Prudential Regulation and the "Credit Crunch": Evidence from Japan

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Abstract

The underlying causes of sharp declines in bank lending during recessions in large developed economies, as exemplified by the U.S. in the early 1990s and Japan in the late 1990s, are still being debated due to the lack of any convincing identification strategy of the supply side capital-lending relationship from lending demand. Using within bank share of real estate lending in the late 1980s as an instrumental variable for bank capital, we find that Japanese banks cut back on their lending in response to a large loss of bank capital in fiscal year 1997.

Keywords: Credit crunch, capital crunch, prudential regulation, instrumental variable
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1. Introduction

The balance sheets of Japanese banks in the late 1990s were damaged by the enormous amount of non-performing loans (NPLs) that had accumulated over the previous decade. NPLs at the end of fiscal year for 1997 (March 1998) reached 30 trillion yen, or 5.5 percent of loans supplied by domestically licensed banks.[1] The write off of NPLs against equity leading to a sharp fall in the ratio of equity capital to assets (the book based capital to asset ratio) of domestically licensed banks in March 1998 was followed by a long lasting fall in the domestic lending growth (Figure 1). Domestic loans fell by 20 trillion yen, or about 4 percent during the three year period from April 1997 to March 2000. The BOJ's *tankan* "lending attitude of financial institutions" diffusion indices also experienced sharp declines in March 1998 (Figure 2).[2]

Did this fall in bank capital, the "capital crunch", cause the reduction in supply of bank loans, the "credit crunch" in the late 1990s? In order to satisfy the capital adequacy requirements, banks may have cut back on their lending in response to large losses of capital as issuing the new equity incurs costs associated with asymmetric information between investors and banks. When a banking system involves binding capital requirements, in addition to the standard reserve requirements, it will be possible that the limitation on the expansion of loans may be capital and not reserves.

The seminal work by Bernanke and Lown (1991) defines a bank "credit crunch" as a "significant leftward shift in the supply curve of bank loans, holding constant both the safe real interest rate and the quality of potential borrowers." The interest rate was very low and stable throughout the late 1990s. The quality of borrowers, in particular their lending demand may have declined under the stagnant economic environment. It is identifying the supply side phenomenon of the "credit crunch" with the alternative hypothesis of declining lending demand that is the most important in our empirical analysis.

[1] The source is Hoshi and Kashyap (1999). Non-performing loans are defined as loans to failed enterprises, loans whose repayments have been suspended for 3 months or more, and loans with relaxed conditions to enterprises under restructuring.

[2] For a detailed discussion of *tankan* indices, see Motonishi and Yoshikawa (1999).

We construct the unique instrumental variable in order to capture the "capital crunch" that is independent of the present lending demand. According to Hoshi and Kashyap (2000), since large firms became almost independent of banks following the capital market liberalization of the late 1980s, and banks themselves were still confined to their traditional lending business, banks replaced their traditional *keiretsu* lending (relationship lending) with lending to opaque small and medium firms, taking land as collateral, while also expanding through even riskier real estate lending. Such a shift in the lending portfolio exposed banks to asset price risks, which did not become apparent until the bubble burst in the 1990s. Based on the stylized fact found by Ueda (2000) and Hoshi (2001) that the bank's real estate lending in the 1980s best explains the bank's NPLs in the late 1990s, we use within bank share of real estate lending in the late 1980s as an instrumental variable for bank capital. We examine the impact of capital "surplus" defined as the gap between the actual and the estimated bank specific target capital to asset ratios on lending supply by running year by year cross section regressions.

The "capital crunch" is regulatory driven. The reported bank balance sheets themselves are the reflection of regulatory toughness or the banks' concessions to the regulator. It was in March 1998, when the MOF required banks to carry out a more rigorous self-assessment of their assets and the adequate loan loss write offs and the provisions that the negative capital shock was observed. As such, the econometric analysis of bank balance sheets needs to control for changes enforced by regulatory and institutional oversight bodies. Any valid interpretation of the results inevitably requires regulatory and institutional information.

We find that banks cut back on their lending supply in the fiscal year 1997 in response to a large loss of bank capital (the "regulatory driven capital crunch") mainly caused by the rigorous self-assessment of assets requested by the regulator. Increased capital mainly due to an injection of public capital in FY 1998, in turn, likely relaxed the capital constraint of banks, thus lead to an increase in the supply of loans. This positive effect on lending, however, barely offsets the "credit crunch" of the previous year.

The remainder of the paper is arranged as follows. In section 2, we introduce the notion of credit crunch and review the literature. In section 3, we discuss the relevant regulatory background. In section 4, data and econometric issues are set out. In section 5, preliminary results are reported. In section 6, main results are reported and some policy implications are derived. Section 7 concludes the paper.

2. Credit Crunch

The "capital crunch" and the "credit crunch"

The observed decline in bank lending over the period of 1990 and 1991 in the U.S. became well known as the "credit crunch". It attracted the attention of politicians and the media alike since it occurred amid an ongoing deep recession. Bernanke and Lown (1991) report that both total lending and commercial and industrial lending fell by more than 10 percent over one year from the second quarter of 1990 through the first quarter of the following year in New England, the area where lending saw the sharpest decline. Peek and Rosengren (1995 a) discovered a large drop in bank capital during the same period in New England. The phenomenon became known as the "capital crunch".

Some 8 years later the popular Japanese translation of "credit crunch", "*kashishiburi*", which literally means "unwillingness to lend", appeared so frequently in Japanese newspapers and other media that it was awarded the "Top Ten Award" of the 1998 annual "Japan New Words and Popular Words Grand Prize".

In general, the "credit crunch" refers to the reduction in credit supply available to borrowers, particularly bank lending supply, for some lender specific reasons. The major explanation for the credit crunch phenomenon is the "regulatory driven capital crunch hypothesis". The internationally recognized bank capital regulation, known as the risk based (adjusted) capital (RBC) standard, is at the center of the banking regulatory framework. The regulation requires that the ratio of capital to risk weighted assets (riskier assets are assigned a higher weight and vice versa) not be below the specified minimum threshold.

Lending was assigned a 100 percent risk weight, irrespective of the credit risks of each contract (credit worthiness of each borrower). It had gone partially into effect by the time of the U.S. credit crunch.

Theoretical works have shown that asymmetric information -- involving investors, a bank, and borrowers -- makes issuing new equity costly.[3] Therefore, undercapitalized banks failing to satisfy the regulatory minimum may raise the (risk based) capital to asset ratio by cutting back on lending (a denominator of the ratio) rather than raising equity capital (a numerator of the ratio) in order to immediately clear the regulatory hurdle. The easiest way to raise the risk-based capital to asset ratio is to shift the asset portfolio away from lending that is assigned the highest risk weight of all asset classes (100 percent risk weight) to assets with less weight, such as the government bonds of OECD countries (0 percent risk weight). It is frequently argued that the introduction of the RBC requirements may have induced the substitution of the lending portfolio away from risky lending to safer lending, and thus could have prevented the credit crunch from occurring, if the variation of credit risks within lending had been considered. [4]

In modeling a bank's profit maximization, the RBC capital adequacy requirements are expressed as the following inequality and usually constitutes one of a set of constraints with typically the reserve requirement representing another.

$$\frac{K_i}{L_i} \geq \gamma \quad (1)$$

K_i is the equity capital of bank i, L_i is bank i's level of lending, and γ is the minimum requirement imposed by the regulator.[5] Then a bank with a binding capital constraint lends out a multiple of its own

[3] Stein (1998) states that the informational asymmetry between investors and a bank leads to the adverse selection problems in that the equity issuing banks are considered to be under-performing. Diamond and Rajan (2000) argue that equity finance generates inefficient rent when a bank is a relationship lender.

[4] On June 26, 2004, the Basel Committee on Banking Supervision that coordinates the international agreement on the RBC regulatory framework announced that the amendment to take into account credit risks within bank lending in computing the risk-weighted asset of an individual bank (Basel II) will take in effect as of year end 2006. Their working paper surveys the empirical literature on the impact of the RBC framework including the capital crunch. (Furfine e al. [1999]) The recognition that the old design of the regulatory framework may have resulted in the capital crunch motivated the proposed amendment.

[5] It is assumed for simplicity's sake that only lending is assigned a 100 percent risk weight.

capital. On the other hand, a bank with an nonbinding RBC constraint determines the level of lending for the optimal interior solution of its unconstrained profit maximization problem in a static model setting.[6]

In reality, it may be the case that banks around the lower threshold of the risk-based capital to asset ratio are capital constrained, whereas banks whose capital to asset ratio is far above the threshold are unconstrained. Alternatively, most banks may be pushed into the lower region of capital to asset ratio and become capital constrained when the entire banking industry is faced with negative aggregate capital shocks. These shocks may be either regulatory -- the requirement of a more stringent assessment of assets (lending) and the widened definition of non-performing loans resulting in write-offs that were previously considered unnecessary -- or macro economic -- a fall in land prices that turn viable loans into non-performing ones through the devaluation of collateral. If this is the case, one may observe few unconstrained banks when there is the positive industry wide capital-lending relationship.

In practice, variations of the following partial adjustment specification of the growth rate of lending have been tested by various researchers.

$$\Delta \ln L_{it} = \alpha_0 + \alpha_1 \Delta \ln L_{it-1} + \beta \frac{K_{it}}{A_{it}} + \lambda X_{it} + \varepsilon_{it} \quad (2)$$

The dependent variable is the lending growth of an individual bank at date *t* whereas explanatory variables are the lagged dependent variable, one of our capital asset ratio measures and other control variables. Many papers take a lag of the capital to asset ratio measure *K/A*, in order to avoid simultaneity of lending growth and the capital ratio.

Empirical literature

Bernanke and Lown (1991) take the book capital for *K* for the U.S. state-by-state cross section data and the New Jersey bank-by-bank cross section data in a one-year period from the second quarter of 1990 to the first quarter of 1991. They find a statistically strong coefficient on the lagged *K/A*. Berger and

[6] If we assume a dynamic optimization model of a banking firm, an unconstrained bank will hold capital stock as a buffer against future uncertainty. See Van den Heuvel (2002).

Udell (1994) run panel regressions with various loan classes as dependent variables using the quarterly data of all U.S. banks from the late 1970s to the early 1990s. They augment (2) by including the interaction terms of the time dummy indicating the credit crunch period (1990-1992) and various capital to asset ratios including the RBC ratio itself, but find no capital effect on lending during the period. With the quarterly panel data in and around the credit crunch period (1989:Q2-92:Q4) Peek and Rosengren (1995 a) find a significant capital effect only for banks with low regulatory ratings which they claim are likely to be linked to binding constraints.[7, 8]

Using panel data for Japanese banks in the early 1990s, Ogawa and Kitasaka (2000) and Ito and Sasaki (2002) estimate variants of (2) with the RBC ratio as the capital to asset ratio and find that only internationally operating banks operating within the Basel RBC regulatory framework have a statistically significant coefficient of the capital ratio.[9] More recently, Montgomery (2005) uses a longer panel from FY 1982 to 1999 and applies the period dummy methodology of Berger and Udell (1994) to the post Basel (after FY 1988) years and finds that coefficients on the book based capital to asset ratio are significant during the post Basel years (FY 1988 to 1999) and insignificant during the pre- Basel years (FY 1982 to 1987) for all international, domestic and "switcher" banks.[10]

Few works have focused on Japan in the late 1990s. Woo (2003) turns to the year-by-year cross section regressions of equation (2). Constructing the total new loan data from FY 1991 to 1997 by adding write offs of NPLs to the net yearly increase in lending reported on the balance sheets, he finds that it is only in FY 1997 that coefficients on such capital to asset ratios as the book ratio and the

[7] In a related study using the same panel data set through the second quarter of 1992, Peek and Rosengren (1995 b) find that the coefficient on the interaction term of the capital asset ratio and the variable indicating a bank under regulatory formal action is significant but that the coefficient on the similar interaction term with the dummy variable indicating a bank not under action is insignificant.

[8] Hall (1993), Hancock, Laing, and Wilcox (1995), Hancock and Wilcox (1998) also find statistically significant coefficients on capital to asset ratios during the period.

[9] Ito and Sasaki (2002) and Ogawa and Kitasaka (1999) examine two-year periods before and after the full implementation of the regulation at the end of fiscal year 1992.

[10] Under the current FSA regime, banks are classified into "international" banks and "domestic" banks. 'International" banks are required to satisfy a higher minimum RBC requirement than "domestic" banks (8 percent for "international" banks and 4 percent for "domestic" banks). "Switcher" banks are banks that abandoned their privilege to conduct

regulatory RBC ratio are significant and positive.[11]

As we discuss later in greater details, we suspect that the incomplete identification of the lending supply with its demand is behind the mixed micro results in examining the events above of falling economy wide bank lending both in the U.S. and Japan.[12]

3. The Regulatory Background of Japanese Banks

In what follows, we review the regulatory history and its influence on bank capital.[13]

Basel Capital Accord: FY 1992

The first generation of the RBC requirements was agreed, representing the Basel Accord of 1988, fixing the minimum ratio at 8%. The Accord allowed for a transitional period so that banks with capital shortages could take measures to meet the minimum standard. In Japan, the minimum ratio of 8 percent has been effective since the end of fiscal year 1992 (March 1993), after a two-year transition period with a temporary target of 7.25 percent.

Several points are worth noting. First, the Bank for International Settlements (BIS) Capital Accord framework classifies elements of capital in two tiers: core capital called Tier 1 and the elements supplementing it called Tier 2. Tier 1 includes equity capital and published reserves from post-tax retained earnings and matches approximately "equity capital" in a bank balance sheet. Elements that can be included in Tier 2 are undisclosed reserves, (asset) revaluation reserves, general provisions/general loan-loss reserves, hybrid debt capital instruments, and subordinated term debts. The Accord mandates

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international business so that the minimum RBC requirement is loosened.

[11] He tests three capital to asset ratio measures, the book based ratio, the Basel RBC ratio, and the market based capital to asset ratio. The book ratio in FY 1991 and the RBC ratio in both fiscal years of 1991 and 1993 are negative and significant whereas coefficients on market based ratios are not significant.

[12] Regarding international lending, Peek and Rosengren (1999) tests the impact of bank capital shocks to Japanese parent banks on lending by their subsidiaries in the US.

