Prudential Regulation, the "Credit Crunch" and the Ineffectiveness of Monetary Policy: 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 a lack of any convincing identification strategy of the supply side capital-lending relationship with lending demand. This paper is a first attempt to construct a strong instrument for bank capital from empirical observation of the banks' behavioral changes in the past and to estimate the impact of capital adequacy on the lending supply. The implications of prudential regulation and the ineffectiveness of a loose monetary policy are discussed based on the micro evidence presented.

Keywords: Credit crunch, prudential regulation, bank lending channel, instrumental variable
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1. Introduction

During the last decade, the Japanese easing monetary policy has not seemed to have had any effect in revitalizing the stagnant Japanese economy. The Bank of Japan's (BOJ) "zero interest rate policy" that has been in effect since February 1999, has caused the overnight call rate to hover around zero percent, but still has not made the economic recovery occur. The BOJ, in principle, gave up the short-term interest rate as its policy goal, and instead has targeted the outstanding balance of its current account, which is now called the "quantitative easing" policy. Furthermore, it is committed to purchasing more long-term government bonds, hoping that there is still room to ease.

Some economists argue that the "credit crunch" is behind the ineffectiveness of the monetary policy. The balance sheets of Japanese banks are damaged by the huge amount of non-performing loans that have accumulated over the last decade through their write-offs against equity capital. In order to satisfy their capital adequacy requirement, banks may have increased their holdings of risk-free assets, and cut back on their lending so that regulators (the government regulatory oversight agency) perceive less risk embedded in their balance sheets. Bayoumi (1999) and Morsink and Bayoumi (1999) find strong macroeconomic ripple-effects resulting from the negative shocks to bank balance sheets using Vector Auto-regression (VAR). Ogawa and Kitasaka (2000) estimate that the conventional marginal q investment rate function is augmented by the growth rate of bank loans, and find a strong correlation between business investment and bank loans. If the bank lending channel of monetary policy transmission has been severely damaged by the so-called "credit crunch" phenomenon, due to the growing non performing loans problem of the banks, monetary policy may lose its ability to influence aggregate spending through corporate business investment.

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. In fact, examination of the "structural non-performing loans" serves as the instrument for identifying the supply side capital-bank lending relationship from the observed equilibrium lending data.

One caveat is that the capital crunch is, by definition, regulatory driven. Furthermore, it is important to note that even the reported bank balance sheets themselves are the reflection of regulatory toughness or the banks' concessions to the regulator. For instance, the sudden increase in non-performing loans (NPLs) may not show the actual increase in the same accounting period. It may simply be a consequence of the regulator's more rigorous assessment of the banks' balance sheets. As such, the econometric analysis of bank balance sheets needs the careful control of the regulatory and institutional oversight bodies. Any valid interpretation of results inevitably requires the regulatory and institutional history.

To best of our knowledge, this paper is the first attempt at identifying the supply side phenomenon of a credit crunch from the equilibrium data by a strong instrument and to estimate the resulting

reduction in the lending supply. We examine the impact of capital "surplus" defined as the gap between the actual and the estimated bank specific target capital asset ratios on lending supply by running year by year cross section regressions. We find that banks cut back on their lending supply in the fiscal year 1997 in response to a large negative capital shock mainly due to the rigorous self-assessment of assets that accompanied the Prompt Corrective Action (PCA) regulation framework. A positive capital shock mainly due to an injection of public capital in FY 1998, in turn, is likely to have induced constrained banks to raise lending supply. This positive shock, however, barely offsets the plunge in the lending supply the year before. The cross section empirical approach that validates the bank specific target inevitably has an unobservable and possibly endogenous fixed effect. Results of the cross section and the auxiliary fixed effect regressions consistently imply that the bias, if any, would be caused by the banks' evergreening behavior that ties them to underperforming borrowers. It turns out that such a bias would not undermine our conclusions.

