right)$$

$$\alpha_2 = \frac{BIS}{L^2}\left(2 \cdot C' + BIS \cdot C''\right) + \left(2 \cdot r_L{}' + L \cdot r_L{}''\right)$$

$$\alpha_3 = \frac{1}{L^2} \cdot C''$$

$$\alpha_4 = 2 \cdot r_R{}' + R \cdot r_R{}''$$

Note that $\alpha_3 \geq 0$ because C" ≥ 0. $\alpha_4 > 0$ because $r_R' > 0$ and $r_R'' > 0$.

Assuming r_B and K are constant in the short run, the following relations can be derived from eq.(4) and (5).

$$(6)\quad \frac{dL}{dF} = \frac{\alpha_1}{\alpha_2} \cdot \frac{\alpha_4}{-\left(\frac{\alpha_1{}^2}{\alpha_2} - \alpha_3\right) + \alpha_4}$$

$$(7)\quad \frac{dR}{dF} = \frac{\left(\frac{\alpha_1{}^2}{\alpha_2} - \alpha_3\right)}{-\left(\frac{\alpha_1{}^2}{\alpha_2} - \alpha_3\right) + \alpha_4}$$

Suppose that the BIS cost function is linear (C"=0), then $\alpha_1<0$, $\alpha_2<0$ and $\alpha_3=0$. This leads to the following results:

$$(8)\quad \frac{dL}{dF}>0 \quad \text{and} \quad \frac{dR}{dF}<0.$$

For more general case (C">0), signs of the dL/dF and dR/dF may not be uniquely determined.[14] However, for small enough C", the above results prevail.

In the following subsection, we will examine Japanese banks' behavior with anticipation of the result (8).

4.2 Impact of the stock price decline on issuance of subordinated debts

First, we investigate how much impact a decline in the latent capital gains (denoted by FUKUMI) would have on the RBC ratio (denoted by BIS). Recall that the RBC ratio is the ratio of tier I capital and tier II capital (in which *fukumi* is included) divided by the risk-based asset (ASSET). First we define the latent capital gains ratio to the risk-based asset (the ratio denoted by FUKUMI/A = FUKUMI/ASSET) in order to normalize FUKUMI for the size.

A simplistic way to check effects of *fukumi* on the RBC ratio is to regress the RBC ratio on *fukumi* normalized by the asset size. However, when the banks would react to the *fukumi* decline by increasing subordinated debt issues, the RBC ratio cannot be used in the regression which attempts to show the causality from *fukumi* to the RBC ratio. Especially, our working hypothesis is that as *fukumi* went down, banks issued subordinated debts, and if this is correct, the regression

of BIS on FUKUMI/A will not fully reveal the relationship, because the RBC ratio will be restored by issuance of subordinated debts, so that the correlation is lost.

In order to eliminate the effect of the banks' reaction function, we construct a variable, the subordinated debts-adjusted RBC ratio (BISLESS) which excludes subordinated debts in calculating the RBC ratio. Using this variable, we can measure how much the RBC ratio would have been lowered if the subordinated debts were not issued. Semiannual data of 85 banks[15] from September 1990 (the first reporting period that subordinated debts were allowed) to March 1993 (the final target date to achieve the Basle Accord) are used to estimate the following equation:

$$(9a)\quad BISLESS(t,j) = \sum_i a_i + \sum_i b_i\, FUKUMI(t,j)/A(t,j) + cTREND + e(t,j)$$

where, i denotes the type of banks (i=0 denotes city banks and long-term credit banks, i=1 denotes the difference between city banks from trust banks, i=2 denotes the difference between city banks from the local banks; t denotes the period; j denotes bank name; and TREND is a time trend variable.

This regression captures how much change in *fukumi* would have impacts on the RBC ratio (BIS) excluding subordinated debts. Since FUKUMI/A is one component of BIS or BISLESS, one might think that b must be estimated to be 1. This is not true. Coefficient b will capture the correlation between the RBC ratio and the *fukumi* component among the different banks, and banks with different FUKUMI/A will have different asset compositions and reactions to shocks in

fukumi so that BISLESS would not necessarily corresponds one to one. The positive b implies that a bank with a smaller latent capital reserves ratio to assets tend to have a lower subordinated debt-adjusted RBC ratio.

A time trend variable is included in order to control for possibly changing macro factors common to all banks' decisions on the dependent variable. However, the movement of these macro factors may not be linear as captured by the trend term. The time dummy variables can be used to control for nonlinear changes in macroeconomic environment common to banks:

$$(9b)\quad BISLESS(t,j)=\sum_i a_i + \sum_i b_i\, FUKUMI(t,j)/A(t,j) + \sum_k c_k TIME_k + e(t,j)$$

where TIME is a time dummy variable, in that when k=t, $TIME_k$ is 1, and otherwise 0.

Table 2, shows that with BISLESS on the left hand side, b is estimated to be statistically significantly positive. The estimate implies that if the *fukumi* ratio to Asset is lowered by 1.7 percentage points, then the RBC ratio of city banks without subordinated debts falls by 1 %. This result is robust with respect to the choice of the trend or time dummy term. Coefficients b2 and b3 are found to be significantly positive. These results indicate that trust banks and the local banks depend more on FUKUMI for increasing their RBC ratio than city-LTC banks (here after, the category of city banks and long term credit banks is simply referred to as "city banks"). The coefficient of FUKUMI/A of trust and local banks, b+b1, and b+b2, respectively are both 0.39 and statistically significant (that is, different from zero).

This represents a large impact on the balance sheet conditions of trust and local banks from stock price movements. Hence, it is a serious consideration for banks how to cope with the change in the FUKUMI.

4.3 Effects of the RBC ratio on subordinated debts issues

Next, we investigate the first working hypothesis directly, namely how much banks would issue subordinated debts in response to the decline in the adjusted RBC ratio (without subordinated debts), BISLESS. Again, the RBC ratio includes subordinated debts (BIS) may not be an appropriate measure in investigating that the impact of the change in the RBC ratio on subordinated debt issues. Hence, the following two specifications are chosen to investigate the channel from the RBC ratio to subordinated debt issues.

For this, first we define by DRET the change in the subordinated debt ratio from t to t+1 in a ratio to the RBC ratio at t.

DRET(t,j) =: {RET(t+1,j)-RET(t,j)} / ASSET(t,j).

where RET(t,j) denotes the amount of subordinated debts outstanding for bank j at time t.