[13] For detailed discussions on the Japanese prudential policy, see Hoshi and Kashyap (2000), chapter 8 of Hoshi and Kashyap (2001), Ueda (2000), and Fukao (2001)

banks to satisfy half of the minimum standard (4 percent in the current regime) by Tier 1 elements.

In Japan, up to 45 percent of unrealized (latent) capital gains were allowed to be included into Tier 2. Thus, in contrast to those of the U.S. banks, the RBC ratios of Japanese banks are vulnerable to swings in stock prices. Moreover, since subordinate debts are counted as Tier 2 capital, banks can manipulate the RBC ratio relatively easily through their accounting policies. Issuing subordinate debts in response to negative capital shocks such as asset price falls and disposal of non-performing loans masks a shortage of core Tier 1 elements.

Prompt corrective action and a rigorous self-assessment of bank assets: FY 1997

The MOF implemented the prudential policy guidelines for prompt corrective action (PCA) at the end of fiscal year 1997. The PCA allows the regulator (then the MOF, currently the Financial Services Agency [FSA]) to intervene in banks with a Basel RBC capital to asset ratio below the regulatory threshold. The regulator intervenes when the RBC ratio falls below the BIS minimum standard of 8 percent. The right to intervene was applied to "international" banks in April 1998 and to "domestic banks" a year later. After the introduction of the PCA, banks were faced with formal government actions based on the Basel RBC standard.

Prior to the PCA taking effect in April 1998 the MOF required banks to carry out a more rigorous self-assessment of their assets and the adequate loan loss write offs and the provisions based on them in March 1998 (the end of the FY for 1998), Loan loss write offs and provisions amounted to 13.3 trillion yen in FY 1997. Toward the closing of the fiscal year 1997, the government decided to inject public capital into some banks (18 large banks and 3 regional banks) for the first time, but it was not sufficient to offset losses caused by the large write offs and loan loss provisions.

Public capital injection: FY 1998

The nationalization of the Long-Term Credit Bank and the Nippon Credit Bank happened in the late 1998. During the crisis, the government rescued other banks facing capital shortages due to the large write offs throughout two consecutive fiscal years. Loan-loss write offs and provisions recorded 13.5 trillion yen in FY 1998, slightly surpassing the previous fiscal year's mark. A total public capital injection of 7.5 trillion yen (6.2 trillion yen of preferred stocks and 1.3 trillion yen of subordinated debts were underwritten by the government) was given to 16 mostly large banks in March 1999 in order to enhance their capital and help them satisfy the RBC requirement in the closing days of FY 1998.[14]

4. Econometrics and Data

We run different versions of equation (2) using micro individual bank level data to see if a "regulatory driven capital crunch" occurred in Japanese banks in the late 1990s. In the following, we discuss issues that arose in conducting the empirical analysis.[15]

Data

The main data source of bank level data is the Nikkei NEEDS bank financials data bank. It has become fairly standard for the analysis of Japanese banks recently (Ogawa and Kitasaka [2000], Hoshi and Kashyap [2000], Ueda [2000], and Hoshi [2001]). The data represents a 27 year-long period from FY 1974 to FY 2000. It contains not only balance sheets and income statements of all domestically licensed banks, but also details of lending classified by industry, by types of collateral, by use (equipment funds/working capital), as well as the amount of lending to small and medium sized firms. The Basel

[14] See Nakaso (1999) for further details on the public capital injection in FY 1998. Another contributing factor to the increased equity capital was the accrued deferred tax assets due to the new accounting standard harmonized with the International Accounting Standard, which amounted to 8.9 trillion yen.

[15] We also examined a specification similar to Ogawa and Kitasaka's including the interest rate differential between the lending rate and the inter-bank call rate. The lending rate is calculated as the interest receipts on loans and discounts divided by the end of fiscal year loan stock. The estimation results were virtually unaltered. The variable, however, is inevitably endogenous which can be a serious source of bias. Besides, differences in the interest rate variable constructed this way may reflect differences in the default risk they face, the rate of arrears, and other factors unrelated to the true return on lending.

RBC ratios and unrealized gains on assets are taken from the Japanese Bankers Association's Analysis of Financial Statements of All Banks.[16]

Sample selection

While a "financial crisis" refers to instability of the financial system due to management crises and eventual bank failures, the "credit crunch" is a phenomenon hurting the lending supply functions of viable banks due to capital shortage. It is efficient that banks defeated in the competition on the lending markets exit the markets. The "credit crunch" is far more serious since it damages the lending supply function of viable banks. To this end, we drop banks affected by bank failures, failed (liquidated or nationalized) banks, as well as banks having experienced rescue mergers or acquisitions. A total of 126 banks remain in the sample. [17]

Dropping "troubled" industries

Similarly, from the borrower side, the "credit crunch" hurts healthy borrowers because of the banks' unwillingness to lend. However, a bank's decision to cut back on lending to firms that will default on loans, and shifting its lending portfolio to healthier firms, is desirable. In the same context, a bank's decision to dispose of existing NPLs, that is, loans that borrowers have already defaulted on, is desirable too. To this end, we construct the lending data for non-troubled industries. Following the BOJ's aggregate survey, we designate s "troubled" industry an industry whose share of NPLs to the industry exceeds the share of total lending.[18] Such industries include the construction, wholesale and retail, service, and real estate industries.[19]

[16] Missing items on recent balance sheets of a few banks are supplemented by their annual reports.
[17] Banks having experienced non-rescue mergers are treated as single banks in pre-merger dates by adding values of variables for banks involved in the deals. One bank was dropped since detailed lending data for the 1980s are missing. Another bank founded in the 1990s is also dropped.
[18] See BOJ (2001)
[19] Ideally, one needs to construct the new loan data as Woo (2003) does. However, this is not possible, since the industry level micro data on write offs of NPLs are not publicly available. We believe that exclusion of troubled industries

Capital to asset ratio measures

Three different measures of capital to asset ratio are examined: the book based ratio (BCAR), the BIS risk based ratio (BIS), and the market based ratio (MCAR). The book capital is a proxy for the core Tier 1 capital.[20] BCAR is constructed by taking the ratio of equity capital minus land price re-evaluation to total assets. MCAR is constructed by taking the ratio of book capital, the numerator of BCAR, plus unrealized gains on holding assets to total assets. As such, both BCAR and MCAR are non-risk based. This is not just because the individual bank level data of the risk-adjusted asset, the denominator of the RBC ratio, is publicly unavailable. It is even advantageous in the sense that "capital constrained" banks should respond to negative capital shocks, that is, negative shocks to the numerator of the risk-adjusted capital to asset ratio. The numerator of the RBC ratio may not uncover the capital shocks masked by the offsetting increase of subordinate debts that are also elements included in the numerator.[21]

Controlling lending demand

As is evident, the equilibrium quantity of bank lending not only decreases in response to the shortage of the lending supply, but also decreases because of a leftward shift of its demand curve. If the aggregate (regional) economic environment worsens, product sales fall due to weak demand, and firms adjust their investment outlay on plant and equipment downwards in response, which in turn results in a fall in their demand for new bank financing.

One may support the demand side argument by including explanatory variables that are proxies to

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defined above is the best way possible. The resulting bias should not be significant since it is mostly lending to "troubled" industries that is disposed of by the banks.

[20] The BIS capital to asset ratio until FY 1996 is subtracted the regulatory minimum for each bank (8 percent for "international" banks or 4 percent for "domestic" banks) when the level itself of the ratio is included in a regression. This procedure smoothes the discontinuity in the level of the ratio due to the accounting policy that allows a bank to clear the regulatory minimum. Until FY 1996 the BIS ratios of many "domestic" banks were around 4 percent. Since FY 1997 when many "international" banks switched their regulatory status to "domestic", the distinction between "domestic" and "international" banks hs disappeared.

[21] See Ito and Sasaki (2002) for the banks' control of the RBC ratio.

lending demand such as aggregate or regional economic indicators (Berger and Udell [1994]). The reduced form approach, however, mixes the demand side with the supply side, and is not designed for extracting the structural lending behavior of banks. Banks from one region behave differently from those from other regions. Yet, they also operate in different markets and face different lending demand curves. In this spirit, Peek and Rosengren (1995a, 1995b) focus only on banks in New England.

One may, instead, use the micro level bank characteristics to control for lending demand indirectly. The institutional classification of Japanese banks rarely changes over time and can be a good candidate for this goal. Banks are conventionally classified into five classes: city banks, long-term credit banks, trust banks, regional banks, and regional 2 banks. Regulatory actions as well as their customer base differ across bank classes. Dummy variables indicating the institutional class, CITY for city banks, TRUST for trust banks, and REGIONAL for regional banks, are included, while regional 2 banks are considered as the base class. [22, 23]

Simultaneity of capital and lending

The OLS estimator of the coefficient on capital asset ratio β is likely to be biased because bank capital and loan growth are very likely endogenously determined through the performance of borrower firms (demand side). If the aggregate (regional) economic environment worsens, the firms' demand for new bank loans falls. Under such circumstances, the firms' sluggish sales performances in their product markets may prevent them from gaining returns high enough to service the repayments to their lender banks on time. Thus, their existing loans become non-performing, which hurts the lender bank's capital

[22] All the banks base their legal foundations on the banking act, though trust banks and long-term credit banks are also regulated by special laws. Regional 2 banks have been classified separately from regional banks since they had been formerly administered under a special law and were converted to standard banks in the deregulation process. 9 city banks, 6 trust banks, 63 regional banks, and 48 regional 2 banks remain in the sample. Long-term credit banks disappear from the sample because two were failed and the remaining one lacks necessary accounting information.

[23] One may think of including the dummy variable indicating whether a bank is registered as "international" or "domestic." We do not do so because many banks have switched their BIS regulatory status from "international" to "domestic" throughout the period of interest. Such a dummy variable may be endogenous. We find that including it into the regressions does not change the results significantly.

position through the provisions taken for loan losses and/or charge offs against their equity capital. Similarly, under continuing deflation, if the larger part of existing borrowing contracts is not indexed, their real burden of existing debt increases. The same simultaneity mechanism between bank capital and bank lending occurs in reverse. In an economic upturn, lending demand soars, while the higher profits of the banks increase their equity capital. The resulting OLS estimate, therefore, may be biased upward.

In overcoming the identification problem, one needs a valid instrumental variable that is independent of the supply shock and strongly and consistently correlated to the capital to asset ratio. Almost all contemporaneous variables are endogenous and are not very effective to this end. The drawback to the commonly used approach of employing lagged "predetermined" variables (Peek and Rosengren [1995 a], Ogawa and Kitasaka [2000]) is that they lack an economic account of the bank capital and that the strong correlation with capital is not guaranteed.[24]

Instrumental variable: structural hypothesis

Ueda (2000) and Hoshi (2001) suggest that the regulatory driven "structural" change of the financial markets in the 1980s forced banks to reorganize their business. The deregulation of corporate bond markets that followed the liberalization of the secondary markets of government bonds made large *keiretsu* firms less dependent on bank lending. While large firms benefited from raising funds in the credit markets, regulations governing the banks' activities confined them to their traditional lending business.[25]

As the asset price bubble developed, banks rapidly increased lending to the real estate industry under the strong and illusory expectation that land prices would never fall. The cross-sectional data of individual banks in the late 1990s show that the banks' portfolios tilt toward real estate lending is the

[24] Peek and Rosengren (1995 a) adds to the lagged variables the current change in equity capital as one of instruments. The point estimate of the coefficient on the capital to asset ratio in the instrumental variable regression (2SLS) and that in the OLS surprisingly coincide. One may wonder whether such instrumental variables are not exogenous to the contemporaneous supply-demand system.

main determination of the accumulation of the NPLs more than a decade later. "Riskier" banks piled up more NPLs while less "risky" banks avoided the deterioration of their balance sheets as the land price bubble busted. Such behavioral responses in the mid-1980s are an exogenous factor to the demand-supply system of bank lending in the 1990s. Banks with higher NPLs wrote off more assets against their equity capital, and incurred more sever capital shortages than banks with lower NPLs. Hence there should be a negative correlation between the banks' portfolio changes toward real estate lending and their capital to asset ratio.[26, 27]

The intuition behind the instrumental variable regression is the following two-step estimation. In the first step we run the regression of the capital to asset ratio on the banks' lending portfolio shift toward real estate lending. The fitted value of the capital to asset ratio represents the structural component of the capital to asset ratio that is independent of current borrowers, whereas the demand side influenced by the business cycle fluctuations is absorbed in the residual. The fitted value is then used as an explanatory variable in running the capital-lending regression. This way, one is able to estimate the response of bank lending to the structural component of capital to asset ratio attributable to the banks' structural behavioral change in the 1980s.

In practice, we construct both the level of and the change in real estate lending over the 1980s and use them as instruments for the capital to asset ratio. For the "level" instrument we use REAL89: each bank's share of lending to the real estate industry in FY 1989, when land prices recorded a historical peak.

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[25] For more on the Japanese financial deregulation process since the 1970s, see Hoshi and Kashyap (2000)

[26] One may argue that the share of real estate lending in the late 1980s and the lending supply in the late 1990s could be endogenously determined. If banks ex-ante had known that real estate lending was a very bad investment and foreseen their losses, an ex-ante correlation of the two variables would occur. However, this argument arises from a confusion between the ex-ante and ex-post banking behavior. It is true that banks ended up with huge losses from real estate lending due to the burst of the land prices bubble. We, however, need to keep in mind that land prices had never significantly fallen before the bubble burst of and that the public, including the banks' managements, believed in the "myth of land speculation". Banks seem to have regarded real estate lending as a lucrative, low risk, high return alternative to *keiretsu* lending.

[27] Suppose, rather, that banks anticipated ex-ante that real estate lending was very risky. Such banks' prescience does not lead to an ex-ante correlation between the real estate lending share in the late 1980s and the lending supply shock in the late 1990s. The expectation of a lending supply shock conditional on the real estate lending share would still be zero because riskier investment does not mean a negative expected return but merely a positive variance.