The remainder of the paper is arranged as follows. In section 2, some aggregate evidence on monetary policy and bank lending is shown. In section 3, the credit crunch is introduced and the literature is reviewed. In section 4, the relevant regulatory and institutional background is discussed. In section 5, data and econometric issues are set out. In section 6, results are reported and some policy implications are derived. Section 7 concludes the paper.

2. Aggregate evidence: monetary policy and bank lending

Monetary policy

Repeated moves to ease the monetary policy since July 1991 resulted in unusually loose money markets, which has not only virtually blocked the BOJ from taking further expansionary actions, but has also prevented the standard interest rate channel from functioning effectively. The monetary policy meeting of the BOJ held in February 1999 voted to try for an un-collateralized overnight call rate fluctuating around zero percent. In March 2001, switching its policy measure (policy target instrument) from the short rate to reserve targeting, in which the outstanding balance of the current account at the BOJ is targeted, the BOJ altered its framework of executing market operations from nominal short rate targeting to a "quantitative easing" policy. In fact, the targeted outstanding balance has been raised several times to reach 27 to 32 billion yen as of November 2003, which is roughly 7 to 8 times as much as the balance before the operational policy framework change. As depicted in Figure 1, despite a series of unusual policy measures, satisfactory upward price movements have not seemed to materialize.[1]

Bank lending

From the banks' point of view, zero-cost external funds would always be available to them regardless of their internal liquidity position. This could also imply that banks do not necessarily lend

[1] The price measure is the consumer price index (excluding perishables, in a nationwide statistic) since this is the measure watched by the BOJ in its policy decisions. The BOJ in its official announcement on March 19, 2001, states, "The new procedures for money market operations continue to be in place until the consumer price index (excluding perishables) on nationwide statistics, registers stably at zero percent or shows an increase year after year."

more in response to additional liquidity if there is already an unusually loose inter-bank market condition. The BOJ's official announcement at the monetary policy meeting on March 19, 2001, refers explicitly to the reforms of the banking sector as a necessary condition for the effectiveness of monetary easing policy.

> *"In order to make this monetary easing fully effective in restoring Japan's economy to a sustainable growth path, progress in structural reforms with respect to the financial system is essential -- e.g., resolution of the non-performing asset problem, as well as in the area of the economy and industry."*

Figure 2 shows the time-series movements of year by year growth rates (the ratio of the amount of total lending to the amount of the same series 12 months before) of domestic lending by all domestically licensed banks and the time-series of the ratio of book equity capital to assets in the balance sheet since July 1990 (The ordering of figures is the same for figures concerning city banks that will appear.). [2] The higher capital asset ratio and decrease in lending growth through September 1993 (the end of the 1993 interim accounting period) may especially indicate that the undercapitalized banks' rush toward complying with a higher risk based capital (RBC) standard which came fully into effect in March 1993 (the end of the fiscal year for 1992).[3] The capital asset ratio falls abruptly at the end of the fiscal year for 1997 by roughly 0.5 percent, and recovers its pre-shock level at the end of the fiscal year for 1998. Meanwhile, the lending growth rate continues to fall into the middle of FY 1999. It bounces back afterwards even though the rate is still negative and the level of lending itself does not grow. Indeed, the lending growth and the one-year or half a year lagging capital asset ratio have been showing the high correlation since April 1999, the beginning of FY 1999.[4] This finding appears to be strong supporting evidence that the "capital crunch" occurred.

Two factors, which cannot be controlled effectively in the aggregate balance sheet data, however, exaggerate the speed in decline of bank lending. The first is the write-offs of NPLs. Removing bad assets from the balance sheets is a result of the banks' unconstrained rational behavior and should be distinguished from the "credit crunch" that deprives viable bank-dependent borrowers of credit access. The second is declining lending demand due to the contracting economy. The aggregate lending figure reveals the reduced form equilibrium relationship between bank capital and lending and is not so informative as to identify the banks' behavioral responses. To this end, we need the micro-level data, and this is what we plan to explore. Specifically, our research goal is to verify the time-series reduced form equilibrium evidence by the micro-level behavioral evidence.