Since the improvement of RBC ratio by new issues of subordinated debts appears on the balance sheet in the future, the following regression would capture the delayed response from the RBC ratio at t and new issues in t+1. Since the subordinated debts became available in the fall of 1990, the semiannual data are used for estimation from September 1990 to March 1993. Again two different

specifications, one with a trend term and the other with time dummy variables, are estimated.

$$\text{(10a)}\quad DRET(t,j) = \sum_i a_i + \sum_i b_i\, BIS(t,j) + c\, TREND + e(t,j)$$

$$\text{(10b)}\quad DRET(t,j) = \sum_i a_i + \sum_i b_i\, BIS(t,j) + \sum_k c_k\, TIME_k + e(t,j)$$

The results are shown in Table 3a. The estimate of b is statistically significantly negative, implying that a typical city bank indeed increases the subordinate debts issues if BIS is lower. An impact from BIS on DRET appears significant also for trust banks (i.e. b+b1=0 is rejected) and for regional banks (i.e. b+b2=0 is rejected).

Since it is difficult to retire the existing stock of subordinated debts and banks (with high capital ratio with zero outstanding subordinated debts) cannot issue negative amounts (or purchase) subordinated debts and lower the BIS ratios, it is more appropriate to estimate equations (10a) and (10b) by TOBIT. Table 3b shows the results of the above equations estimated by TOBIT. The estimate of b is significantly negative and so are (b+b1) and (b+b2). The estimate shows, again, that a bank increases subordinate debts when the BIS becomes lower. According to results using TOBIT, behaviors of trust banks and regional banks are not different from that of city banks. Therefore, results are robust with respect to the estimation method, either OLS or TOBIT. Since the non-zero constraint seems to be binding for some banks, we regard TOBIT results more reasonable.

The second way to test the impact of RBC ratio (and not change) on subordinated debt issues is to regress the subordinated debt ratio to assets (denoted by RET/A) on the BISLESS.

$$(11a)\ RET(t,j)/A(t,j) = \sum_i a_i + \sum_i b_i\ BISLESS(t,j) + c\ TREND + e(t,j)$$

$$(11b)\ RET(t,j)/A(t,j) = \sum_i a_i + \sum_i b_i\ BISLESS(t,j) + \sum_k c_k\ TIME_k + e(t,j)$$

This amounts to regressing one component of the definition of the RBC ratio on the other component of the RBC ratio. Hence, if the bank target a particular RBC ratio and any change in components other than subordinated debts are made up by issuing subordinated debts, then b becomes -1. It means that substitution between subordinated debts and other items is one to one, namely subordinated debts becomes a residual to keep the RBC ratio constant.[16] In this specification, it would not be appropriate to use BIS as an explanatory variable. This can be seen as follows. Suppose that stock prices declined so that the BIS ratio as well as *fukumi* decreased. However, banks can issue subordinated debts by the time of semi-annual accounting deadline. If the decline in *fukumi* was completely offset by subordinated debts issues, then BIS would not fluctuate, while RET would increase. In that specification (with BIS on the right hand side), not finding a significant coefficient on the BIS variable would not be evidence for a lack of banks' actions on subordinated debt issues in response to the (possible intra-accounting period) change in the BIS. Within the semi-annual accounting period,

both RET and BIS would be endogenous variables, and running a regression of one variable on the other is not appropriate. By using BISLESS, the endogeneity problem is mostly avoided. As shown above, BISLESS reflects the portion of BIS which is not affected by RET movements.

Table 4 shows the results of (11a) and (11b). Indeed, for the city banks, the coefficient is very close to –1. Hence, the low adjusted RBC ratio is made up by issuing subordinated debts, even controlling for other factors which are captured by the time dummy variable. The estimates of b1 and b2 are significantly positive. But the magnitude is less than that of b. The substitution effect is lower for trust banks and regional banks, although some substitution occurs. It also implies that the banks with weaker capital base issue more subordinated debts. The two equations (9) and (10) especially the latter show that subordinated issues were increased in response to the level of adjusted RBC ratio that measures the RBC ratio in the case subordinated debts had not been issued.

In sum, the story of this subsection is consistent, that stock prices affected latent capital gains, as a part of tier II capital. The more affected, the more a bank issued subordinated debts. For city banks, the decline in the BIS ratio was completely offset by issuing subordinated debts.

4.4 Effects of the RBC ratio on lending

In this section, an effect of the RBC ratio on lending is examined. Lending is a major component of the denominator of the RBC ratio. If banks reacted to reduce loans, in addition to issuing subordinated debts, in an attempt to achieve

the 8 % threshold for the RBC requirement, we expect to pick it up through examining the bank loans data. During the period that preceded the deadline for achieving the RBC requirement, a suspicion was raised that banks were unnecessarily restricting lending to help achieve the 8 % RBC ratio. If banks were to reduce lending because of the RBC ratio, this would be called "credit crunch." Various papers investigated whether bank lending growth in a particular period (1991-1993 in Japan; and 1990 - 1992 in the U.S.) was lower than otherwise, controlling for factors that determine demand for and supply of bank lending, such as real activities and the interest rate that would be applicable for the banks to borrow from the market. [17]

During this period, in addition to the RBC ratio and other demand and supply factors, nonperforming loans had become an issue. As the land prices sharply declined in 1991 and 1992, many corporations, especially those in the real estate businesses, became essentially bankrupt. Banks which lent to these corporations were left with nonperforming loans. As the size of nonperforming loans became large, the banks became more cautious in lending. An examination of lending behavior in this period has to take into account the effect of nonperforming loans. It is difficult to know the exact amount of nonperforming loans. Disclosure of nonperforming loans was very inadequate before 1994. We will use two proxy variables in an attempt to capture effects of nonperforming loans.

First, the amount of special provisioning for nonperforming loans (Saiken Tokubetsu Kanjo, or SAITOKU for short) can be used for an proxy for

nonperforming loans. If provisioned amounts are a constant proportion of nonperforming loans which is unobserved by the econometricians, then the provisioning-lending ratio, SAITOKU/LEND, is a good proxy to the nonperforming ratio. The credit crunch implies that the coefficient of SAITOKU in relative to lending is negative. However, during the period, this may not necessarily be the case. The provision tended to lag behind the increase in nonperforming loans, if banks did not have enough profits. Weaker banks could not put aside enough reserves, while stronger banks could. Hence, more provisioning may imply that the bank is out of the problem and is ready to increase investment. If this effect is stronger, then the coefficient of SAITOKU becomes positive.