For the "change" instrument we use PORT: each bank's 10-year growth of lending share to the real estate industry since FY 1980.[28]

5. The Level Regression Results

Strength of our instrument

As Table 1 shows, REAL89 is negatively correlated to the book based capital to asset ratio (BCAR) since FY 1997. The strong correlation in FY 1997 suggests that the serious writing off of NPLs to the real estate industry against equity capital did not begin until the start of the rigorous self-assessment of bank assets in that year.[29] As with BCAR, the market based capital to asset ratio (MCAR) has been negatively correlated to REAL89 since FY 1997. The BIS risk based ratio (BIS) is not sufficiently negatively correlated to REAL89 in any year except for a modest correlation in the fiscal years 1999 and 2000. Surprisingly, REAL89 has virtually no correlation with BIS in FY 1997. Large losses in the book capital of banks which specialized in the real estate sector may have been wiped off the books by creative accounting techniques.

Regression results

Tables 2 shows coefficients on the book based capital to asset ratio in year-by-year regressions of equation (2) from FY 1995 to FY 2000. The first two columns correspond to total domestic non-troubled lending consisting of consumer, manufacturing, and non-troubled non-manufacturing lending. Industries classified as the non-troubled non-manufacturing industries include agriculture, mining,

[28] In addition, constant, predetermined variables including lagged and twice lagged loan growths, lagged and twice lagged interest rate differentials, and other lagged variables including twice, three times, and four times lagged deposit growth rates, and lagged and twice lagged land price growths, are included as a set of instrumental variables. The (one period) lagged deposit growth is excluded from these instruments due to a concern about the possible behavioral endogeneity between lending and deposits as described by Diamond and Rajan (2000).

[29] A puzzling absence of negative correlation in FY 1996 that marks the liquidation of *jusen* housing loan companies and the resulting accounting losses of banks reflects the fact that *jusen*, which specialized in real estate lending, are classified as non-bank financial companies. If the lending to *jusen* companies were classified as real estate loans instead, a negative correlation would appear.

finance and insurance, transportation and telecommunications, and utilities. The third and the fourth columns correspond to lending to the manufacturing industry. Finally, the fifth and the sixth correspond to lending to the non-troubled non-manufacturing industries. The book based ratio takes one-year lag (Lag) in the first column of the two columns for each lending category, and is contemporaneous (Cont.) in the second.

Only one cell reports a positive and significant coefficient in the top OLS table up until FY 1996. Then coefficients in all cells turn positive and significant in FY 1997. In FY 1998, only one coefficient of the contemporaneous capital ratio for manufacturing lending is positive and significant. In FY 1999, all coefficients, except in manufacturing, turn positive and significant again.

The bottom table on 2SLS (two stage least square) regressions implies a demand side simultaneity bias in the OLS estimates. In contrast to the OLS regression results, all coefficients before FY 1997 are statistically insignificant. In FY 1997, with the exception of manufacturing, none of the coefficients on lagged capital are significant. In FY 1998, coefficients of the contemporaneous capital ratio for total and manufacturing lending are positive and significant at the 10 percent level. The coefficient on the lagged BCAR for total lending is found to be weakly positive at the 10 percent significance level.[30]

6. Target Behavior

6.1. The Specification and the Estimation Strategy

Target behavior

What is uncertain from the level regression (2) is how a bank changes its lending in response to changes in its own capital position. Consider equation (3).

$$\Delta \ln L_{it} = \alpha_0 + \alpha_1 \Delta \ln L_{it-1} + \beta_t \left\{ \frac{K_{it}}{A_{it}} - \left(\frac{K_i}{A_i} \right)^{target} \right\} + \lambda X_{it} + \varepsilon_{it} \quad (3)$$

[30] We also estimated equation (2) with BIS and the market based MCAR (the results are not reported). The results with BIS are hard to interpret since REAL89 is not negatively correlated to BIS in most specification-year pairs. The results

The only modification relative to equation (2) is the replacement of the level of capital to asset ratio, K/A, with the difference between the actual and desired levels of the ratio, $K/A-(K/A)^{target}$ and the time subscript attached to β. This specification assumes that each bank has its own target. A bank will cut back on its lending only when the actual ratio falls below the target ratio. This allows us to compute the portion of (negative) aggregate lending growth due to capital constraint. One is able to compute the average of the product of the point estimate of β and capital shortage (surplus) measured by each bank's $K/A-(K/A)^{target}$ weighted by asset A. By doing so one can extract the component of the aggregate lending growth accounted for by capital constraint.

Estimating the target

One needs to estimate the target capital to asset ratio, K/A^{target}. The aggregate capital to asset ratio of domestically licensed banks steadily soars at the beginning of the 1990s up until around the end of FY 1992, it then stays at a high plateau of around 5 percent until FY 1994 (Figure 1). Based on our interpretation that banks set their capital target to move toward the full implementation of the BIS risk based capital regulation framework, we estimate the target using data from FY 1992 through FY 1994. This is not only the period when the capital to asset ratio is stably high but also the post Basel pre- "credit crunch" period. We should not include the "credit crunch" period because it is quite likely that banks were running short of the target at that time. We should not include the pre- Basel period because banks may have been short of capital and in the process of achieving their goals as the end of the fiscal year for 1992 approached.

In the estimation, we apply a relatively simple method: we compute the time-series average of each capital to asset ratio measure for each bank over the fiscal years of 1992-1994 and use it as a target. The target variable constructed this way is bank specific and time invariant. It may vary depending on a

with the market based MCAR resemble the results with the book based BCAR.

bank's characteristics such as risk averseness, size and institutional and legal status. [31]

The actual internal capital target may vary across fiscal years. For example, banks facing a tougher regulator in certain fiscal years may tighten their "internal" targets as Hancock and Wilcox (1994) discuss. The regulatory toughness may vary from year to year, though the FSA/MOF does not explicitly change actual regulatory minimum requirements over time. Unfortunately it is impossible to measure to what extent banks responded to the regulatory action, since it is solely an unreported internal response. Such changes in regulatory toughness are likely to accompany changes in the banks' balance sheets reflecting increases or decreases in NPLs, and therefore had better be treated as changes of the banks' capital positions rather than changes in targets.

On the other hand, in an economic downturn, banks may lower their internal targets. Under such circumstances, at the micro level, each bank may reach its internal goal, but from a macroeconomic point of view, it is fair to say that negative aggregate shocks lowered their capital rather than that the banks lower their targets in response to negative shocks. The relative capital position of an individual bank among other banks may not change, but its absolute capital position does.

Possible non-linearity in banks' adjustments and the cross section regression

The coefficient of capital "surplus" β is left time variant. It is only when banks are capital constrained that the coefficient β should be positive and statistically significant. When a bank is adequately capitalized, and the capital position is far from the position that incurs regulatory intervention,

[31] Suppose that banks that shifted most to real estate during the 1980s began experiencing the negative effects of the decline in the early 1990s and therefore increased their capital to asset ratio then in anticipation of the losses. This would explain why our results using the difference between the actual and "desired" capital-to-asset ratio are stronger than when only using the actual ratio. Ideally one should estimate the relationship between the banks' capital ratio and their characteristics (size, regulatory and institutional dummy variables from pre- crisis and post Basel years (1992-1994) and then compute fitted values for out of sample crisis years (1995-2000). This would accommodate the banks' switch in regulatory status from higher to lower minimum capital requirement if they actually do so between FY 1995 and FY 2000. In principle, the target would not vary much over the time horizon unless their size or regulatory status changed dramatically. Yet, each individual bank has its own target each year according to its size and institutional characteristics. We estimated the target taking into account these characteristics as an experiment. The relationship over 1992-1994 is very inaccurately estimated, and many banks have *negative* values for their targets

its decision is free from the constraint. Its lending supply decisions are constrained only when the actual capital to asset ratio is approaching the target. This assumption implies that banks adjust lending supply either upwardly or downwardly in response to changes in capital only when the absolute level of capital is sufficiently low.[32]

Such non-linearity in lending supply advocates the use of econometric techniques that allow for time variation in the coefficient on the capital to asset ratio, in particular, use of year-by-year cross section regressions. It also allows us to keep the bank specific target not removed unlike standard fixed effect estimation techniques. From our earlier discussion on the regulatory history, we believe that capital shocks are aggregate and that all banks move in and out of the constraint region at the same time.[33] The regulatory regime switches are aimed at the entire banking industry rather than at individual banks. Thus, the ordering of banks' capitalization does not change dramatically after a regulatory shock.

6.2. Results

Capital "shortage" and "surplus"

Figure 3 plots the estimated target BCAR and the actual BCAR of every individual bank over the three year "credit crunch" period starting in FY 1997. The horizontal axis represents the target BCAR whereas the vertical axis gives the actual BCAR. Thus, the actual BCAR of a bank plotted above the 45-degree line is higher than its own target, and therefore such a bank shows a "surplus" of capital. The actual BCAR of a bank below the 45-degree line, on the other hand, falls short of the target,showing a "shortage" of capital.

In FY 1997 all large banks are plotted far below the 45-degree line, meaning that they are all showing a severe capital shortage. Relatively fewer regional and regional 2 banks are below the 45-degree line. A majority of regional banks concentrate slightly above the 45-degree line, and many

during FY 1997- FY 1999.

[32] Van den Heuvel (2002) formalizes such non-linear behavior in his simulation study.

regional 2 banks are clustered around the line. The highly concentrated structure of the Japanese bank lending market suggests that the Japanese banking industry is experiencing a severe shortage of capital in the aggregate sense.

In FY 1998, ten large banks cross above the 45-degree line, and only five such banks remain in a capital shortage position. This is the direct positive influence of capitalization by using public funds. Positions of regional and regional 2 banks largely remain the same. In FY 1999, large banks still mostly maintain a capital surplus. In addition, most regional and regional 2 banks are plotted higher than in FY 1998. This may imply that because they recently came under the RBC based PCA regulatory framework, domestic banks raised the level of capital to minimize the likelihood of falling below the regulatory minimum threshold due to unpredictable negative shocks.

Strength of the instrument

Table 3 shows the correlation coefficients of REAL 89 and the capital "surplus" of each capital to asset ratio measure since FY 1994. All three types of capital "surplus" measures are quite negatively correlated to REAL89 for almost the entire sample period. The correlation coefficient between REAL89 and BCAR is strongly negative from FY 1995, and the value of the coefficient varies from -0.27 to -0.54. Similarly the coefficient between REAL89 and MCAR since FY 1994 stays in the large negative range of -0.39 to -0.54. Unlike the "level" of BIS, the "surplus" measure for BIS is also negatively correlated to REAL89 from the beginning of the sample period, though the correlation coefficient is somewhat more modest than that with other measures. REAL89 appears to serve as a much better instrument for the capital "surplus" measures than the ratios themselves. The strong negative correlation of REAL89 to capital "surplus" measures, with the use of the targets constructed above, supports the legitimacy of such estimated targets.[34]

[33] If the shock were idiosyncratic, a non-linear specification could be used.
[34] The negative correlation between capital to asset ratios and REAL89 remains unchanged after the injection of large

Regression results

Table 4-1 reports the regression results of the target behavior specification, (3), and shows how much banks have changed the lending supply of three classes of lending: non-troubled total lending, manufacturing lending, and non-troubled non-manufacturing lending, in response to the capital "surplus" or "shortage" measured by the target - actual gap of a book based capital ratio, BCAR. The top table and the bottom table represent the OLS results and the 2SLS instrumental variable regression results respectively.

A glance at the OLS results reveals a slightly different picture from the results of the level regressions. In FY 1997, coefficients on both lagged and contemporaneous BCAR are strongly positive and significant for all classes of lending, as in level regressions. In FY 1998, unlike the level regression results, the coefficient on the contemporaneous BCAR is positive and significant for total and manufacturing lending. Unlike the level regression results, In FY 1999, coefficients on both lagged and contemporaneous BCAR are positive and significant for all classes of lending with the exception of the lagged BCAR for non-manufacturing lending.

The 2SLS regression results are the most important ones, upon which the aggregate implications are drawn. In FY 1997, coefficients of the contemporaneous BCAR are positive and significant at the 1 percent level for all classes of lending. Coefficients of the contemporaneous BCAR in FY 1998 are also positive and significant at least at the 10 percent level. The structural capital - lending relationship is not observed in FY 1999. Point estimates of the statistically significant coefficients are largest in FY 1997 in most cases.

Against our anticipation, all point estimates of coefficients which remain statistically significant with a correct positive sign in 2SLS regressions are much larger than OLS point estimates. One possible

public funds into 12 large banks and one regional one. Indeed, the MOF decided to purchase preferred stocks of these banks almost proportionally to their pre-injection capitalization. The correlation coefficient between size of preferred

explanation for this puzzle is that the lending demand and the lending supply moved in opposite directions during these years. In FY 1997, "capital constrained" banks with a "shortage" of capital cut back on their lending while the "strong" aggregate demand (economic recovery) shifted the lending demand function rightward, rather than the "weak" aggregate demand reducing the lending demand as the standard literature on credit crunches claim. As a consequence, the observed decrease in the equilibrium quantity of lending was smaller than the leftward shift of the lending supply function.

Conversely, in fiscal years 1998 and 1999, the same banks, still constrained by their capital positions in making their lending supply decisions, were driven by the "surplus" of capital and "increased" their lending supply, while the "weak" aggregate demand in the ongoing recession shifted the lending demand function to the left. Therefore, the observed equilibrium increase in lending was again smaller than the rightward shift of the supply function. Table 4-2 presents the complete results of the 2SLS regressions over the "credit crunch" period.[35]

The issue of the timing of events

In fact, in regressions with both lagged and contemporaneous ratios, the coefficients of the lagged ratios are not statistically significant in any fiscal year. In addition, overidentification tests reject the null hypothesis at 10 % level for the lag specification for "non-troubled" lending in fiscal years 1997 and 1998. Therefore our discussion will be based on the results using contemporaneous capital. It is a common regulatory practice to announce actions before the close of the fiscal year so that banks act accordingly toward the end of fiscal year. For instance, regulators' official announcement of the rigorous assessment framework of bank assets was published on March 5th, 1997, about a year before the end of

stocks purchased by the government and core capital less preferred stocks purchased as of FY 1998 is 0.92.