Direct testing method of the bank lending channel

The naïve way to test effectiveness of the bank lending channel is to directly relate bank lending

[2] The monthly aggregate balance sheet statistics of domestically licensed banks has been published by the BOJ only since July 1989. Thus the growth rate can only date back to July 1990. Similarly, the monthly data have not been available since October 2000.

[3] Berger and Udell (1994) survey the alternative explanation to the phenomenon of higher capital and lower lending, which they call the "voluntary risk-retrenchment hypothesis". According to the hypothesis, such an observation is the consequence of the banks' risk averseness.

[4] The capital asset ratio is based on the balance sheets of domestically licensed banks including their foreign business

growth to the monetary policy measure. Lending growth disaggregated by industry is regressed on lagged and present values of the BOJ's reserves and the corresponding index of industrial production. The reserves are used as the policy measure since targeted interest rates (call rate/official discount rate) barely varies in the second half of the 1990s in Japan and the reserves are chosen to be a targeting instrument under the "quantitative easing policy".[5,6] The equation over two different periods is estimated. One is the longest period available to us: the second quarter of 1994 through the second quarter of 2001. The other is the period since the "ultra low" interest rate policy was implemented: the first quarter of 1996 through the second quarter of 2001. Results are shown in table 1. For the entire period, no coefficients for the monetary measure are statistically significant at the 10 percent level. For the date under the "ultra low" interest rate policy, no coefficients on reserve growth (except for the current reserve growth) are statistically significant at the 10 percent level. The F test on the sum of current and lagged growth rates of reserves shows the statistical significance over the latter period at only the 10 percent level. These seem to be suggestive of the ineffectiveness of monetary policy.

The problem of this approach, however, results from the very nature of unusually loose policy. Under such an exceptional circumstance, lack of sensitivity to the liquidity of their own balance sheets may not imply that the banks are unresponsive to monetary policy. Instead, it may simply reflect the fact that excess liquidity available to banks in the inter-bank markets is already extremely abundant and that the incremental increase in liquidity by further easing market operations has no economic meaning to banks needing to finance their lending. The methodology, which is most productive under normal market conditions as found in Kashyap and Stein ([1995], [2000]), exhibits serious limitations.

3. Credit crunch

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

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units.

[5] Industries included are manufacturing, construction, utility, transportation and communications, commerce, non-bank finance, real estate, services and local government. In addition, lending to individuals and international loans are included. The real Japanese GDP and the U.S. GDP are used to "proxy" economic activities of individual lending and international lending respectively.

[6] We chose lending by city banks (large commercial banks) as they traditionally specialize in short-term lending and are more likely to respond quickly to open market conditions.

In general, the "credit crunch" refers to the reduction in credit supply available to borrowers, particularly bank lending supply, for some lender specific reasons.[7] 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 principle of the regulation is that banks exposed to higher risks should hold more equity capital as a buffer against any realization of risk.[8] In practice it requires that the ratio of capital to risk weighted assets (riskier assets are assigned to a higher weight and vice versa) not be below the specified minimum threshold. Lending has been assigned to 100 percent 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 the new equity costly.[9] Therefore, undercapitalized banks failing to satisfy the regulatory minimum may raise the (risk based) capital asset ratio by cutting back on lending (a numerator of the ratio) rather than raising equity capital (a denominator of the ratio) in order to immediately clear the regulatory hurdle. The easiest way to raise the risk-based capital 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 were considered. [10]

In modeling a bank's profit maximization, the RBC capital adequacy requirements is 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 a bank i, L_i is a bank i's holding of lending, and γ is the minimum requirement

[7] Banks may charge higher lending rates in a crisis period rather than reducing lending supply directly. Such a phenomenon is not observed in the data. This could be because the banks' selection of better borrowers with lower interest rates in the crisis period offsets higher lending rates for less qualitative borrowers as discussed by Bernanke (1983). Furthermore, it has not been usual for Japanese banks to differentiate interest rates according to the borrowers' credit worthiness.