Another proxy variable for nonperforming loans is constructed exploiting a limited disclosure of actual nonperforming loans. The amount of lending to borrowers that went bankrupt (HATAN), which is only a part of nonperforming loans, has been disclosed since 1993. If the ratio of provisioning to HATAN had been constant for a bank, but varied across the banks, in 1990-1992, we would be able to recover the nonperforming loans (HATAN) can be recovered from SAITOKU. If the ratio of HATAN to total nonperforming loans have been constant, the nonperforming loans variable can be SAITOKU multiplied by the ratio of HATAN to SAITOKU:

NPL(t,j)=(SAITOKU(t,j)*(SAITOKU(1993,j)/HATAN(1993,j))

For the "credit crunch" effect of the RBC ratio on the behavior of lending, it is unclear whether the published data of the RBC ratio (BIS) is a good variable. As shown in an earlier section, banks tended to issue subordinated debts when the

latent capital gains declined. The RBC ratio (BIS) itself may not be a good proxy for the need for raising the RBC ratio, if subordinated debts were issued one to one for the loss in the latent capital gains. Hence, both the RBC ratio (BIS) and the adjusted RBC ratio (BISLESS) are used and compared in search for a variable which shows constraints in achieving the RBC ratio.[18]

A reduced form of the bank lending equation is constructed. First of all, the dependent variable is an increase in bank lending to industries other than real estate, constructions, and financial corporations, from time t to t+1, for bank j, DLEND(t,j) is divided by the amount of risk based asset A(t,j). Lending to the three industries is excluded from DLEND because it is said that in the early 1990s, banks often continued to lend to those corporation that stopped paying interests, in the hope that land prices would quickly rebound to save these corporations. This phenomenon (Oigashi) would make the statistical relationship reversed: With more nonperforming loans, the bank would appear to increase lending to these sectors. By removing the lending to these sectors, we can avoid these problems. This is appropriate because a (more realistic) "credit crunch" scenario is that too much lending to real estates continued even when a nonperforming loans problem has emerged, while lending to fixed investment (plants and equipment) was limited.

Other macro variables that affect either demand for and supply of bank lending are included explanatory variables. The industrial production index (IPI) is expected to increase the demand for bank loans, thus to be positively correlated with DLEND/A. The call rate (CALL) at which banks can borrow from other

banks is expected to be negatively correlated with DLEND/A. This is a proxy for the supply side function. These macro variables are common to all banks.

Our contribution to the literature on the credit crunch in Japan is credit crunch due to the RBC ratio requirement and credit crunch due to nonperforming loans are tested by explicitly including the RBC ratio and the problem of nonperforming loans in the lending equation. The analysis is conducted with the time-series (1990-1992), cross-section (85 banks) pooled data. The semi-annual data could not be used because the data of lending amounts by industries are available only annually. Since effects of RBC ratio and effects of SAITOKU on lending behavior may be different for different types of banks, we introduce dummy variables of trust banks and regional banks for the BIS, SAITOKU, in addition to the constant term.

With a choice in the combination of the RBC variable (BIS or BISLESS) and nonperforming loans variables (SAITOKU or NPL), there are four different specifications.

$$\text{(12a) } DLEND(t,j) = \Sigma_i a_i + \Sigma_i b_i BIS(t,j) + \Sigma_i c_i SAITOKU(t,j)/LEND(t,j) + \Sigma_k z_k Z_k(t) + e(t,j)$$

$$\text{(12b) } DLEND(t,j) = \Sigma_i a_i + \Sigma_i b_i BISLESS(t,j) + \Sigma_i c_i SAITOKU(t,j)/LEND(t,j) + \Sigma_k z_k Z_k(t) + e(t,j)$$

$$\text{(13a) } DLEND(t,j) = \Sigma_i a_i + \Sigma_i b_i BIS(t,j) + \Sigma_i c_i NPL(t,j)/LEND(t,j) + \Sigma_k z_k Z_k(t) + e(t,j)$$

$$\text{(13b) } DLEND(t,j) = \Sigma_i a_i + \Sigma_i b_i BISLESS(t,j) + \Sigma_i c_i NPL(t,j)/LEND(t,j) + \Sigma_k z_k Z_k(t) + e(t,j)$$

where, Z represents other macro variables: Z1 is CALL and Z2 is IPI.

Results are shown in Tables 5-6. In all tables, macroeconomic variables, IPI and CALL, have right signs and statistically significant. Results imply that when production activities increase, the demand for lending increases, and when the interbank interest rate increases, the supply of lending declines. This is entirely consistent with theoretical prediction, and it shows that the essential part of the model is estimated well.

Tables 5a and 5b use the SAITOKU variable. The coefficient of SAITOKU for city banks and trust banks has a negative sign, that is, more provisioning indicates less lending. It is only marginally significant for city banks, but is statistically significant with a larger magnitude for trust banks. This is consistent with a hypothesis that indicated "credit crunch" due to nonperforming loans. However, for regional banks, the sign apparently indicates that more provisioning encourage lending. (c1 and c2 coefficients indicate the additional effects for trust and regional banks over the city banks). If our approximation of nonperforming loan is appropriate, this result implies that the regional banks took moral hazard behavior. However, the fact that the estimated sign for the regional banks is opposite of that for the rest of the banks may be due to the characteristics of SAITOKU variable. As argued above, a higher SAITOKU amount may mean a weaker bank with more nonperforming loans (if the ratio of SAITOKU to nonperforming loans is constant) or a stronger bank with sufficient provisioning (if the ratio of SAITOKU to nonperforming loans vary in proportion to soundness of banks' balance sheet.)

The effect of the RBC ratio for city banks is positive and significant, but not

different from zero for trust or regional banks. (Again, b1 and b2 are additional effects for the trust and regional banks. The effect on trust banks for example is measure by b+b1.) The risk-based capital requirement was a serious hurdle only for banks with internationally active banks. The damage from not achieving the 8 % threshold would have been much greater for city banks. Therefore only among city banks, the less RBC ratio acted as a brake for lending. As the RBC ratio, both BIS and BISLESS seems to work, with higher significance (t-statistics) for BISLESS. Recall that in the subordinated debt issues, all three types of banks had significant coefficients. City banks were serious in achieving the RBC requirement, they both increased subordinated debt issues and decreased lending in reaction to the decrease in the RBC ratio (for example, a shock of decreasing latent capital gains), while trust and regional banks tended to issue more subordinated debts, but did not decrease lending.

Tables 6a and 6b use NPL as a proxy for nonperforming loans. Results with NPL are similar. The effects of capital requirement (BIS or BISLESS) on lending is significant only for city banks. The effect from NPL is barely significant for city banks, but large and significant for trust banks. Again, for regional banks, it has a wrong sign. In this case, the HATAN data for regional banks may not be reliable.