[35] The "partial squared correlation coefficient" proposed by Shea (1997) serves as a goodness of fit test for a capital to asset ratio with the set of instruments employed. This testing is, roughly speaking, an R-square taken into account the collinearity among the instrumental variables. The results are reasonably good for the Japanese banks' cross-sectional data. 20 out of 36 partial squared correlation coefficients when the book ratios are used are greater than 0.1. Shea gives an example where the normal R-square is 0.1 and this statistic is 0.05, and concludes that the goodness of fit is not as good as the standard R-square test implies.

fiscal year 1997. Banks knew a year in advance that a large loss of capital was inevitable at the end of fiscal year 1997.

6.3. Robustness Tests

Further discussion on the instrument

A potential problem is a possible correlation between REAL89 and lending supply shock. A bank that shifted its lending portfolio more aggressively toward real estate lending may have also supplied more loans to ex-post risky firms in the "non-troubled" industries than other banks. If so, attempting to make its loan portfolio less risky, such a bank may have written off more NPLs, terminated more existing lending contracts to poor performers in the "non-troubled" and "troubled" industries alike, and thereby, supplied less loans in the "non-troubled" industries than banks that had not been much dependent on the real estate lending. The resulting correlation would be negative. Or such a bank may have acted in the opposite manner, and launched more rescue lending programs to poor performing borrowers. In this case the correlation would be positive.

This type of endogeneity can be described as the correlation between an unobservable bank specific fixed effect and REAL89. Our empirical strategy is much less prone to this type of problem. Remember that our main explanatory variable is constructed as the actual capital to asset ratio less the bank specific target. The target and the dummy variables on the bank's institutional characteristics likely absorb the fixed effect. Hansen's (1982) overidentification tests do not imply endogeneity over the period FY 1997 to FY 1999. The correlation coefficients for REAL89 and the estimated residual are found to be small in absolute values.

More importantly, the point estimate of the coefficient on BCAR changes inconsistently with the negative correlation, and correcting the bias caused by the positive correlation would rather strengthen our interpretation of the larger reactions by banks in FY 1997. Since BCAR is on average smaller in FY

1997 than in FY 1996 for most of the banks, as Figure 3 shows, a simple analysis of the 2SLS formula demonstrates that the point estimate of the coefficient on BCAR in FY 1997 must be smaller than that in FY 1996 if the bias caused by the negative correlation were large enough to reverse the order of the coefficients' magnitudes over the two years. The result of point estimates is opposite to what the negative correlation would lead to. Similarly, since BCAR is greater in FY 1998 than in FY 1997, the point estimate in FY 1998 must exceed the corresponding estimate in the preceding year.[36] This, in turn, suggests that it is harder to rule out the opposite scenario of a positive correlation. Should this be true, the symmetric discussion suggests that the coefficient would be underestimated in FY 1997 and overestimated in fiscal years 1998 and 1999.

Fixed effect estimation

Removing the fixed effect makes it impossible to identify the level regression model (2), with the target regression model (3) since the time invariant target disappears. Having said that, the fixed effect estimation of the lending supply function provides persuasive side evidence on how the endogenous fixed effect would bias the cross section estimator of the coefficient on capital adequacy. We consider the following model.

$$\Delta \ln L_{it} = \alpha_0 + \alpha_1 \Delta \ln L_{it-1} + \beta_t \left\{ \frac{K_{it}}{A_{it}} - \left(\frac{K_i}{A_i} \right)^{t \arg et} \right\} + \lambda X_i + \eta_i + \mu_t + u_{it}, \; t=1,\ldots,T \qquad (4)$$

Equation (4) is the same as equation (3) except that the residual is further decomposed into a fixed bank

[36] Let us consider the simple panel regression of one time variant explanatory variable, x_t (capital to asset ratio in our empirical setup), and one time invariant instrumental variable, z_i (REAL89 in our empirical setup). We estimate the following regression using instrumental variable regression period by period.

$y_{it} = x_{it}\beta_t + \eta_i + u_{it}$ where η_i is the fixed effect.

We assume that u_{it} is independent of z_i.

Since $p\lim \hat{\beta}_t = \beta_t + E_t[z_i x_{it}]^{-1} E[z_i \eta_i]$, $p\lim(\hat{\beta}_t - \hat{\beta}_{t-1}) = (\beta_t - \beta_{t-1}) + \left\{ E_t[z_i x_{it}]^{-1} - E_{t-1}[z_i x_{it-1}]^{-1} \right\} E[z_i \eta_i]$

The data show $\hat{E}_{97}[z_i x_{i,97}] < \hat{E}_{96}[z_i x_{i,96}]$. If $E[z_i \eta_i] < 0$, the second term in the right hand side at t=97 is negative. Therefore if this source of bias is large enough to reverse the order of the estimated coefficients' magnitudes, $\hat{\beta}_{97} < \hat{\beta}_{96}$ must result. The argument for t=98 is symmetrical.

effect η_i, a time effect μ_i, and a random error u_{it}. After first differencing equation (4), and transforming the result, we obtain the following equation that involves interaction terms of time dummy variables D_t's with the history of capital to asset ratios stretching over the entire panel.

$$\Delta \ln L_{it} - \Delta \ln L_{it-1} = \alpha_1 (\Delta \ln L_{it-1} - \Delta \ln L_{it-2}) + \sum_{\tau=1}^{T} \beta_\tau^* \left(D_t \frac{K_{i\tau}}{A_{i\tau}} - D_{t-1} \frac{K_{i\tau}}{A_{i\tau}} \right) + \Delta \mu_t + \Delta u_{it}, \; t=2,\ldots,T \quad (5)$$

In practice, besides the interaction terms we use time dummy variables as explanatory variables to represent the time effect $\Delta \mu_t$. In estimating (5), a set of instruments almost identical to the one used for cross section regressions is employed.[37]

Table 4-3 reports results of the fixed effect estimation for the three year period from FY 1997 to FY 1999.[38] It turns out that the coefficient of the contemporaneous BCAR in FY 1997 is large and statistically significant at least at the 5 percent significance level for all definitions of lending. On the other hand, the coefficients of BCAR are not statistically significant for all definitions of lending in later years. Such results are consistent with our conjecture that the possible biases are underestimated for the coefficient in FY 1997 and overestimation in later years.

Alternative capital to asset ratio measures

The regression results with alternative capital to asset ratio measures (BIS in Table 5-1 and MCAR ion Table 5-2) support our findings when using book based BCAR. Regardless of measures used, coefficients on the contemporaneous capital to asset ratio are positive in FY 1997 and 1998. In particular, coefficients on the contemporaneous MCAR are positive and significant at least at the 10 percent level for five of six cases.

[37] In order to deal with the lagged dependent panel dynamic nature of the model, predetermined variables including twice and three times lagged dependent variables, twice, three times, and four times lagged deposit growths, the twice lagged interest rate differential, the twice lagged and the three times lagged land price growth are used as instrumental variables. In addition REAL89, PORT and first differenced time dummies are used.

Regional and regional 2 banks

We apply the same methodology to subgroups of banks. Groups investigated are regional banks registered as "domestic" as of the end of the fiscal year 2000, and regional 2 banks. Regional banks are limited to "domestic" banks in order to control the banks' regulatory status (49 banks). All 48 regional 2 banks in the sample are registered as "domestic".[39]

Table 6-1 reports the 2SLS regression results of equation (3) using BCAR for domestically operating regional banks. All coefficients on BCAR are positive and significant in FY 1997. In FY 1998, non-manufacturing lending supply seems strongly constrained, whereas manufacturing lending is free from the constraint. The coefficient on the contemporaneous capital ratio for total lending supply is significant only at the 10 percent level. In FY 1999, only coefficients for manufacturing lending are positive and significant. Table 6-2 reports the 2SLS regression results of equation (3) for regional 2 banks. Both total and manufacturing lending respond to the contemporaneous book based capital to asset ratios in FY 1997. [40]

Further discussion on the instrument

Table 7 shows the results of various robustness tests. The estimated coefficients presented are those of the contemporaneous book based capital "shortage" in FY 1997. The baseline results from Table 4-1 are presented in the row 1.

Do only banks with capital "shortage" reduce lending?

Our approach using a cross-section target specification is motivated by the non-linear reaction of

[38] Longer panels result in imprecise estimates of coefficients.
[39] Large banks are not analyzed as a single group owing to the small number of observations (15 banks) which becomes even smaller when divided into two smaller institutional sub groups (city banks and trust banks).
[40] We also estimated equation (3) with alternative capital to asset ratio measures for these sub samples. (Results are not reported.) The results using MCAR are generally consistent using those with BCAR. The results using BIS are hard to interpret because of the weakness of REAL89 as an instrument for BIS in FY 1997.

banks to a large negative aggregate capital shock in FY 1997. Nonetheless, the banks' non-linear reaction may be observed cross-sectionally as well; i.e., banks with capital "shortage" may reduce lending whereas banks with capital "surplus" may not. The estimated coefficients are positive and statistically significant for the sample of banks with capital "shortage" (row 2) but they are statistically insignificant for the sample of banks with capital "surplus" (row 3). Coefficients for the sample of banks with capital "shortage", however, are not substantially larger than those for the entire sample (row 1), suggesting that the cross-sectional non-linearity may not be substantial.

Controlling for the region that the bank is headquartered in

Controlling for bank type does control for loan demand variation but may not be sufficient. When seven region dummies indicating the region in which the bank is headquartered in are included as additional control variables, estimated coefficients are virtually unaltered (row 4).[41, 42]

Excluding the finance and insurance industry from the "non-troubled" industries

Since the finance and insurance industry includes non-bank finance companies that anecdotal evidence shows to be "troubled" industries, including loans to this industry in the "non-troubled" non-manufacturing industries' group may be misleading. When the finance and insurance industry is excluded from the "non-troubled" non-manufacturing industry, the estimated coefficient of capital "shortage" remains positive and statistically significant and its magnitude is not very different from the one estimated with lending to non-manufacturing industries that include the finance and insurance industry (row 5).

6.4. Tests on Alternative Hypotheses

[41] The eight regions are Hokkaido and Tohoku, Kanto, Koshinetsu, Tokai, Kinki, Chugoku, Shikoku, and Kyushu.
[42] We examined the regression with the 46 prefecture dummies. Many of estimates are imaginary numbers, which we

Collateral squeeze or the "credit crunch"?

Holmstrom and Tirole (1997) discuss a collateral squeeze affecting borrowers and resulting in decreased loan demand as one form of bank capital tightening. So if a bank's borrowers are tied to the bank through historical relationships, the collapse of real estate prices would not only have caused loss of bank capital but would also have weakened loan demand during the 1990s. To see which of the "credit crunch" or the collateral squeeze is dominant, we look at the data to test their prediction that a credit crunch leads to an increase in the spread between intermediated debt (loans) and the market debt (deposits), a decrease in the solvency of banks, and an increase in that of firms; and vice versa if it is a collateral squeeze.

The solvency of banks suddenly fell and the spread between short loans and deposits of three to six months reversed its downward trend in March 1998 (Figure 4-1). The coefficient of capital "surplus" in the results of the OLS regression of the spread is also negative and statistically significant (Table 8-1).[43] The solvency of manufacturing firms (the ratio of equity to asset) kept rising in the first quarter of 1998 (Figure 4-2). These findings at the end of fiscal year 1997 are all consistent with the "credit crunch."

Do banks with inadequate capital abandon their "international" status?

In response to a capital loss, banks may abandon their "international" status which imposed a higher minimum risk-based capital requirement (8%) compared to a "domestic" status (the minimum requirement is 4%). There were only three such "switcher" banks before FY 1996. Switches regulatory status was mainly concentrated in FY 1997. 34 out of 76 previously "international" banks in the sample switched to "domestic" status during this year. Ten banks switched in FY 1998, seven in FY 1999, and

suspect is due to the small degree of freedom (too many independent variables relative to the sample size).

[43] The lending rate and the deposit rate are calculated as the interest receipts on loans and discounts divided by the end of fiscal year loan stock and the interest expenses on deposits divided by the end of fiscal year deposit stock respectively. Then the spread is calculated as the constructed lending rate less the deposit rate. Other independent variables included are the lagged spread and bank type dummies. The estimated effect of capital "surplus" on the spread roughly corresponds to that on the net inflows of funds into banks as the lagged spread separates effects of interests earned on stock of past loans and interests paid on past deposits.

just one in FY 2000. Do these "switcher" banks bias our finding? Not necessarily. Table 8-2 shows the results of the probit regression of the probability of switching to "domestic" status by a previously "international" bank in FY 1997. It is financially "strong" banks with adequate capital that chose to abandon their "international" status.

Does "capital crunch" reduce bank deposits?

Peek and Rosengren (1995 c) argue that if banks are not constrained by binding capital requirements, then a reduction in capital increases deposits as banks seek funds, while if capital requirements are binding, both deposits and loans decrease. Table 8-3 shows the results of the 2SLS regression of the growth of deposits. Independent variables remain the same as in the main regression with loan growth as a dependent variable except that lagged loan growth is replaced by lagged deposit growth. Instrumental variables remain the same as in the main regression except that lagged lending growths are excluded. The coefficient of the book based capital "shortage" in FY 1997 is positive and statistically significant at the 10 percent level, supporting the claim by Peek and Rosengren (1995 c).

How does a "capital crunch" influence lending to "troubled" industries?

Watanabe (2005) applies the same approach as ours to "troubled" industries, which do not include real estate and construction (wholesale and retail, and services), with the real estate lending share in the late 1980s (REAL89) as an instrumental variable. He finds that the estimated coefficient is smaller than our estimate for "non-troubled" industries. His finding suggests that the "capital crunch" in FY 1997 not only caused a contraction of bank lending supply ("credit crunch") but also caused a misallocation of lending towards unhealthy industries.

Did banks become more conservative in FY 1997?

Banks may have become more conservative in FY 1997 not because of binding capital requirements, but due to other factors correlated with their capital to asset ratio. For example, banks may assess future credit risk based on past loan performance, and their non-performing loans would be one indication of their past loan performance. Since our instrument, REAL89, explains bank capital adequacy through NPLs in the late 1990s, a comparison of our "credit crunch" hypothesis with the alternative hypothesis would be needed. To this end, we estimated the main target specification with NPLs and the interaction term of NPLs and capital "shortage" as additional independent variables, but failed to obtain plausible results due to multicollinearity (the correlation coefficient between NPLs and capital "shortage" is above 0.6, the results are not shown).