[8] A few works have theoretically justified the banks' capital constraint from the viewpoint of the informational friction between banks and borrower firms rather than assuming the regulation. Holmstrom and Tirole (1997) discuss that bank capital is used for monitoring of borrower firms. Bond (2003) shows that the joint liability arrangement among borrowers that reduces the expected costs of information disclosure of a bank leads to capital crunch in that a failure of some of borrower firms reduce bank capital and subsequently bank lending supply to viable borrowers.

[9] 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.

[10] The Basel Committee on Banking Supervision that coordinates the international agreement on the RBC regulatory framework has proposed the amendment to take into account credit risks within bank lending in computing the risk-weighted asset of an individual bank. 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.

imposed by a regulator.[11] Then a bank with binding capital constraint lends out the multiple of its own capital. On the other hand, a bank with an unbinding RBC constraint determines the level of lending for the optimal interior solution of its unconstrained profit maximization problem in the static model setting.[12,13]

In reality, it may be the case that banks around the certain lower threshold of the risk-based capital asset ratio are capital constrained, whereas banks whose capital asset ratio is far above the threshold are unconstrained. Alternatively, most banks may be pushed into the lower region of capital asset ratio and become capital constrained when the entire banking industry is faced with negative aggregate capital shocks. These shocks may be either regulatory -- a requirement of the more stringent assessment of assets (lending) and the widened definition of non-performing loans resulting in charge-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 in the positive industry wide capital-lending relationship.

In practice, variations of the following partial adjustment specification of the lending growth have been tested with the data of a set of banks at certain time periods in the literature.

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

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

Empirical literature

Bernanke and Lown (1991) examine a book capital as *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, and find a statistically strong coefficient on the lagged *K/A*. Berger and Udell (1994) run panel regressions with various loan classes as a dependent variable 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 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 with binding constraints.[14, 15]

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

[12] If we assume the dynamic optimization model of a banking firm, an unconstrained bank holds capital stock as a buffer against future uncertainty.

[13] Alternatively, one can interpret that lower capital incurs cost and that the higher capital benefits a bank. Such cost includes facing a tougher regulator, a higher risk of regulatory intervention, and the market's underrating based on the lower regulatory rating.

[14] In the related study with the panel through the second quarter of 1992 of the same data set, 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

Using the panel data of Japanese banks of the early 1990s Ogawa and Kitasaka (2000) and Ito and Sasaki (2002) estimate variants of (2) with the RBC ratio as the capital asset ratio and find that only internationally operating banks operating within the Basel RBC regulatory framework have a statistically significant coefficient of the ratio.[16] More recently, Montgomery (2001) uses the 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 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.[17]

There are few works focusing on Japan in the late 1990s, though the "credit crunch" over that period may have had serious macroeconomic impact and have caused the recession in the fiscal years of 1998 and 1999. To this end, Woo (1999) turns to the year-by-year cross section regressions of equation (3). Constructing the total new loan data from FY 1991 to 1997 by adding charge offs of NPLs to net yearly increase in lending on balance sheets, he finds that it is only in FY 1997 that coefficients on such capital asset ratios as the book ratio and the regulatory RBC ratio are significant and positive.[18] Surprisingly he finds strong negative coefficients in some of the introductory years of the Basel RBC framework.

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 three events above of falling economy wide bank lending both in the U.S. and Japan.[19]

Credit crunch and its impact on real economic activities

Economists have examined the aggregate and semi aggregate data to assess the impact of the bank lending supply on real economic activities. If borrowers could manage to find substitutes for bank loans the (bank) credit crunch would not have a real negative effect. With the semi-aggregate state by state cross section data Bernanke and Lown (1991) find that the impact of the loan growth predicted by the capital asset ratio on the employment growth was negligible during the 1990-91 period. Hancock and Wilcox (1998), however, find that both loans by and bank capital of small banks have a strong effect on real economic activity through their influence on bank dependent smaller firms.[20] Hayashi

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variable indicating a bank not under action is insignificant.