Hence, we conclude that the credit crunch due to nonperforming loans tended to be confirmed for city and trust banks, the more so for the latter, if SAITOKU is a right proxy for the seriousness of nonperforming loans. Only among city banks, credit crunch with the RBC ratio is confirmed.[19]

5. Concluding Remarks

Evidence contained in this paper suggests that the risk-based capital standard (the Basle Accord) had a significant impact on Japanese banking behavior. When stock prices fell, latent capital gains were reduced quickly. As the RBC ratio became low and the regulation changed, banks started to issue subordinated debts. Less latent capital gains a bank has, more subordinated debts did the bank issue. At the same time, banks with a lower capital ratio made less bank loans. In the summer of 1990, stock prices had declined sharply, and subordinated debts issues were not available, the RBC ratios of many banks were below 8 %. Although subordinated debt issues made banks with weak capital ratios cleared the hurdle in 1991, the stock prices made another big drop in 1992. More subordinated debts were issued, and loans were curtailed, as the final target date of March 1993 approached. Whether lower bank loans caused a real effect on the economy or not is beyond the scope of this paper. Credit crunch existed. The risk-based capital requirement had a large impact on city banks' lending behavior, while lending behavior of trust banks' had most affected by nonperforming loans.

Notes:

[1] The Basle Accord is typically known as the "BIS ratio" requirement in Japan. Although the discussions and negotiation took place in BIS (Bank for International Settlements in Basle), the agreement was not part of BIS functions. In this paper, we use the Basle Accord, the (risk-weighted) capital standards, capital adequacy requirements and the RBC ratio, interchangeably. See Appendix 1 for details of the standard.

[2] In the early 1980s, regulators in major industrial countries became concerned with banks' capital positions. Especially, in the aftermath of debt crisis of 1982, the public as well as regulators became aware of banks' vulnerability. The United States adopted more stringent capital guidelines in 1981 and 1983. At the same time, international activities of banks were increasing. In particular, Japanese banks, which were undercapitalized from the viewpoints of the U.S. and European regulators, were expanding their businesses quickly into the United States and Europe. Strength of these Japanese banks in international activities were analyzed by many researchers and scholars. (See for example, Kane (1991).) Some felt that Japanese banks enjoyed high profits in the regulated (such as low deposit interest rates) and protected domestic market with a low capital ratio, and compete unfairly in the international businesses. Critics argue that if different countries impose different standard for banks taking risk, unfair competition and unwanted international spillovers from bank's failure might result.

At the time the Federal Reserve approved an application of Fuji Bank acquiring a nonbank subsidiary (Walter E. Heller International Corporation) in December 1983, the Federal Reserve Board observed and raised questions about that the reported capital ratio of Fuji Bank was much less than the 5 % ratio that then applied to U.S. banks. (Kim and Moreno (1994, p.35))

Thus, the risk-based capital standards were partly motivated as a minimum standard that can be imposed to alleviate concerns: "the single item on which I place greatest emphasis relates to bank capital adequacy standards and specifically to the goal of moving Japanese bank capital standards into closer alignment with emerging international standards." (U.S. Senate testimony by E. G.

Corrigan, May 6, 1987, cited by Hall (1993))

On December 11, 1987, a proposal was made by the Committee on Banking Regulations and Supervisory Practices of the Bank for International Settlement in Basle, which consisted of Group of Ten countries (U.S., Japan, Germany, UK, France, Canada, Italy, Belgium, Sweden, the Netherlands) plus Switzerland and Luxembourg. The final agreement was signed on July 11, 1988.

[3] The long-term business relationship between a bank and a corporation is described as a "main bank" relationship and a "keiretsu" relationship in the literature. For details of this feature, see Ito (1992; ch. 7) for example.

[4] Before the significant stock price decline in 1990, many banks issued new equities. One might conjecture that these issues are motivated by increasing the RBC ratio. According to Petteway et al. (1991), wealth effects of new issues (samples of 27 large banks from January 1985 to March 1989) are different from the United States experiences.

[5] This literature follows a more traditional approach, looking at the relationship between unweighted capital ratio and loan growth, such as Bernanke and Lown (1991), and Peek and Rosengren (1991, 1992).

[6] Hall (1993; p.426) noted that "at the beginning of 1990, banks representing almost 30% of bank assets failed both of the [risk-based capital] standards. Less than two years later, at the end of 1991, ... , banks representing only 9% of bank assets failed any of the requirements.

[7] The effects of the nonperforming loans on city and regional banks were just opposite. He interpreted this as an evidence that achieving the RBC ratio (to 8 % or higher) was very important for the city banks (with international business), while lending behavior of regional banks were more affected by the nonperforming loans problem. It should be noted that in the data used by Ueda coverage of nonperforming loans among 21 leading banks and other regional banks are different, so that results for the two categories are not directly comparable.

[8] Baba (1995) used the ratio of interest payment to cash flows, the credit (unsecured) ratio of lendings, and the interest rate. The nonlinear supply curve is motivated by the equilibrium credit rationing literature which emphasizes adverse selection of borrowers.

[9] Horiuchi and Shimizu (1996) test the moral hazard hypothesis, of which model based on Dewatripont and Tirole(1993). They shows that the banks with higher capital/equity ratios tended to reduce their credit supply.

[10] The transitional standard was to be achieved by the end of December 1990, except for the Japanese banks by the end of March 1991.

[11] "The difference arise, of course, in those instances where the Basle Committee determined to allow for national discretion. In virtually all such cases, the Japanese authorities have seen fit to adopt the lowest weights permissible under the BIS agreement." M. Hall (1992, p.39)

[12] Ichimura and Milne (1993) pointed out some structural problems with the Japanese banks which made it difficult to achieve high risk-weighted capital ratio and to earn high profits.

[13] The RBC ratio reported in Table 2 is calculated according to the "final criteria" which would become effective in March 1993 for Japanese banks. They were allowed to calculate the ratio in a slightly lenient way, and the minimum clearance ratio was slightly lower, during the transition period, the fact that banks were below 8 % in 1990 through 1992 in the table does not necessarily mean that these banks were in violation of the RBC standards. See M. Hall (1992) for special provisions for Japanese banks during the transition period.

[14] For a general case, a note is available from the authors upon request.

[15] All of the major 21 banks (14 city banks, 3 long-term credit banks, 7 trust banks) are included in the sample. In addition, 64 regional banks that have

international operations are included. Iyo bank and Sanin-Godo bank are excluded because they merged during the sample period.