6.5. Macroeconomic implications

Aggregate lending growth

Table 9 reports the aggregate lending growth rates over the six-year period from FY 1995 to FY 2000 of all the selected 126 banks. Lending to "troubled" industries and real estate lending are added to the three "non-troubled" classes of lending analyzed above.

Non-troubled total lending in the first column is steady over time with its growth rate ranging from -1.2 percent to 1.8 percent. It grew by a modest 2 percent over the six-year period. It experienced a modest decline for two years in a row since FY 1996, but recovered in FY 1998. Manufacturing lending declined until FY 1997. After two years of recovery from FY 1998, it plunged again in FY 2000. In all years except for FY 1999, non-manufacturing lending experienced negative growth. As a consequence, non-manufacturing lending dropped by a little over 15 percent over the six years, whereas manufacturing lending dropped by just 8 percent. Not only in the "credit crunch" years but also in the fiscal years 1995, 1996, and 2000, lending to industries declined. The fall in lending in these years is probably mostly due to a decline in lending demand.

Surprisingly, aggregate growth rates of lending to troubled industries and the real estate industry stayed almost always higher than those to healthier industries. Though lending to troubled industries never grew positively, compared to lending to the healthier non-manufacturing industries, its growth rate was higher for all years except for FY 1999. Lending to troubled industries declined by a little less than 8 percent over the six-year period, about half of the corresponding figure for the sounder non-manufacturing lending. More surprisingly, real estate lending grew until FY 1997, when all other classes of lending declined. Afterward, the rate of decline of real estate lending was modest. Real estate lending grew by 3 percent over the six-year period.

Such data may indicate that firms with high lending demands in the weak macroeconomic environment were highly leveraged firms groaning under the burden of NPLs and in desperate need for infusions of more cash for debt repayment. Japanese banks were said to be engaged in a lending practice called "evergreening", which allows economically bankrupt firms to keep operating. Taking into account the large write offs of NPLs in troubled industries, the difference in new lending sound industries and that to troubled industries may be even larger.[44]

The aggregate impact of the capital constraint

Table 10 reports what we consider to be the most important results of this paper, how much either the capital "shortage" or the capital "surplus" of banks, measured by the three definitions of capital, contributed to the growth of aggregate lending supply.

The effect of the negative book capital shock in FY 1997 is large for all classes of lending. It cuts non-troubled total, manufacturing, and non-manufacturing lending by 3.72 percent, 5.70 percent, and 8.54 percent respectively. The positive capital shock in FY 1998 results in a modest recovery in lending in the same year. It raises non-troubled total, manufacturing, and non-troubled non-manufacturing

[44] The empirical literature on the Japanese banks' evergreening has been growing recently. See Kobayashi, Saita and Sekine (2002), Peek and Rosengren (2003), and Caballero, Hoshi and Kashyap (2004).

lending supply by 1.07 percent, 1.43 percent, and 3.82 percent respectively. The recovery of lending, made possible by the positive capital shock in FY 1998, does not make up for the lending cut caused by the negative capital shock in FY 1997. However, it may have been a positive shock large enough to help the Japanese banks escape from the capital constraints.

The net effect of capital shocks in the fiscal years 1997 and 1998 on total, manufacturing, and non-manufacturing lending is -2.67 percent, -4.35 percent, and -5.04 percent respectively in contributing to the growth rate of the lending supply. Had the Japanese banks not been constrained by the contemporaneous book capital shock of FY 1997, non-troubled total lending, manufacturing lending, and non-troubled non-manufacturing lending supply would have grown by 3.02 percent, 3.78 percent, and 4.62 percent respectively. On the other hand, had Japanese banks not responded to the positive shock in FY 1998, each lending category would have shown a decline of 0.51 percent, 0.25 percent, and 9.23 percent respectively.

Results using the BIS ratio and the market based ratio MCAR are more positive and more negative than the results using BCAR. We suspect that the former are overestimated (the most optimistic estimates) and the latter are underestimated (the most pessimistic estimates). None of banks suffering from a severe shortage of core (book) capital failed to meet the BIS requirements in FY 1997, implying that BIS is a poor measure of bank capital. The target market based ratio is based on the high post bubble stock prices of FY 1992 to FY 1994.

The "capital crunch" caused the "credit crunch" in FY 1997

These findings lead to the following interpretation of the banks' lending behavior during the late 1990s. Accounting losses, arising mainly from the liquidation of *jusen* companies in FY 1996, caused a large negative capital shock, which resulted in considerable losses in the banks' equity capital. A rigorous self-assessment of bank assets revealed large non-performing loans that had been covered up for

years. Large, newly discovered NPLs coupled with tougher regulations pressuring the banks to dispose of them under the watchful eye of the newly introduced PCA, caused huge accounting losses, hurting further the banks' book capital in FY 1997. The accumulative effect of these two negative shocks over a two years period was enough to push the banks' capital positions downward. As a result the banks became capital constrained.

Many of them, in turn, failed to satisfy their individual targets and cut back on their lending irrespective of the borrowers' credit worthiness. Such a negative lending supply shock narrowed channels of credit supply to bank dependent borrowers who needed more funding to finance their real and immediate needs, at a time when the economic outlook looked sunnier and aggregate demand for lending was in an upturn during a period of fragile economic recovery. Thus, the observed amount of loans supplied in equilibrium ran short of the amount an unconstrained equilibrium would have brought about.

The impact of public capital infusion in FY 1998

The same mechanism may have worked in reverse in FY 1998 and eased borrowing conditions more than an unconstrained equilibrium could have. The positive capital shock represented by the infusion of public capital encouraged the previously capital constrained banks to increase lending. In fact, the amount of capital injected in the form of preferred stocks into the sample of 126 banks totaled 58,090 million yen and was equivalent to 0.7627 percent of their assets.[45] Knowing that the industry wide capital to asset ratio exceeded the target ratio by just 0.68 percent in FY 1998, the injected public funds must have created the positive shock large enough to raise bank capital a little beyond the desired level. It is certain that without public funds, the banks would have remained severely short of capital into

[45] Nakaso (1999) classifies the public funds into two categories: those raised in the form of preferred stocks and those classified as subordinated debts. As a whole, 61,590 million out of 74,590 million yen was issued in the form of preferred stocks. The Industrial Bank of Japan, which is omitted from the sample, had 3,500 million yen of preferred stocks underwritten by the government. Note that Yokohama Bank, the largest regional bank, was the only local bank to

FY 1998. In response to such a positive shock it looks like banks shifted their lending supply upward.[46] The declining quantity of lending simply reflects the weak lending demand due to the worsening macroeconomic performance and disposal of structural NPLs.

The net impact of capital on lending was negative

However, the positive impact, if it existed at all, was too small to offset the negative lending supply shock of the previous year. It is not readily clear from combined findings of the main cross section regressions and the auxiliary fixed effect estimation whether the positive impact boosted lending supply in FY 1998 or it simply helped banks escape from their capital constraints. After all, the net impact of capital on bank lending supply appears substantially negative by all accounts. Particularly, industry lending was hit hard. Banks returned to capital constraint free decision making by FY 2000.

Evergreening?

As our findings from both main cross section regressions and the auxiliary fixed effect estimation suggest, the bias due to the possible endogeneity of REAL 89 may underestimate the negative impact of capital shortage in FY 1997 and overestimate the positive impact of capital surplus in subsequent years. As we discussed earlier, these findings can be interpreted as circumstantial evidences that banks that had been engaged in aggressive real estate lending in the 1980s may have been indulged in evergreening of underperforming firms across the board.

Economic significance of the "credit crunch" in FY 1997

According to the discussion by Bernanke and Lown (1991), the fact that such alternative forms of

receive public funds in FY 1999.

[46] The same regression as equation (3) for FY 1998 and FY 1999 that replaces the gap of actual and target capital to asset ratios with the same gap less the public fund to asset ratio and the public fund to asset ratio supports this view. The coefficient on the public fund to asset ratio in FY 1998 is found to be statistically significant for non-troubled total

credit as commercial paper, non-bank credit and trade credit did not grow much during the New England "credit crunch" period in 1990-1991 is likely an indication of an overall decline in credit decline. In Japan in FY 1997, on the contrary, alternative forms of credit grew steadily. Commercial paper, loans excluding mortgage loans by government financial institutions, and corporate bonds grew by 39.7 percent, 3.8 percent, and 19.9 percent, respectively. The sum of the three dominant alternative forms of credit for Japanese firms grew by 12.5 percent. This implies that credit demand by Japanese firms in FY 1997 was solid. Private bank loans remain the dominant source of credit for Japanese firms. Total loans supplied by the 126 banks in the sample amounted to 352 trillion yen, whereas the three alternative forms of credit mentioned above are added up to only 128 trillion yen. The steady growth of alternative forms of credit to firms coupled with the bank centered financial structure in Japan imply that the bank "credit crunch" in FY 1997 contributed negatively to the aggregate demand and led to an end of the short-lived economic recovery and ultimately to the recession in the following years.[47, 48]

A rise in the lending supply in FY 1998, mainly brought about by an infusion of public funds into the severely capital constrained large banks, may have contributed positively to the aggregate demand and prevented the declining aggregate demand from getting worse.

Policy implications on prudential regulation

We can draw two major policy implications from our empirical findings. First, under the current BIS regulatory framework, the tougher stance against banks that requests them to recognize and dispose of non-performing loans is dangerous, as banks would become capital constrained and a credit crunch may occur. Such a tougher policy should be accompanied by a simultaneous accommodating policy that would infuse public capital into banks. If large amounts of public capital infusion and tougher

lending in FY 1999 at the 10 percent level but it is not so for lending in FY 1998.

[47] The *tankan* "lending attitude of financial institutions" diffusion index for large firms quickly recovered after a sharp fall in FY 1997 whereas the index for small firms remained negative into FY 2000.

[48] According to Ito (2003), the contractionary fiscal policy in April 1997 (combined with the Asian crisis) had an

assessment of bank assets had been executed simultaneously in FY 1997, not only would the NPLs have been removed from the banks' balance sheets, the banks would not have lost their capital and the credit crunch would have been avoided. Second, the prudential authority and the fiscal and monetary authorities should be well coordinated. If the Banking Bureau of the MOF had been well informed of fragile macroeconomic conditions by the National Accounting Bureau of the MOF, the Bank of Japan, and the Economic Planning Agency, introduction of the tougher prudential policy would have been deterred, and the economy may not have entered the prolonged recession.

What would have happened if the amount of injected public capital had been larger?

The interesting policy question to ask is what would have happened if the amount of funds injected were much larger than they actually were. Would banks have raised their lending supply even more? Our answer drawn from our micro evidence is "probably not". Further public capital would have changed the structure of the lending supply function sooner and lifted the constraint on banks which actually happened later. Thus banks would not have responded positively to any marginal increase in their equity capital, and the quantity of lending would have been simply governed by contracting lending demand under extremely low lending rates.[49]

Should capital requirements be countercyclical?

Another policy question to ask is whether capital requirements should be countercyclical.[50] The

important (negative) impact on Japan's recovery.

[49] There is one caveat to interpreting the empirical findings for FY 1998. What seems to be a negative contribution of capital shortage to bank lending may not be a causal relationship but just simultaneously occurring phenomena. On the one hand, banks raise their lending supply in response to the regulatory measures outside the regulatory framework based solely on the numerical RBC standard aimed exclusively at preventing a credit crunch from occurring. On the other hand, public capital injection raises the banks' equity capital. Strictly speaking, the fact that the capital to asset ratios of several large banks receiving public funds far exceed their targets is contrary to the idea that "capital constrained" banks adjust lending negatively in response to capital shortage. The distinction between the two hypotheses is not possible in the current analytical framework. The alternative hypothesis, however, does not change the aggregate implication. The positive lending shock remains the supply shock even if this alternative is true.

[50] Recent works such as Kashyap and Stein (2004) and Catarineu-Rabell, Jackson and Tsomocos (2005) raise the

economy started to slow down in the early FY 1997 and experienced a negative growth in the third quarter of FY 1997. Postponing the start of the PCA framework and stringent self-assessment of bank assets, or relaxing capital requirements in the weakening economy in FY 1997 would have prevented the adverse effect of the reduced supply of loans on the real sector. The tougher prudential regulations in FY 1997 are one of the primary reasons of the annual negative growth in the following FY 1998.

7. Conclusion

The "capital crunch" experienced by banks was said to have caused the "credit crunch", reduction in the supply of bank loans, under the BIS capital regulation framework. Following the conventional wisdom of the abundant credit crunch literature using micro data, lending growth is regressed on measures for the capital to asset ratio.

Making use of the empirical finding that the structural component of non-performing loans are best explained by the portfolio reorganization toward real estate lending during the 1980s, we employ the within bank share of real estate lending in the late 1980s as an instrumental variable for bank capital. We then measured the aggregate impact of capital "shortage" or "surplus" on lending growth. The bank specific target capital to asset ratio is estimated as a time-series average in the three year period from FY 1992 to FY 1994, when banks seemed to have been meeting their targets. Lending growth is regressed on the gap between the actual and the estimated target capital to asset ratios. Aggregating the impacts of bank capital on the individual supply of loans gives the change in supply of loans caused by the capital constraint.

We found that banks cut back on their lending supply in fiscal year 1997 in response to a large loss of bank capital caused by the rigorous self-assessment of assets requested by the regulator (a "regulatory driven capital crunch"). Then a positive capital shock mainly due to an injection of public capital in FY

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concern of "procyclicality" of the new Basel Accord. In economic downturns, downgraded ratings of borrowers result in higher capital requirements for banks, and thus banks are more likely to become capital constrained.

1998 likely induced previously capital constrained banks to accelerate supply of loans. This positive effect on lending, however, barely offset the “credit crunch” of the previous year.

Further research is needed. If we find that some structural behavior change of banks in years before explains capital shortages in the 1990 - 1991 period of the U.S. credit crunch, it would be possible to settle the debate over whether the “credit crunch” is merely the reflection of the recession or is a supply side phenomenon. This paper mainly focuses on the “unwillingness to lend” of healthy banks to healthy lenders. As Bernanke (1983) and Calomiris and Mason (2003) explore in the context of the U.S. Great Depression, the financial distress itself could have been a negative lending supply shock. Increasing bank failures may have been a negative financial shock for bank dependent borrowers in the fiscal years of 1998 and 1999.