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

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

[17] "Switcher" banks are banks that abandoned their privilege to conduct international business so that the minimum RBC requirement is loosened.

[18] He tests three capital asset ratio measures, the book based ratio, the Basel RBC ratio, and the market based capital 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.

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

[20] In their time series data analysis Ogawa and Kitasaka (1999) estimate the standard investment function with Tobin's marginal q and the growth of bank loans as independent variables and find that smaller firms are more constrained to bank loans than larger firms are. There are a large number of empirical works on the advantage of banks as relationship lenders in small business finance. For example see Berger and Udell (1995), Cole (1998), Degryse and

and Prescott (2002) run similar cross section regressions of GDP growth on loan growth across prefectures in Japan during three long lasting recessions since 1975 and find that it was only in the recent recession from FY 1996 to FY 1998 that bank lending made a difference.

However, one should be careful in interpreting such results since it is even harder to isolate lending supply with aggregate or semi aggregate data than it is with data from individual banks.[21] Motonishi and Yoshikawa (1999), though working on the aggregate data, effectively avoid the demand-supply simultaneity problem by using the *tankan* diffusion index measuring the banks' willingness to lend which is constructed from the direct qualitative questions asked borrower firms regarding their perceptions of the attitude of lenders (banks), and find that the negative effect of the bank lending supply on business investment emerges only in FY 1997.

4. The regulatory background of Japanese banks

In what follows, we review the regulatory history and its influence on bank capital. Amounts shown on the balance sheets of banks depend on the regulator's judgement. In particular, any managerial decisions effecting their capital position inevitably involve their consultation with the regulator and virtually needs its agreement, although the degree of closeness of the regulator and banks has been somewhat eased since the market oriented FSA took over the role of the Ministry of Finance and led the way to fairer and more transparent rule-based regulatory actions.[22]

Basel Capital Accord: FY 1992

The first generation of the RBC requirements was agreed to by the G-10 countries, representing the Basel Accord of 1988.[23] The Accord allowed a transitional period so that banks with capital shortages could take measures to meet the minimum standard. In Japan, the current minimum ratio of 8 percent has been effective since the end of the fiscal year for 1992 (March 1993), after the two-year transition period with a temporal target of 7.25 percent.

Several points are worth noting. First, the BIS Capital Accord framework classifies elements of capital in two tiers: core capital called Tier 1 and the element supplementing it called Tier 2. Tier 1 includes equity capital and published reserves from post-tax retained earnings. "Equity capital" in a bank balance sheet matches approximately Tier 1. Elements that can be included are undisclosed reserves, (asset) revaluation reserves, general provisions/general loan-loss reserves, hybrid debt capital instruments, and subordinated term debts. The Accord mandates banks to satisfy half of the minimum standard (4 percent in the current regime) by Tier 1 elements.

Cayseele (2000) and Berger, Klapper, and Udell (2001).

[21] Bayoumi (2001) conducts the VAR analysis and finds that innovation in bank loans has a large impact on aggregate demand. Using the similar VAR approach Morsink and Bayoumi (1999) find that the aggregate influence of bank lending is predominantly attributable to the banks' financial health measured by the stock price index of the banking industry. Ogawa and Kitasaka (1999) estimate the standard classical investment function augmented by bank lending and find its significant impact on investment, and find

[22] 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)

[23] Belgium, Canada, France, Germany, Italy, Japan, the Netherlands, Sweden, Switzerland, the United Kingdom, and the United States

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 not resistant to swings in stock prices. 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.[24]

Liquidation of *jusen*: FY 1995

Jusen companies are housing loan companies founded by mainly large banks and financed by banks and other lending institutions. After the bubble burst, most of their loans, which had been shifted to the real estate businesses, were deemed non-performing and their liquidation was just a matter of time. Toward the end of the fiscal year for 1995, that is, early 1996, the government implemented its liquidation plan. 6.41 trillion yen of unrecoverable assets of the *jusen* companies were written off. Founder institutions, which are mainly large banks, contributed 3.5 trillion.