[16] This is a correct statement when "other" components are declining. When "other" components becomes higher, the assets can be increased (loans to increase) rather than retiring subordinated debts.

[17] Gibson (JJIE 1997) showed that investment declined as the soundness of banking deteriorated in Japan. Honda et al. (1995) shows that RBC standard itself (instead of each bank's own RBC ratio) plays the role of restriction for lending behavior of all the banks in Japan.

[18] Brinkmann and Horvitz (1995).

[19] This conclusion is in sharp contrast to some of other studies, in particular to Yoshikawa (1994). The difference is that Yoshikawa used only a one-time cross section data, while we use the time series, cross section data and that Yoshikawa used all lending while we excluded lending to real estate, constructions, and financial corporations.

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Table 1

Panel A. Components of Capital in Japan

Tier I capital	a. Common stock of the bank b. Non cumulative, perpetual preferred stock c. Disclosed reserves d. Published retained earnings e. Consolidated subsidiaries minority interest
Tier II capital	a. 45 % of latent revaluation reserves related to securities holding. b. General loan loss reserves c. "Allowable" hypbrid capital instruments: Convertible subordinated bonds; Perpetual, cumulative preferred stock and limited life redeemable preferred stock. (Up to 50% of tier I capital) d. "Allowable" subordinated term debt," subject to a limit: subordinated loans (of banks adhering to the BIS rules); subordinated bonds. (Up to 50% of tier I capital, after April 1993; and if the maturity is less than 5 years, reduce the amount by 20% every year)
Deduction	a. Goodwill (deduction from tier I) b. "International" reciprocal holdings of capital instruments of banks aimed at raising capital ratios

Panel B. Risk-weights applied to asset items

Asset Items	Risk weight (%)
Cash; Gold; Loans to, and claims fully guaranteed by, OECD central governments [government bonds] and central banks including claims on the EC. Loans to non-OECD central governments or central banks denominated in local currency and funded in that currency.	0
Claims fully collateralized by cash	0 Japan&UK 20, US
Claims on multilateral development banks [international development banks] and claims fully-guaranteed by or fully-collateralized by the securities issued by these institutions; claims on credit institutions incorporated in the OECD and claims guaranteed (or accepted or endorsed) by OECD-incorporated credit institutions.	20
Loans fully secured by mortgage on residential property owned or rented out by the borrower	50
Claims on the non-bank private sector; Claims on credit institusions incorporated outside the OECD with a residual maturity of over one year; Claims on commercial companies owned by the public sector; Claims on central governments and central banks outside the OECD (unless denominated in the national currency and funded in that currency); Claims guaranteed by non-OECD central governments or central banks which are not denominated in local currency and funded locally; Premises, plant, equipment and other fixed assets.	100

Source: M. Hall (1992), Kin-yu zaisei jijo, various issues.

Table 2 : Fukumi impact: the adjusted RBC ratio

$$BISLESS(t,j) = \Sigma_i a_i + \Sigma_i b_i \; FUKUMI(t,j)/A(t,j) + c \; TREND + e(t,j) \qquad (9a)$$

$$BISLESS(t,j) = \Sigma_i a_i + \Sigma_i b_i \; FUKUMI(t,j)/A(t,j) + \Sigma_k c_k \; TIME_k + e(t,j) \qquad (9b)$$

Freq. semi-annual, March *:3 and September *:9.
Coverage: 85 banks
Observation periods; 90:9-93:3.

	(9a)c=:0	t-value	(9a)	t-value	(9b)	t-value
a	6.16	24.68	6.07	22.23	6.13	22.05
a1	0.7	1.67	0.7	1.66	0.7	1.66
a2	0.19	0.72	0.23	0.85	0.21	0.78
b	0.17	3.51	0.18	3.6	0.17	3.38
b1	0.22	3.16	0.22	3.13	0.22	3.14
b2	0.22	4.02	0.21	3.83	0.21	3.86
c	--	--	0.02	0.81	Not reported	
R bar sq.	52.8		52.7		52.5	
b+b1	0.39	7.82	0.4	7.84	0.39	7.56
b+b2	0.39	17.08	0.39	17.08	0.39	15.84

Table 3: Subordinated Debt issue in reponse to the RBC ratio

$$DRET(t, j) = \Sigma_i a_i + \Sigma_i b_i\ BIS(t, j) + c\ TREND + e(t, j) \qquad (10a)$$

$$DRET(t, j) = \Sigma_i a_i + \Sigma_i b_i\ BIS(t, j) + \Sigma_k\ c_k\ TIMEk + e(t, j) \qquad (10b)$$

Freq. semi-annual, March *:3 and September *:9.
Coverage: 85 banks
Observation periods; 90:9-93:3.

Table 3.a (OLS)

	(2a)c=:0	t-value	(2a)	t-value	(2b)	t-value
a	4.49	9.29	3.84	7.91	3.57	7.33
a1	-3.08	-5.03	-2.31	-3.77	-2.16	-3.56
a2	-2.28	-4.49	-1.84	-3.68	-1.74	-3.52
b	-0.48	-8.48	-0.39	-6.81	-0.35	-6.06
b1	0.35	5.15	0.26	3.82	0.24	3.56
b2	0.25	4.16	0.2	3.33	0.18	3.15
c	--	--	-0.04	-5.37	not reported	
R bar sq.	36.5		39.8		41.6	
b+b1	-0.13	-3.3	-0.13	-3.44	-0.11	-2.93
b+b2	-0.23	-13.13	-0.2	-10.58	-0.17	-8.14

Table 3.b (TOBIT)
Positive Observations: 43.5%

	(2a)c=:0	t-value	(2a)	t-value	(2b)	t-value
a	5.19	6.15	4.16	4.83	3.46	3.78
a1	-0.52	-0.36	0.4	0.28	0.77	0.53
a2	-0.73	-0.81	-0.24	-0.26	0.71	0.75
b	-0.57	-5.73	-0.43	-4.16	-0.36	-3.22
b1	0.06	0.35	-0.05	-0.32	-0.1	-0.62
b2	0.04	0.37	-0.02	-0.18	-0.13	-1.2
c	--	--	-0.07	-4.12	not reported	
sigma	0.47	19.38	0.45	19.46	0.44	19.5
b+b1	-0.52	-3.95	-0.48	-3.89	-0.46	-3.58
b+b2	-0.53	-12.75	-0.45	-10.36	-0.49	-9.47

Table 4: Response function of banks in issuing subordinated debts

$$RET(t,j)/A(t,j) = \Sigma_i a_i + \Sigma_i b_i\ BISLESS(t,j) + c\ TREND + e(t,j) \quad (11a)$$

$$RET(t,j)/A(t,j) = \Sigma_i a_i + \Sigma_i b_i\ BISLESS(t,j) + \Sigma_k\ c_k\ TIME_k + e(t,j) \quad (11b)$$

Freq. semi-annual, March *:3 and September *:9.
Coverage: 85 banks
Observation periods; 90:9-93:3.