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Table 1. Correlation coefficients of REAL89 and capital asset ratios (level variables)

	1994	1995	1996	1997	1998	1999	2000
Book based ratio (BCAR)	0.2447	-0.0511	0.0281	-0.2515	-0.1230	-0.0951	-0.2485
BIS risk based ratio (BIS)	0.0186	-0.0816	-0.0434	0.0371	-0.0326	-0.1230	-0.0868
Market based ratio (MCAR)	0.0375	-0.0247	-0.0980	-0.3475	-0.2867	-0.1614	-0.3236

Table 2. Year by year coefficients on the book based capital to asset ratios (BCAR) since FY 1995

OLS

	Non-troubled lending					
	Total		Manufacturing		Non-manufacturing	
	Lag	Cont.	Lag	Cont.	Lag	Cont.
1995	0.3893	0.5941	-0.1951	0.1435	-0.3124	0.2765
	(1.1324)	(1.6534)	(-0.2758)	(0.2269)	(-0.4199)	(0.4127)
1996	-0.2313	-0.1532	0.0144	0.0426	1.7939**	0.7447
	(-0.7938)	(-0.6139)	(0.0409)	(0.12333)	(2.4650)	(0.9932)
1997	0.9555**	1.7049***	2.3082***	2.7782***	2.5863*	4.5159***
	(2.1975)	(5.2717)	(3.4080)	(5.5751)	(1.9241)	(4.6154)
1998	-0.1897	0.3077	0.3952	1.1540**	-1.3191	-0.1037
	(-0.3721)	(0.8203)	(0.7140)	(2.4850)	(-1.2100)	(-0.1036)
1999	0.6771**	0.9870***	0.4868	0.6909	2.8447***	3.2006***
	(2.0605)	(2.8108)	(1.1241)	(1.52153)	(2.9907)	(3.2394)
2000	-0.2630	0.1072	0.0095	0.5745*	0.2977	0.3301
	(-0.5763)	(0.2532)	(0.02140)	(1.7191)	(0.2149)	(0.2470)

2SLS

	Non-troubled lending					
	Total		Manufacturing		Non-manufacturing	
	Lag	Cont.	Lag	Cont.	Lag	Cont.
1995	0.7001	0.4822	2.0398	0.9884	-0.2592	2.2223
	(0.4334)	(0.3358)	(0.59056)	(0.33669)	(-0.0738)	(0.5791)
1996	-0.1836	0.7890	-2.9265	-0.2012	1.6175	0.0678
	(-0.0640)	(0.4798)	(-0.7131)	(-0.1087)	(0.2431)	(0.0164)
1997	0.2842	*2.7925***	4.8777**	*5.5042***	-0.8185	*6.3679***
	(0.2319)	*(2.7169)*	(2.1350)	*(2.8580)*	(-0.3222)	*(2.4500)*
1998	*1.7687*	*3.5250**	*6.6540*	*4.7152**	*-4.8418*	*6.7106*
	(0.8088)	*(1.8862)*	*(1.2195)*	*(1.9287)*	*(-1.0686)*	*(1.1986)*
1999	*3.6444**	*4.6037*	*0.9267*	*1.5397*	*5.7412*	*2.2697*
	(1.7321)	*(1.4196)*	*(0.7313)*	*(0.7958)*	*(1.5366)*	*(0.4415)*
2000	*0.3414*	*0.9119*	*0.4476*	*0.9016*	*2.4911*	*6.1826**
	(0.2290)	*(0.7181)*	*(0.26974)*	*(0.6435)*	*(0.5939)*	*(1.6953)*

Note:

1. Cells at the bottom of the table in italic indicate that BCAR is negatively and significantly correlated with REAL89. 2. Independent variables used are the lagged dependent variable, BCAR, a city bank dummy, a trust bank dummy, and a regional bank dummy.

3. *** shows significance at 1%, **, 5%, and *, 10%, respectively and t statistics computed with a robust standard error are in parentheses.

Table 3. Correlation coefficients of REAL89 and measures of capital "surplus"

	1994	1995	1996	1997	1998	1999	2000
Book based "surplus"	-0.0096	-0.4607	-0.2767	-0.5345	-0.3443	-0.3214	-0.4358
BIS risk based "surplus"	-0.2551	-0.2321	-0.2139	-0.1055	-0.1568	-0.2340	-0.1933
Market based "surplus"	-0.3940	-0.3255	-0.3740	-0.5392	-0.5105	-0.3149	-0.5102

Note: The "surplus" is the difference between actual and desired levels of the capital to ratio

Table 4-1. Year by year coefficients on the book based capital (BCAR) "surplus" measures

OLS

	Non-troubled lending					
	Total		Manufacturing		Non-manufacturing	
	Lag	Cont.	Lag	Cont.	Lag	Cont.
1995	3.1117	1.8926**	5.9431	2.7331**	6.3877*	4.3631***
	(1.3352)	(2.0058)	(1.2712)	(2.4724)	(1.8480)	(2.8269)
1996	0.1630	0.0299	1.5339*	0.5644	3.9105**	0.0629
	(0.2159)	(0.0713)	(1.7468)	(0.8728)	(2.0549)	(0.0433)
1997	2.5916***	2.7034***	4.6387***	3.5159***	5.0866**	6.1439***
	(3.29557)	(8.7837)	(4.0107)	(5.9217)	(2.1813)	(5.2751)
1998	0.6116	0.9486*	0.8160	1.5017**	1.2395	1.8368
	(1.0233)	(1.9483)	(1.4981)	(2.3485)	(0.8470)	(1.5471)
1999	1.2463**	1.5436***	0.8764*	1.0820**	1.8688*	1.7384
	(2.6381)	(3.4795)	(1.8241)	(2.2324)	(1.7164)	(1.4898)
2000	-0.0807	0.2924	0.8442*	1.2409***	0.9464	0.7719
	(-0.1689)	(0.5989)	(1.6662)	(3.8787)	(0.6641)	(0.5818)

2SLS

	Non-troubled lending					
	Total		Manufacturing		Non-manufacturing	
	Lag	Cont.	Lag	Cont.	Lag	Cont.
1995	-4.6343	*-0.7305*	16.3497	*-1.6173*	-4.0994	*3.5128*
	(-0.3762)	*(-0.2755)*	(1.0945)	*(-0.3795)*	(-0.2069)	*(0.4978)*
1996	*-1.6159*	*0.3448*	*5.5886*	*3.0451*	*-3.5591*	*-2.0894*
	(-0.6961)	*(0.3132)*	*(1.3479)*	*(1.1117)*	*(-0.6138)*	*(-0.4231)*
1997	*4.5115*	*3.9885****	*12.3775****	*6.1146****	*4.3003*	*9.1686****
	(1.2371)	*(3.6800)*	*(3.5254)*	*(3.5618)*	*(0.7476)*	*(3.2906)*
1998	*2.1365*	*2.7277***	*3.6816*	*3.6378**	*5.7499*	*9.6862***
	(1.3912)	*(2.4536)*	*(1.0753)*	*(1.8401)*	*(1.1221)*	*(2.3555)*
1999	*2.5871*	*1.8600*	*0.7608*	*0.8394*	*2.3607*	*-2.7237*
	(1.6750)	*(1.1959)*	*(0.6914)*	*(0.6327)*	*(0.8281)*	*(-0.7116)*
2000	*0.4165*	*0.8554*	*0.6258*	*1.0091*	*2.4694*	*4.4351*
	(0.3670)	*(0.7732)*	*(0.5529)*	*(0.9308)*	*(0.8538)*	*(1.6671)*

Note:

1. Cells at the bottom of the table in italic indicate that gaps between capital to asset ratio and its target levels are negatively and significantly correlated with REAL89. Independent variables used are the lagged dependent variable, the book based capital "surplus", a city bank dummy, a trust bank dummy, and a regional bank dummy.
2. *** shows significance at 1%, **, 5%, and *, 10%, respectively and t statistics computed with a robust standard error are in parentheses.

Table 4-2. Regression results for equation (3) using book based capital (BCAR) "surplus" measures

FY 1997

	Non-troubled lending					
	Total		Manufacturing		Non-manufacturing	
	Lag	Cont.	Lag	Cont.	Lag	Cont.
Constant	0.0130**	0.0257***	-0.0238*	-0.0068	0.0304	0.0611**
	(2.3828)	(3.9357)	(-1.839)	(-0.4388)	(1.5385)	(2.5829)
Lagged dependent variable	0.4196***	0.4440***	-0.2420	-0.2101	-0.1234	-0.0432
	(2.7269)	(2.8711)	(-1.3843)	(-1.1427)	(-0.7378)	(-0.3087)
BCAR capital "surplus"	4.5115	3.9885***	12.3775**	6.1146***	4.3003	9.1686***
	(1.2371)	(3.6800)	(2.3816)	(2.9289)	(0.7265)	(3.2830)
City bank dummy	0.0231	0.0342	0.0723	0.0609	-0.0962	0.0151
	(0.5224)	(1.0182)	(1.0417)	(1.0298)	(-0.9845)	(0.1773)
Trust bank dummy	-0.0202	-0.0006	0.1096*	0.0585	-0.1113	0.0051
	(-0.2679)	(-0.0218)	(1.3206)	(1.0654)	(-0.9548)	(0.0565)
Regional bank dummy	0.0018	-0.0028	0.0082	0.0138	-0.0122	-0.0356
	(0.1854)	(-0.3333)	(0.4093)	(0.8063)	(-0.4332)	(-1.2562)
J statistics	12.9991	3.2190	3.0471	8.5953	2.3966	3.4398
	(0.0431)	(0.7809)	(0.8029)	(0.1977)	(0.8799)	(0.7520)

FY 1998

	Non-troubled lending					
	Total		Manufacturing		Non-manufacturing	
	Lag	Cont.	Lag	Cont.	Lag	Cont.
Constant	0.0197	0.0182**	-0.0136	-0.0203*	0.0566*	0.0567**
	(1.6373)	(2.2771)	(-0.8032)	(-1.9653)	(1.7613)	(2.2595)
Lagged dependent variable	0.1594	0.1138	-0.1299	-0.0886	-0.0540	-0.1346
	(1.1775)	(0.8554)	(-0.5483)	(-0.6798)	(-0.3110)	(-0.8484)
BCAR capital "surplus"	2.1365	2.7277**	3.6816	3.6378*	5.7499	9.6862**:
	(1.3911)	(2.4536)	(1.0753)	(1.8401)	(1.1221)	(2.3556)
City bank dummy	0.0493*	0.0015	0.1294**	0.0582	-0.0202	-0.1457*
	(1.7061)	(0.0668)	(2.2321)	(1.6696)	(-0.2630)	(-1.6723)
Trust bank dummy	-0.0607*	-0.0930***	0.0766	0.0260	-0.0800	-0.1567***
	(-1.7257)	(-3.9937)	(1.5148)	(0.8834)	(-0.8148)	(-3.1559)
Regional bank dummy	-0.0225	-0.0251*	-0.0094	-0.0093	-0.0884**	-0.1077**
	(-1.3600)	(-1.6993)	(-0.3991)	(-0.4924)	(-2.2512)	(-2.6694)
J statistics	11.7720	7.1144	9.8956	10.1171	5.4541	5.5215
	(0.0673)	(0.3104)	(0.1291)	(0.1198)	(0.4870)	(0.4789)

Note:

1. Cells at the bottom of the table in italic indicate that gaps between capital to asset ratio and its target levels are negatively and significantly correlated with REAL89.
2. *** shows significance at 1%, **, 5%, and *, 10%, respectively and t statistics computed with a robust standard error are in parentheses.

FY 1999

	Non-troubled lending					
	Total		Manufacturing		Non-manufacturing	
	Lag	Cont.	Lag	Cont.	Lag	Cont.
Constant	0.0028	-0.0114	-0.0255**	-0.0299**	-0.0098	-0.0081
	(0.2775)	(-1.4480)	(-2.1541)	(-2.1442)	(-0.4170)	(-0.3622)
Lagged dependent variable	0.2765*	0.3669**	0.3332**	0.3427**	-0.1316	-0.0783
	(1.7709)	(2.6533)	(2.2509)	(2.3780)	(-0.8841)	(-0.5185)
BCAR capital "surplus"	2.5871*	1.8600	0.7608	0.8394	2.3607	-2.7237
	(1.6750)	(1.1959)	(0.6374)	(0.6327)	(0.8281)	(-0.7116)
City bank dummy	0.0233	0.0253	0.0815**	0.0808**	0.1060	0.1196
	(0.8618)	(0.9897)	(2.3191)	(2.3973)	(1.2063)	(1.4131)
Trust bank dummy	-0.0419	-0.0315	0.0038	0.0062	-0.0109	-0.0289
	(-0.9618)	(-0.7806)	(0.1280)	(0.17074)	(-0.1702)	(-0.4800)
Regional bank dummy	-0.0195	-0.0073	-0.0364**	-0.0338**	-0.0401	-0.0194
	(-1.1360)	(-0.5401)	(-2.3747)	(-2.2532)	(-1.1850)	(-0.5901)
J statistics	11.0862	16.7203	6.7370	6.7550	8.5883	10.8697
	(0.0857)	(0.0104)	(0.3459)	(0.3441)	(0.1981)	(0.0925)

Note:
1. Cells at the bottom of the table in italic indicate that gaps between capital to asset ratio and its target levels are negatively and significantly correlated with REAL89.
2. *** shows significant at 1%, **, 5%, and *, 10%, respectively, t statistics computed with a robust standard error are in parentheses, and numbers shown in parentheses below J statistics are p-values.