Prompt corrective action: FY 1997

The failure of the Hokkaido Takushoku Bank in November 1997, which marked the first failure of a large bank, along with the bankruptcy of two securities companies, spawned a financial crisis. In response, the MOF implemented the prudential policy guidelines for prompt corrective action (PCA). The PCA allows the regulator (then the MOF, currently the FSA) to intervene in banks with a Basel RBC capital asset ratio below the regulatory threshold. The regulator intervenes when the RBC ratio falls below the BIS minimum standard of 8 percent. Several intermediate action thresholds were set up. As a bank enters the lower interval, crossing a threshold, government intervention enters the more rigorous action stage. It was applied to "international" banks in April 1998, and to "domestic banks" a year later. The minimum requirement was set higher for "international" banks (8 percent) than for "domestic" banks (4 percent). At the time when the PCA was introduced, banks were faced with formal government actions based on the Basel RBC standard. The PCA marks the first occurrence of institutionalizing the RBC standard to the domestic formal action framework.

Prior to the PCA taking effect in April 1998 (the beginning of the FY for 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. Loan loss write offs and provisions amounted to 13.3 trillion yen in FY 1997.[25] Toward the closing of the fiscal year 1997, the government decided to inject public capital into the banks (18 large banks and 3 regional banks) for the first time, but it was not adequate to offset losses caused by the large write offs and loan loss provisions.[26]

Public capital injection: FY 1998-

[24] Ito and Sasaki (2002) give empirical evidence of such behavior by Japanese banks.
[25] These are the aggregate figures reported by the BOJ and include figures in trust accounts.
[26] It was in FY 1998 that the PCA framework, based on the RBC capital asset ratio, was extended to include domestic banks, of which most were regional, and regional 2 banks.

The nationalization of the Long-Term Credit Bank and the Nippon Credit Bank, both of which are long-term credit banks, happened almost simultaneously; the former in October 1998 and the latter in the following December. 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.[27]

In order to mitigate the credit crunch, the FSA approved public capital infusions to banks only on the condition that there would be "measures for smoothing lending funds and other credit supplies" in the "management improvement plans" that banks with public capital injection were required to submit and .[28] The FSA also had meetings with the top management of different banks to insist on a sound lending supply.

5. Econometrics and data

We run versions of equation (2) using the micro individual bank level data to see if the "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.[29]

Data

The main data source of bank level data is the Nikkei NEEDS bank financials data bank. It is the standard data source for any research on Japanese banks. 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 Nikkei data has become fairly standard for the analysis of Japanese banks recently.[30] The Basel RBC ratios and unrealized gains on assets are taken from the Japanese Bankers Association's Analysis of Financial Statements of All Banks.[31]

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[27] 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 asset due to the new accounting standard harmonized with the International Accounting Standard, which amounted to 8.9 trillion yen.

[28] The FSA was founded as the Financial Supervisory Agency in June 1998. It was reorganized as the Financial Services Agency and undertook policy planning functions with regard to the financial industry from the MOF in July 2000. I designate both with the same abbreviation, FSA, to avoid inconvenience.

[29] We also examined the specification similar to Ogawa and Kitasaka's in which the interest rate differential between the lending rate and the inter-bank call rate. The estimation results were virtually unchanged. The variable, however, is inevitably endogenous and 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.

[30] Ogawa and Kitasaka (2000), Hoshi and Kashyap (2000), Ueda (2000), and Hoshi (2001)

[31] Missing items on recent balance sheets of a few banks are supplemented by their annual reports.