	(3a)c=:0	t-value	(3a)	t-value	(3b)	t-value
a	8.34	14.1	5.61	11.68	5.31	12.69
a1	-5.58	-6.72	-4.11	-6.36	-3.37	-6.01
a2	-3.66	-5.91	-1.45	-2.94	-1.07	-2.5
b	-0.98	-11.64	-0.67	-9.87	-0.67	-11.45
b1	0.72	6.91	0.49	5.93	0.41	5.74
b2	0.5	5.71	0.18	2.62	0.13	2.2
c	--	--	0.21	18.48	not reported	
R bar sq.	57.6		74.7		81.2	

b+b1	-0.26	-4.2	-0.18	-3.75	-0.26	-6.25
b+b2	-0.48	-20.33	-0.48	-26.35	-0.54	-32.83

Table 5a:

$$\mathbf{DLEND(t,j) = \Sigma_i a_i + \Sigma_i b_i BIS\ (t,j) + \Sigma_i c_i SAITOKU(t,j)\ /LEND(t,j) + \Sigma_k z_k Z_k\ (t) + e(t,j)}$$

(12a)

Freq. annual.
Coverage: 85 banks.
Observation periods: 1990–1993.

		t-stat.
a	−38.99	−4.22
a1	11.28	1.31
a2	16.29	2.09
b	1.86	2.01
b1	−1.24	−1.23
b2	−1.67	−1.77
c	−0.36	−1.69
c1	−1.36	−1.66
c2	3	2.74
z1	−1	−4.36
z2	0.33	5.54
A_R**2	0.374	

		t-stat.
b+b1	0.62	1.54
b+b2	0.19	0.94

c+c1	−1.72	−2.17
c+c2	2.64	2.45

Table 5b:

$$DLEND(t,j) = \Sigma_i a_i + \Sigma_i b_i\, BISLESS(t,j) + \Sigma_i c_i\, SAITOKU(t,j)/LEND(t,j) + \Sigma_k z_k Z_k(t) + e(t,j) \quad (12b)$$

Freq. annual.
Coverage: 85 banks.
Observation periods: 1990–1993.

		t-stat.
a	-27.48	-4.82
a1	4.11	0.8
a2	10.29	2.64
b	1.09	2.21
b1	-0.44	-0.75
b2	-1	-2
c	-0.2	-0.9
c1	-1.56	-1.91
c2	2.77	2.54
z1	-0.8	-3.45
z2	0.27	4.03
A_R**2	0.376	

		t-stat.
b+b1	0.65	1.8
b+b2	0.09	0.61

c+c1	-1.76	-2.24
c+c2	2.57	2.4

Table 6a:

$$\mathbf{DLEND(t,j) = \Sigma_i a_i + \Sigma_i b_i BIS\ (t,j) + \Sigma_i c_i\ NPL(t,j)\ /LEND(t,j) + \Sigma_k z_k Z_k\ (t) + e(t,j)}$$

(13a)

NPL(t,j) = Saitoku(t,j)*(Hatan(1993) / Saitoku(1993))
Freq. annual.
Coverage: 85 banks.
Observation periods: 1990-1993.

		t-stat.
a	-38.92	-4.24
a1	13.52	1.55
a2	15.56	2
b	1.8	1.96
b1	-1.48	-1.48
b2	-1.6	-1.7
c	-3.4	-1.89
c1	-14.85	-1.67
c2	5.34	2.77
z1	-0.98	-4.31
z2	0.33	5.63
A_R**2	0.379	

		t-stat.
b+b1	0.32	0.82
b+b2	0.21	1.04

c+c1	-18.25	-2.1
c+c2	1.94	2.79

Table 6b:

$$\mathbf{DLEND(t,j) = \Sigma_i a_i + \Sigma_i b_i BISLESS\ (t,j) + \Sigma_i c_i NPL(t,j)/LEND(t,j) + \Sigma_k z_k Z_k\ (t) + e(t,j)} \quad \textbf{(13b)}$$

NPL(t,j) = Saitoku(t,j)*(Hatan(1993) / Saitoku(1993).

Freq. annual.

Coverage: 85 banks.

Observation periods: 1990-1993.

		t-stat.
a	-27.19	-4.87
a1	5.93	1.14
a2	9.73	2.57
b	1.08	2.22
b1	-0.66	-1.13
b2	-0.97	-1.96
c	-2.38	-1.29
c1	-16.42	-1.85
c2	4.3	2.19
z1	-0.78	-3.37
z2	0.27	4.02
A_R**2	0.381	

		t-stat.
b+b1	0.42	1.16
b+b2	0.12	0.76

c+c1	-18.79	-2.16
c+c2	1.92	2.76

Appendix Table 1 Panel dataof RBC ratio for Japanese banks (%)