Table 4-3. Results of the fixed effect estimation of equation (5)

	Non-troubled lending					
	Total		Manufacturing		Non-manufacturing	
	Lag	Cont.	Lag	Cont.	Lag	Cont.
Lagged dependent variable	-0.1430	0.0295	-0.0828	-0.1597	-0.1361	-0.1056
	(-0.3459)	(0.1479)	(0.3573)	(-1.6164)	(-0.3569)	(-0.6906)
D_{97} BCAR	5.8691*	5.0180***	7.8755	9.7063***	3.9379	13.3096**
	(1.6756)	(3.0538)	(2.2502)	(3.3621)	(0.5737)	(2.3939)
D_{98} BCAR	1.8303	1.5455	-1.2122	5.6154	-2.0759	4.7578
	(0.4448)	(0.7510)	(-0.19733)	(1.6112)	(-0.1403)	(0.8766)
D_{99} BCAR	1.2500	2.5989	-2.8378	3.0100	-3.5085	6.4665
	(0.4954)	(0.9720)	(-0.9256)	(0.6525)	(-0.7864)	(0.8924)
D_{98}	0.1495	0.1038*	0.3343*	0.1152	0.3724	1.3339*
	(1.9655)	(1.7000)	(1.6505)	(1.1166)	(0.3724)	(1.3339)
D_{99}	0.1540	0.0437*	0.3759*	0.1775	0.2540	0.1563*
	(1.8384)	(1.4836)	(3.4167)	(1.2330)	(1.2614)	(0.6967)
N	378	378	378	378	378	378
J statistics	7.4652	3.0498	3.5134	7.0719	4.2944	5.5635
	(0.2800)	(0.8026)	(0.7422)	(0.3144)	(0.6369)	(0.4738)

Note:
1. *** shows significance at 1%, **, 5%, and *, 10%, respectively and t statistics computed with a robust standard error are in parentheses.
2. p-values are in parentheses below J statistics.

Table 5-1. Year by year coefficients on the BIS risk based capital "surplus" measures

	Non-troubled lending					
	Total		Manufacturing		Non-manufacturing	
	Lag	Cont.	Lag	Cont.	Lag	Cont.
1995	*-1.2880*	*-0.8611*	*23.7172*	*-1.8901*	*-23.2494*	*-5.0820*
	(-0.1139)	*(-0.6146)*	*(1.2646)*	*(-1.0026)*	*(-0.8052)*	*(-1.59735)*
1996	*-0.9350*	*-0.8996*	*1.7597*	*1.1874*	*-5.2090*	*-2.8174*
	(-0.6285)	*(-0.8885)*	*(0.7862)*	*(0.7521)*	*(-1.5752)*	*(-1.0688)*
1997	*6.4798*	*1.8096*	*5.5378*	*1.5959*	*17.1556*	*9.8893*
	(1.4708)	*(1.47077)*	*(1.4191)*	*(0.5428)*	*(1.26313)*	*(1.5864)*
1998	*2.0713*	*1.5393***	*7.6596*	*2.7031***	*0.2987*	*4.2528**
	(0.8309)	*(2.3476)*	*(0.93228)*	*(2.5753)*	*(0.0508)*	*(1.9422)*
1999	*2.2806**	*1.3485*	*1.3096*	*0.7898*	*1.1858*	*-1.8280*
	(1.9194)	*(1.13735)*	*(1.2192)*	*(0.7718)*	*(0.5550)*	*(-0.7253)*
2000	*0.2275*	*0.6818*	*0.3312*	*0.6767*	*2.1014*	*4.0075**
	(0.3374)	*(0.7196)*	*(0.5121)*	*(0.7983)*	*(1.3033)*	*(1.7879)*

Table 5-2. Year by year coefficients on the market based (MCAR) capital "surplus" measures

	Non-troubled lending					
	Total		Manufacturing		Non-manufacturing	
	Lag	Cont.	Lag	Cont.	Lag	Cont.
1995	*-5.1154*	*-2.3156**	*-4.0616*	*-0.8450*	*-10.1156*	*-5.9153***
	(-1.4177)	*(-1.9292)*	*(-0.7738)*	*(-0.5907)*	*(-1.3177)*	*(-2.1877)*
1996	*-0.2959*	*-0.2054*	*-0.2571*	*1.6414*	*-3.2084*	*-3.0940*
	(-0.3974)	*(-0.2814)*	*(-0.2153)*	*(1.0792)*	*(-1.5605)*	*(-1.2798)*
1997	*4.1685***	*2.6700****	*7.2309***	*4.0634****	*7.0660**	*5.9576****
	(2.4384)	*(4.0796)*	*(2.6782)*	*(2.8496)*	*(1.7895)*	*(3.4270)*
1998	*1.0551*	*1.4821**	*0.9333*	*1.6617*	*2.3332*	*5.1633***
	(1.1112)	*(1.8798)*	*(0.7386)*	*(1.3314)*	*(1.0715)*	*(2.3821)*
1999	*1.5086*	0.9799	*0.3140*	-0.0859	*0.3895*	-0.7325
	(1.5272)	(1.2452)	*(0.3942)*	(-0.1305)	*(0.2133)*	(-0.4300)
2000	0.2742	*0.2781*	0.4375	*0.3904*	2.6039	*2.1791*
	(0.3403)	*(0.45593)*	(0.4841)	*(0.57473)*	(1.0882)	*(1.0978)*

Note:
1. Cells in italic indicate that gaps between capital to asset ratio and its target levels are negatively and significantly correlated with REAL89.
2. Independent variables used are the lagged dependent variable, the capital "surplus" (BIS/market based), a city bank dummy, a trust bank dummy, and a regional bank dummy.
3. *** shows significance at 1%, **, 5%, and *, 10%, respectively and t statistics computed with a robust standard error are in parentheses.

Table 6-1. Year by year coefficients on the book based capital “surplus” measures, regional banks

	Non-troubled lending					
	Total		Manufacturing		Non-manufacturing	
	Lag	Cont.	Lag	Cont.	Lag	Cont.
1995	*4.5859*	*3.0071*	*24.0536**	*1.3794*	*2.2662*	*7.4764***
	(0.4762)	*(1.4842)*	*(1.80791)*	*(0.4675)*	*(0.1803)*	*(2.0507)*
1996	*-1.1297*	*-0.5654*	*0.2344*	*0.6303*	*5.4119**	*0.9829*
	(-0.6290)	*(-0.5434)*	*(0.1057)*	*(0.4729)*	*(1.9578)*	*(0.53953)*
1997	*4.5970****	*3.3836****	*5.8640****	*4.0976****	*7.7449***	*6.4116****
	(6.6337)	*(7.5838)*	*(3.6273)*	*(3.8730)*	*(2.3305)*	*(2.9790)*
1998	*2.1982*	*2.8101**	*-0.5405*	*-0.0835*	*11.3092****	*8.4511****
	(1.6782)	*(1.7087)*	*(-0.37382)*	*(-0.0893)*	*(3.0420)*	*(3.9808)*
1999	*1.1228*	*0.8013*	*1.7190***	*2.5032***	*3.5083**	*2.1911*
	(1.67608)	*(1.1983)*	*(2.20358)*	*(2.4418)*	*(1.8722)*	*(0.93240)*
2000	*-0.9152*	*-0.4589*	*-0.2561*	*0.6860*	*1.8227*	*3.7935*
	(-1.2743)	*(-0.55454)*	*(-0.3447)*	*(0.9248)*	*(05754)*	*(0.7154)*

Note:
1. Cells in italic indicate that gaps between capital to asset ratio and its target levels are negatively and significantly correlated with REAL89.
2. Independent variables used are the lagged dependent variable, the book based capital “surplus”, a city bank dummy, a trust bank dummy, and a regional bank dummy.
3. *** shows significance at 1%, **, 5%, and *, 10%, respectively and t statistics computed with a robust standard error are in parentheses.

Table 6-2. Year by year coefficients on the book based capital “surplus” measures (BCAR), regional 2 banks

	Non-troubled lending					
	Total		Manufacturing		Non-manufacturing	
	Lag	Cont.	Lag	Cont.	Lag	Cont.
1995	*-1.5858*	*-0.1850*	*-3.9529*	*-2.9487*	*24.6967*	*-0.4540*
	(-0.1397)	*(-0.0480)*	*(-0.2672)*	*(-0.5098)*	*(0.8506)*	*(-0.0484)*
1996	*0.3169*	*0.5489*	*4.0102*	*1.0068*	*1.6216*	*1.4291*
	(0.1650)	*(0.9137)*	*(0.7998)*	*(0.7123)*	*(0.1496)*	*(0.3470)*
1997	*2.6622*	*2.1666***	*2.2299*	*4.3635****	*-3.3035*	*1.8580*
	(0.7973)	*(2.7859)*	*(0.3834)*	*(3.2738)*	*(-0.4899)*	*(0.6725)*
1998	*0.3388*	*0.0868*	*0.0630*	*0.0485*	*-1.1813*	*-0.5111*
	(0.31756)	*(0.1062)*	*(0.0557)*	*(0.0418)*	*(-0.4694)*	*(-0.1982)*
1999	*-0.9611*	*0.3129*	*0.1421*	*1.1614*	*-4.5208*	*-7.1490**
	(-1.1633)	*(0.34317)*	*(0.1322)*	*(0.8253)*	*(-1.4509)*	*(-1.7786)*
2000	*-0.1649*	*0.1458*	*1.5281*	*1.2129*	*-0.6743*	*-0.1052*
	(-0.1913)	*(0.2529)*	*(0.7277)*	*(1.0076)*	*(-0.2664)*	*(-0.0626)*

Note:
1. Cells in italic indicate that gaps between capital to asset ratio and its target levels are negatively and significantly correlated with REAL89.
2. Independent variables used are the lagged dependent variable, the book based capital “surplus”, a city bank dummy, a trust bank dummy, and a regional bank dummy.
3. *** shows significance at 1%, **, 5%, and *, 10%, respectively and t statistics computed with a robust standard error are in parentheses.

Table 7. Estimated coefficients of the book based capital "shortage" in FY 1997 for robustness tests

	Non-troubled		
	Total	Manufacturing	Non-manufacturing
Baseline	3.9885***	6.1146***	9.1686***
	(3.6800)	(3.5618)	(3.2906)
Banks with capital "shortage"	3.0302	7.8340*	8.7195
	(1.4001)	(1.7686)	(1.4312)
Banks with capital "surplus"	2.3556	8.6538	13.5196
	(0.6249)	(1.5570)	(0.99231)
With regional dummies	4.0768**	5.9299**	7.5614**
	(3.6924)	(2.5863)	(2.4553)
Excluding the "finance and insurance" from non-troubled non-manufacturing			7.9786***
			(3.1913)

Note:
1. Gaps between capital to asset ratio and its target levels are negatively and significantly correlated with REAL89 for all models. Independent variables used are the lagged dependent variable, the book based capital "surplus", a city bank dummy, a trust bank dummy, and a regional bank dummy.
2. *** shows significance at 1%, **, 5%, and *, 10%, respectively and t statistics computed with a robust standard error are in parentheses.
3. Among 126 banks in the baseline sample, 69 bankshave a capital "shortage" and the remaining 57 banks have a capital "surplus".

Table 8-1. Estimation results of the regression of the spread between lending and deposit rates in FY 1997

Constant	-0.00662
	(-0.8285)
Lagged dependent variable	1.2117***
	(3.7545)
BCAR (book based capital "surplus")	-0.1470**
	(-2.0587)
Large bank dummy	0.0906
	(0.4327)
Trust bank dummy	0.0450
	(0.7604)
Regional bank dummy	0.0019
	(1.2109)
N	126

Note:
1. The gap between capital to asset ratio and its target level is negatively and significantly correlated with REAL89.
2. *** shows significance at 1%, **, 5%, and *, 10%, respectively and t statistics computed with a robust standard error are in parentheses..
3. The equation is estimated using the OLS.
4. The lending rate and the deposit rate are calculated as the interest receipts on loans and discounts divided by the end of fiscal year loan stock and the interest expenses on deposits divided by the end of fiscal year deposit stock respectively. Then the spread is calculated as the lending rate less the deposit rate.

Table 8-2. Estimation results of the probit regression of the probability of switching to "domestic" status by a previously "international" bank in FY 1997

	The effect on the probability of switching to "domestic" status
BCAR (book based) capital "surplus"	66.1435**
	(20.4827)
Trust bank dummy	0.2603
	(0.4459)
Regional bank dummy	0.2510**
	(0.2042)
Hokkaido/Tohoku	0.6853**
	(0.1566)
Kanto	0.6360*
	(0.2717)
Koshinetsu	0.5521*
	(0.2369)
Tokai	0.0573
	(0.2270)
Kinki	0.0638
	(0.2423)
Shikoku	0.0348
	(0.2461)
N	76

Note:
1. *** shows significance at 1%, **, 5%, and *, 10%, respectively and robust standard errors are in parentheses.
2. The city bank dummy and the Chugoku dummy are dropped since neither any of the city banks nor any of the banks headquartered in Chugoku switched to "domestic" status, and estimating the effect of these dummy variables on the probability of switching is not possible.

Table 8-3. Estimation results of the regression of the deposit growth in FY 1997

Constant	0.0285
	(1.4433)
Lagged dependent variable	0.0734
	(0.1106)
BCAR (book based capital "surplus")	3.2826*
	(1.7351)
Large bank dummy	-0.0724
	(-1.5319)
Trust bank dummy	0.0476
	(0.3821)
Regional bank dummy	-0.0295**
	(-2.1444)
N	126

Note:
1. The gap between capital to asset ratio and its target level is negatively and significantly correlated with REAL89.
2. *** shows significance at 1%, **, 5%, and *, 10%, respectively and t statistics computed with a robust standard error are in parentheses..

Table 9. Aggregate loan growth, all banks

	Non-troubled			Troubled	Real estate
	Total	Manufacturing	Non-manufacturing		
1995	1.75	-2.41	-1.10	-0.15	1.30
1996	-1.19	-4.69	-4.65	-0.32	2.32
1997	-0.70	-1.92	-3.92	-0.66	3.12
1998	0.56	1.18	-5.41	-1.97	-1.44
1999	1.29	1.27	4.08	-2.18	-0.25
2000	0.04	-1.64	-5.00	-2.57	-1.71

Note: The aggregate loan growth is the growth of the sum of loans actually supplied by all the selected 126 banks.