	1990.3	1990.9	1991.3	1991.9	1992.3	1992.9	1993.3	1993.9
City banks:11								
DKG	8.28	7.3	8.75	8.38	8.25	8.53	9.36	9.8
Sumitomo	8.44	7.81	8.87	8.94	8.43	8.82	9.37	9.91
Fuji	8.24	8.01	9.08	8.72	8.04	8.71	9.26	9.82
Mitsubishi	8.46	7.62	8.7	8.71	8.2	8.73	9.12	9.81
Sanwa	8.45	7.5	8.5	8.5	8.1	8.81	9.43	10.2
Tokai	7.72	8.87	8.05	8.34	8.38	8.7	8.97	9.27
Taiyo-kobe	Sakura *							
Mitsui	7.05	7.22	7.35	7.57	7.92	8.37	8.96	9.05
Kyowa	8.8	8.51	8.8	Asahi**				
Saitama	8.26	7.6	8.7	8.9	8.3	8.6	9.22	9.93
Daiwa	8.41	8.22	8.92	9.01	8.27	8.92	9.37	9.32
Takushoku	8.33	7.6	8.7	8.8	8.26	8.92	9.09	9.19
Tokyo	8.02	7.86	8.12	8.5	8.12	8.8	9.61	10.42
Long-term credit banks:3								
Kogin	7.78	7.4	8.14	8.39	8.33	8.71	8.87	9.25
Chogin	8.23	7.6	8.35	8.56	8.27	9.07	8.27	9.25
Nissai	7.29	7.6	7.65	8.03	8.32	9.06	8.32	9.1
Average(City banks and Long-term credit banks:14)								
	8.12	7.78	8.45	8.53	8.23	8.77	9.09	9.59
Shintaku banks:7								
Mitsubi	11.1	8.5	10.3	10	8.38	9.19	9.77	10.98
Sumitomo	11.1	8.6	10.3	10.2	8.78	8.83	10.01	11
Mitsui	10.23	9.14	10.54	10.7	10.71	9.01	10.22	10.71
Yasuda	10.2	8.54	10.2	9.6	8.41	8.41	10.25	11.05
Toyo	12.1	9.16	10.4	9.7	8.54	8.77	9.79	10.64
Chuo	9.2	7.4	9.3	8.9	8.12	9.15	10.04	10.75
Nihon	13.3	11.7	12.9	12.9	10.38	9.71	10.34	11.51
Average(21 banks)								
	9.05	8.17	9.12	9.11	8.5	8.85	9.41	10.05
Average(Regional banks: 66)								
	8.65	7.62	8.95	9	8.5	8.76	9.16	9.71
Average(87 banks)								
	8.75	7.75	8.99	9.03	8.50	8.78	9.22	9.79

* Taiyo-Kobe and Mitsui banks merged and became Sakura bank in 1990.
**Kyowa and Saitama banks merged and became Asahi bank in 1991.
Source: Balance Sheets of individual banks.

Appendix Table 2 Panel data of fukumi (in billions of Yen)

	1990.3	1990.9	1991.3	1991.9	1992.3	1992.9	1993.3	1993.9
City banks:11								
DKG	3346	1780	2631	2219	1318	1097	1323	1724
Sumitomo	2903	1621	2274	1914	1116	858	1087	1501
Fuji	3107	1633	2318	1944	938	743	975	1437
Mitsubishi	3382	1876	2698	2375	1455	1277	1497	1961
Sanwa	3099	1728	2449	2076	1169	984	1219	1712
Tokai	2485	1545	1966	1668	942	769	921	1140
Taiyo-kobe	Sakura*							
Mitsui	2293	2390	3250	2820	1702	1446	1755	2204
Kyowa	1514	940	1218	Asahi*				
Saitama	848	419	626	1487	921	765	923	1175
Daiwa	1642	983	1303	1102	643	527	610	834
Takushoku	711	356	535	481	271	239	258	349
Tokyo	1145	523	933	832	348	245	384	634
Long-term credit banks:3								
Kogin	3900	1994	3062	2746	1696	1582	1867	2350
Chogin	2900	1553	2286	2043	1196	1102	1255	1639
Nissai	1420	610	1048	930	486	439	531	722
Total Fukumi(City banks and Long-term credit banks:14)								
	34695	19951	28597	24637	14201	12073	14605	19382
Trust banks:7								
Mitsubi	1680	773	1319	1158	704	627	788	1055
Sumitomo	1614	866	1291	1142	712	591	727	890
Mitsui	1814	983	1526	1332	850	746	903	1102
Yasuda	1376	647	987	790	361	226	340	507
Toyo	960	514	761	627	299	215	291	443
Chuo	478	219	340	258	95	54	93	148
Nihon	201	96	137	108	50	28	38	65
Total Fukumi(21 banks)								
	42818	24049	34958	30052	17272	14560	17785	23592
Total Fukumi(Regional banks:66)								
	83380	38552	67740	61864	43235	42094	49609	64187
Total Fukumi(87 banks)								
	126198	62601	102698	91916	60507	56654	67394	87779

The Nikkei 225								
	32306	23936	26458	23039	20351	18203	18039	20615

Source: Balance Sheets of individual banks.

Appendix Table 3 Panel data of subordinated debts stocks (in billions of Yen)

	1991.3	1991.9	1992.3	1992.9	1993.3	1993.9
City banks:11						
DKG	462	464	766	934	1028	995
Sumitomo	420	601	789	1024	1076	1036
Fuji	619	622	768	1013	1053	1003
Mitsubishi	424	498	672	852	868	819
Sanwa	280	427	680	1014	1063	1023
Tokai	349	377	503	575	648	689
Taiyo-kobe Mitsui	611	593	723	909	1074	1032
Kyowa	27	Asahi *				
Saitama	128	202	302	401	451	450
Daiwa	53	87	173	293	310	283
Takushoku	120	139	169	225	271	259
Tokyo	428	461	435	478	472	519
Long-term credit banks:3						
Kogin	324	382	482	680	679	662
Chogin	200	200	300	545	543	538
Nissai	266	262	258	301	377	367
Trust banks: 7						
Mitsubi	0	0	0	93.5	92.9	90.2
Sumitomo	0	0	0	60	118.1	112.5
Mitsui	0	0	0	0	50	50
Yasuda	0	0	45	66.3	142.6	133.3
Toyo	0	0	30	60	94.8	91.5
Chuo	0	0	40	80	100	100
Nihon	0	0	0	0	0	0
Total(21 banks)						
	4711	5315	7135	9603.8	10511.4	11184.5
Total(Regional banks :66)						
	10347	12003	14392	17416	18765	17447
Total(87 banks)						
	15058	17318	21412	26660	28678	28054

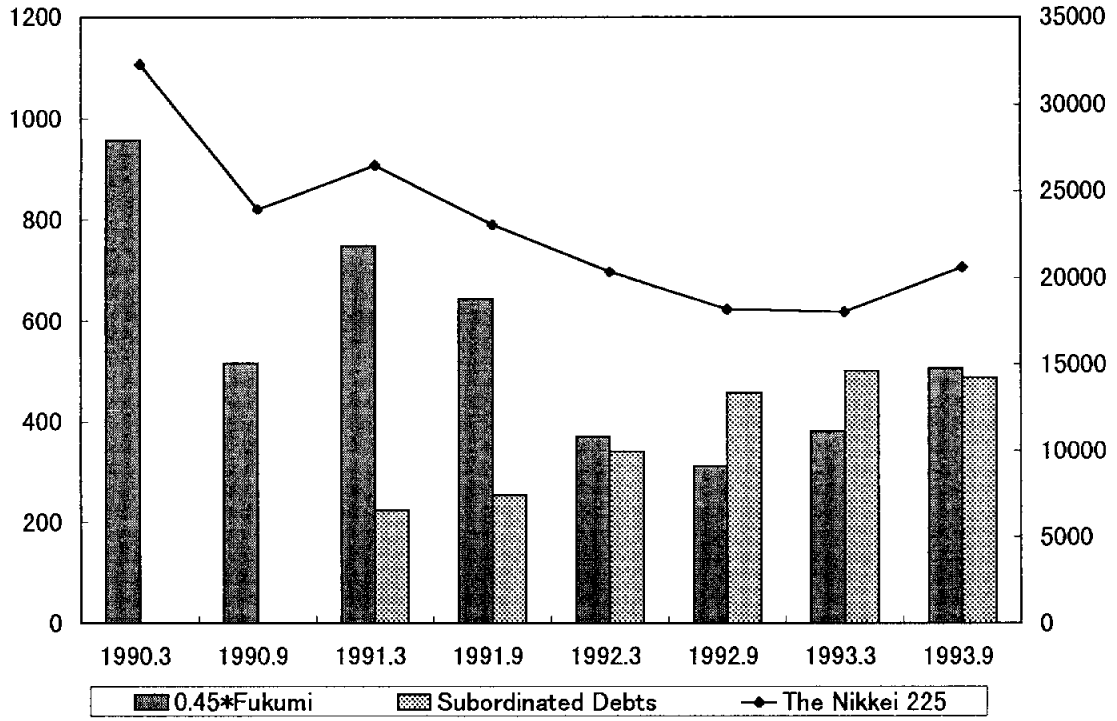
Source: Balance Sheets of individual banks.

Appendix Table 4 Panel data of bank loans outstanding (in billions of Yen)

	1990.3	1990.9	1991.3	1991.9	1992.3	1992.9	1993.3	1993.9
City banks:11								
DKG	32626	33204	34107	34215	34394	34490	34314	33703
Sumitomo	29967	30528	31791	32840	34254	34481	34772	34378
Fuji	29331	29867	30968	31281	31788	31558	32096	31872
Mitsubishi	28442	29391	30748	31515	32098	31699	31776	31204
Sanwa	29012	29937	31263	31787	32754	33750	34144	33384
Tokai	19300	19475	20127	20391	20581	20249	20373	19961
Taiyo-kobe	Sakura*							
Mitsui	36426	37237	37835	37707	37476	36914	36618	36174
Kyowa	9696	10121		Asahi*				
Saitama	8693	8886	10438	19885	20113	20234	20768	20682
Daiwa	10668	10890	11184	11334	11894	12108	12179	12003
Takushoku	6786	6802	7072	7101	7344	7355	7472	7426
Tokyo	12519	12734	12709	12629	12551	11919	11629	11459
Long-term credit banks:3								
Kogin	23017	23683	24896	24295	24356	23854	23853	23391
Chogin	18339	18600	18992	19152	19453	19107	19299	19153
Nissai	10846	11069	11453	11530	11566	11013	11031	10865
Total(City banks and Long-term credit banks:14)								
	305668	312424	313583	325662	330622	328731	330324	325655
Trust banks:7								
Mitsubi	13360	13843	14135	14338	14670	14766	14845	14515
Sumitomo	12391	12917	13326	13405	13688	13811	14188	13863
Mitsui	12701	12974	13297	13361	13256	13008	12914	12308
Yasuda	9843	10161	10408	10411	10456	10207	10347	10220
Toyo	8116	8510	8643	8805	8821	8715	8766	8625
Chuo	4614	4793	4899	4993	4999	4905	4973	4862
Nihon	1554	1574	1602	1622	1654	1763	1846	1812
Total(21 banks)								
	368247	377196	379893	392597	398166	395906	398203	391860
Total(Regional banks: 66)								
	1179062	1191162	1255578	1261151	1292965	1314809	1342224	1347114
Total(87 banks)								
	1547309	1568358	1635471	1653748	1691131	1710715	1740427	1738974

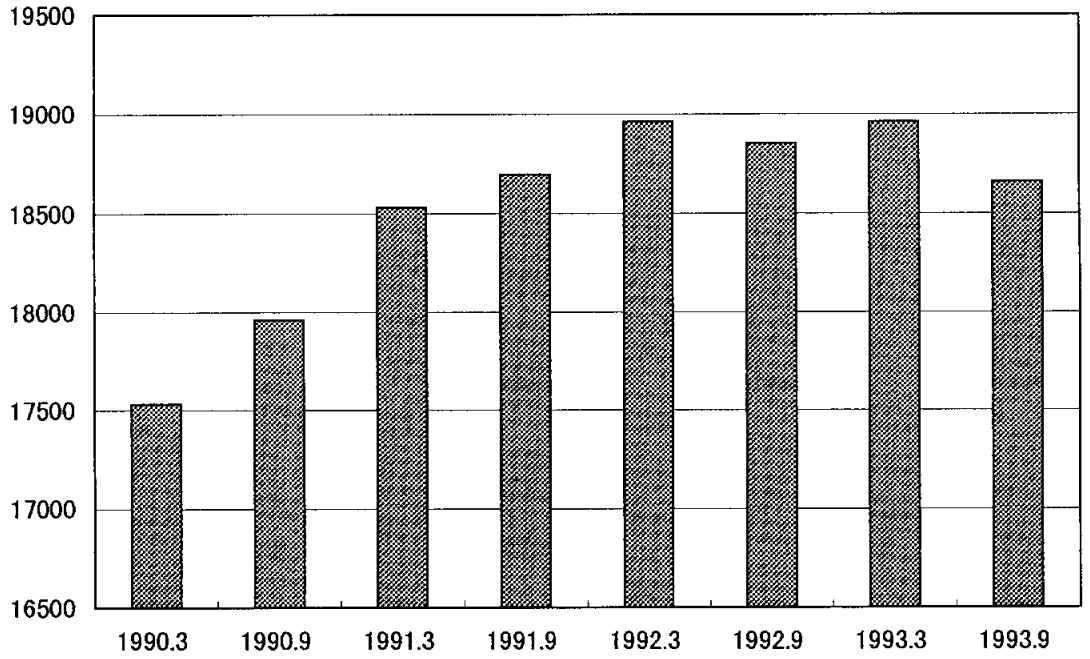
Source: Balance Sheets of individual banks.

Figure 1 Components of Tier II (21 banks)



*Left axis: 45% of Fukumi and subordinated debts (billions of Yen).
Right axis: Nikkei 225.

Figure 2 Lending (21 banks)



(Billions of Yen)

Figure 3 BIS and BISLESS