Table 10. Contribution of capital "surplus" or "shortage" to aggregate supply of bank loans (all 126 banks)

Book based (BCAR)

	Non-troubled		
	Total	Manufacturing	Non-manufacturing
1997	*-3.72****	*-5.70****	*-8.54****
1998	*1.07***	*1.43**	*3.82***
1999	*1.27*	*0.57*	*-1.85*

BIS risk based (BIS)

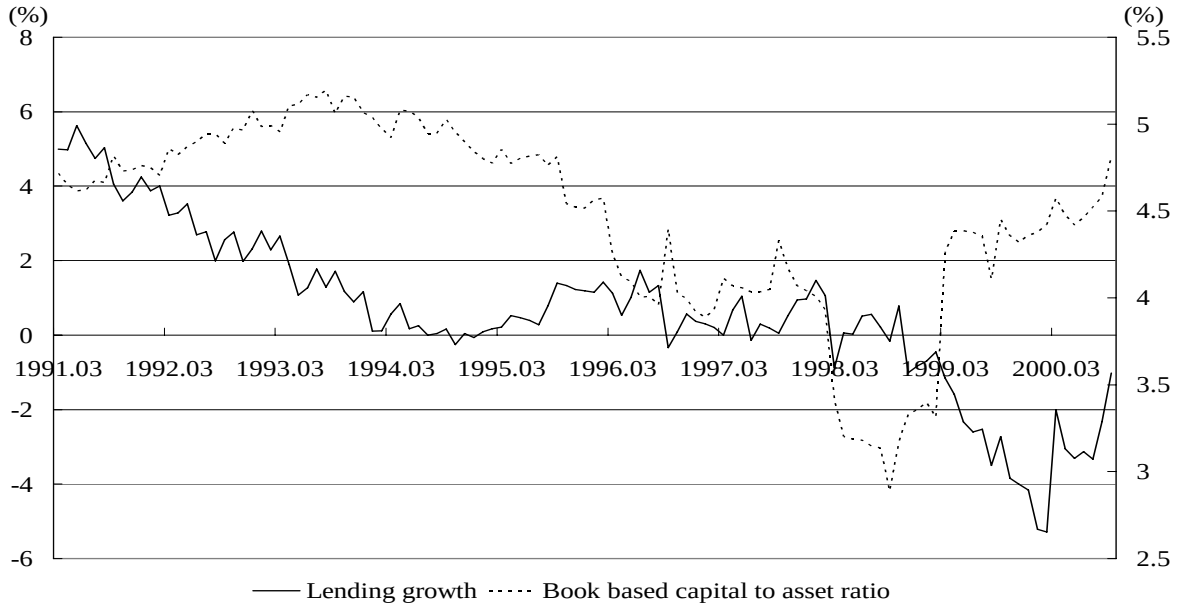
	Non-troubled		
	Total	Manufacturing	Non-manufacturing
1997	*0.37*	*0.33*	*2.02*
1998	*2.76***	*4.85***	*7.64**
1999	*3.04*	*1.78*	*-4.12*

Market based (MCAR)

	Non-troubled		
	Total	Manufacturing	Non-manufacturing
1997	*-7.15****	*-10.88****	*-15.94****
1998	*-2.08**	*-2.33*	*-7.23***
1999	-0.30	0.03	0.23

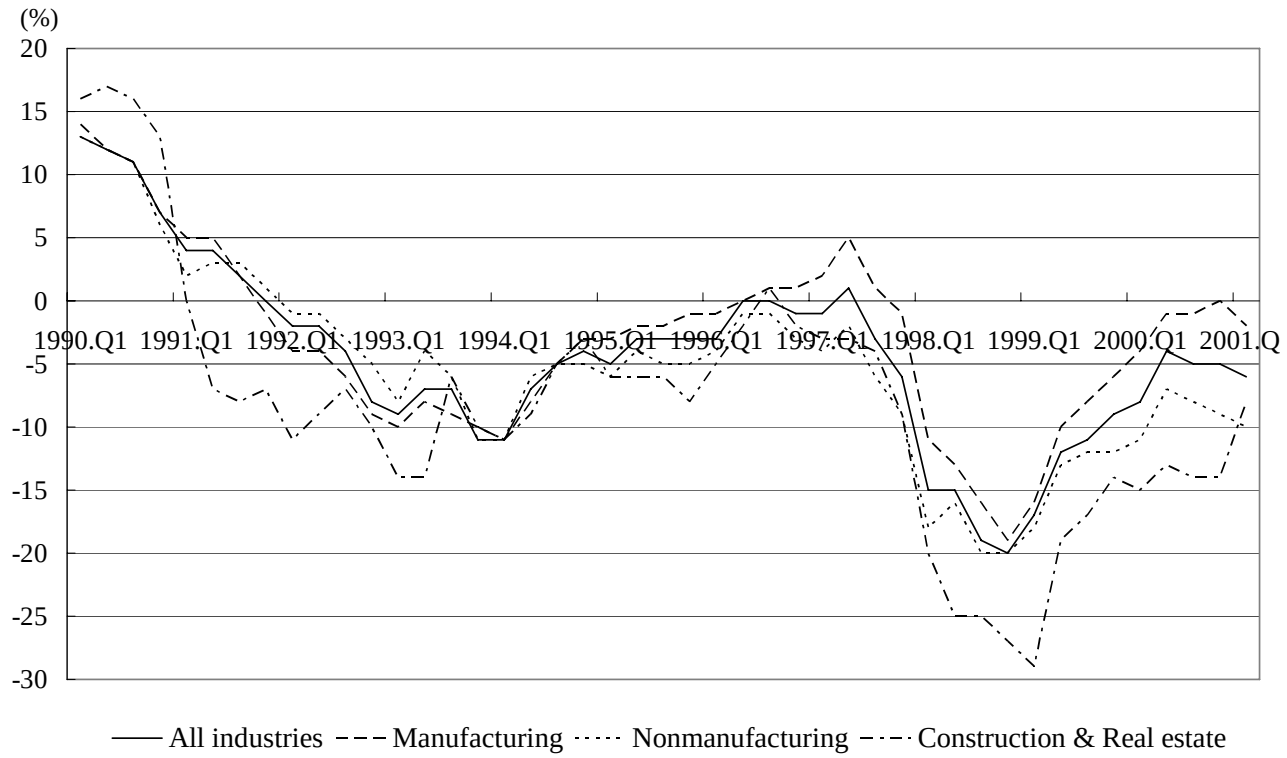
Note:
1. *** shows significance at 1%, **, 5%, and *, 10%, respectively.
2. The contribution of capital "surplus" or "shortage" to aggregate supply of bank loans is computed by taking the average of the product of the point estimate of the coefficient of capital "shortage" ("surplus") and capital "surplus" ("shortage") weighted by the bank's asset size.

Figure 1. Domestic loan growth and book based capital to asset ratio of domestically licensed banks



Note: The left scale and the right scale measure lending growth and the book based capital to asset ratio respectively. The data frequency is monthly.

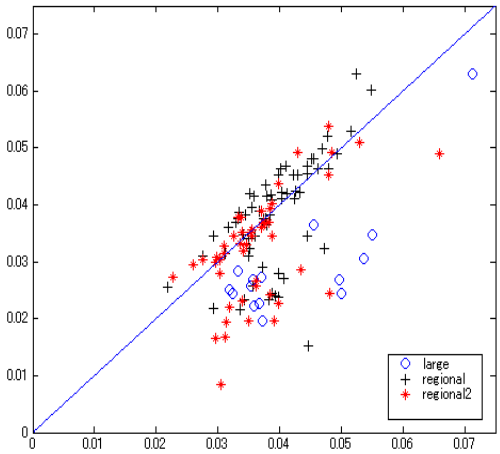
Figure 2. The *tankan* "lending attitude of financial institutions" diffusion indices (DIs)



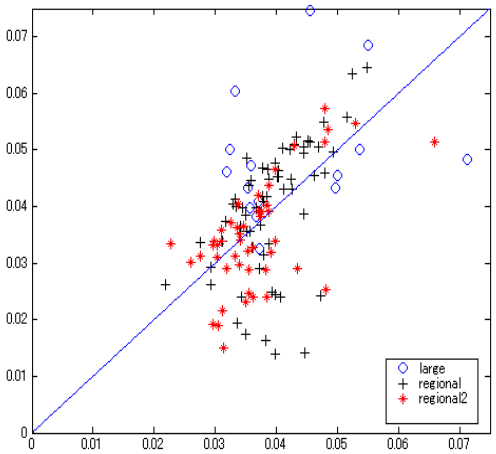
Note: The DI represents the "accommodative" – "severe" percentage points about the present lending attitude of financial institutions (quoted from Motonishi and Yoshikawa (1999)). The data frequency is quarterly.

Figure 3. Target and actual book based capital to asset ratios

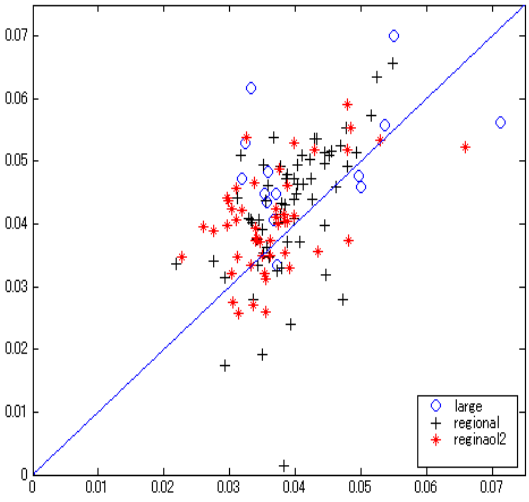
FY 1997



FY 1998

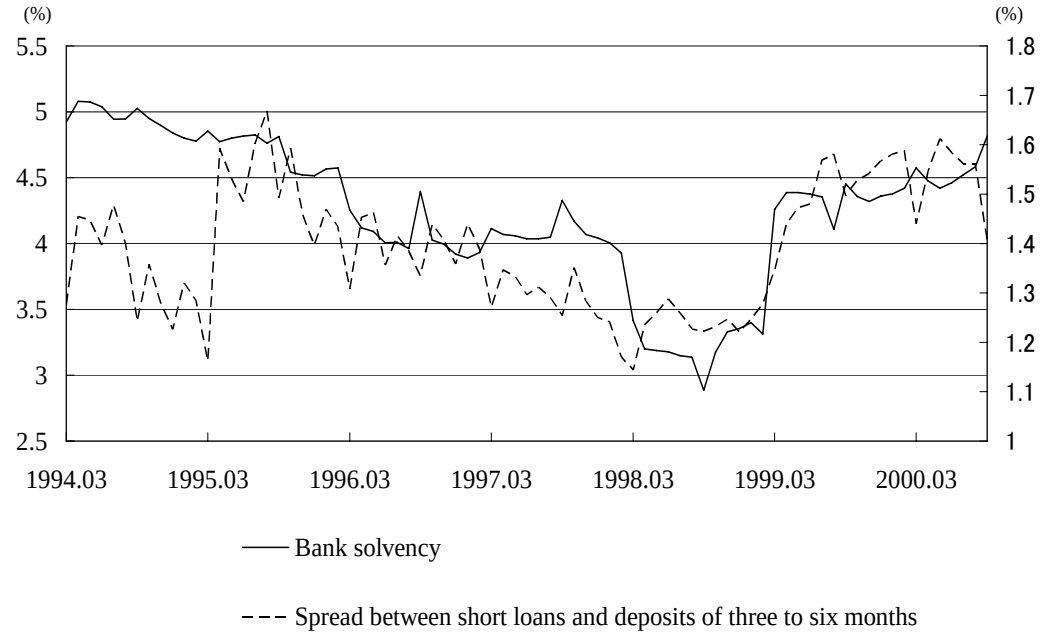


FY 1999



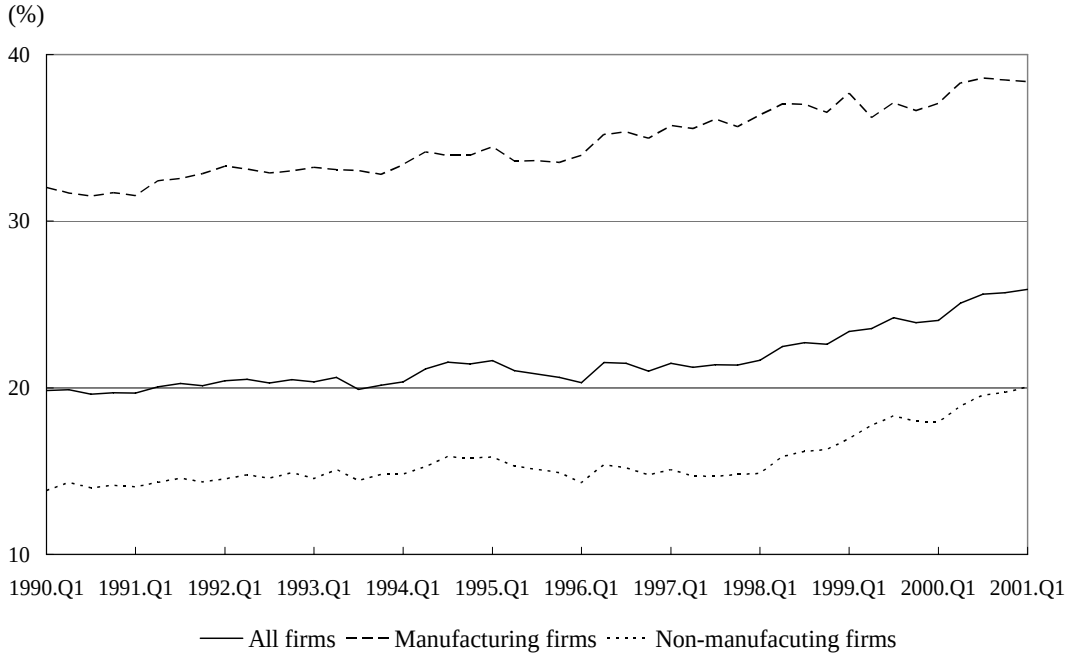
Note: The horizontal and the vertical axes represent the target and the actual capital to asset ratios respectively.

Figure 4.1. Bank solvency and the spread between short loans and deposits



Note: The left scale and the right scale represent bank solvency and the spread between short loans and deposits of three to six months respectively. Bank solvency is the book capital to asset ratio of banks.

Figure 4.2. Solvency of firms



Note: The data frequency is quarterly. Solvency of firms is the book capital to asset ratio of firms.