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 of the lending markets exit the markets, as Hoshi and Kashyap (2000) discuss. The "credit crunch" is far more serious since it damages the lending supply function of viable banks.[32] 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.[33] A total of 126 banks remain in the sample.

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 an industry whose share of NPLs to the industry exceeds the share of total lending a "troubled" industry.[34] Such industries include the construction, wholesale and retail, service, and real estate industries.[35]

Capital asset ratio measures

Three different measures of capital asset ratio: the book based capital asset ratio (CARP), the Basel RBC ratio (BIS), and the market based capital asset ratio (CAPRM) are examined. The book capital is a proxy for the core Tier 1 capital.[36] The book capital to asset ratio, CAPR is constructed by taking the ratio of equity capital minus land price re-evaluation to the total asset. CAPRM is constructed by taking the ratio of book capital, the denominator of CAPR, plus unrealized gains on

[32] Recall Diamond and Rajan (2000). Lower capital does not necessarily mean that banks are not viable. Unlike non-financial firms whose higher net worth (economic capital) lowers the cost of external funding through lowering the external finance premium, banks need to finance lending by demand deposits in order to provide liquidity to borrowers. Net worth for banks is the buffer against unexpected large negative shocks such as a fall in the collateral value through a fall in land prices. The necessity of higher book capital required by the Basel Accord is even more difficult to justify.

[33] 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 long-term credit bank was dropped since detailed lending data for the 1980s are missing. One regional 2 bank founded in the 1990s is also dropped.

[34] The BOJ (2001)

[35] Ideally, one needs to construct the new loan data as Woo (1999) does. 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 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.

[36] The BIS capital asset ratio until FY 1996 is subtracted the regulatory minimum for each bank that is 8 percent or 4 percent depending on whether a bank is "international" or "domestic" 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 certain accounting policy that allows a bank to clear the regulatory minimum. Until FY the BIS ratios of many "domestic" banks are around 4 percent. Since FY 1997 when many "international" banks switched their regulatory status to "domestic", distinction of "domestic" and "international" banks disappears.

holding assets to the total asset. As such, both CAPR and CAPRM are non-risk based. This is not just because the individual bank level data of the risk-adjusted asset, the numerator 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 denominator of the risk-adjusted capital asset ratio. The RBC ratio by definition may behave like the weighted average of CAPR and CAPRM. On the other hand, the denominator of the RBC may not uncover the capital shocks masked by the offsetting increase of subordinate debts that are also elements included in the denominator.[37]

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 accordingly with a leftward shift of its demand curve. If the aggregate (regional) economic environment worsens, product sales fall with 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. Such a fall in bank loans, however, is not the cause of the recession. but the simple reflection of the weak economy.

One may argue for the demand side by including explanatory variables that are the proxy to lending demand. Such variables could be 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. One may, rather, use the micro level bank characteristic (institutional) variables to control the demand side indirectly. Banks from one region behave differently from those from other regions. Yet, they also operate in different markets and face different lending demands. Along with this approach, Peek and Rosengren (1995a, 1995b) focus only on banks in New England. In addition, Peek and Rosengren (1995 b) include the ratio of off balance sheet income to the total income since the larger off balance activities indicate the banks' relatively smaller exposure to changes in the lending demand. One, however, needs to be cautious in selecting such supply variables since items on the banks' balance sheets themselves are likely to be endogenously determined and do not particularly represent the bank supply behavior per se.

The institutional classification of 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, and the first three classes form the large banks operating nationwide. Regulatory actions as well as their customer base differ across bank classes. All the banks base their legal foundations on the banking act, though trust banks and long-term credit banks are regulated by additional respective 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. 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. [38, 39]

[37] See Ito and Sasaki (2002) for the banks' control of the RBC ratio.
[38] 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.

Simultaneity of capital and lending

The similar storyline holds for the OLS estimator of the coefficient on capital asset ratio, β. It 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 position through the provisions taken for loan losses and/or charge offs against their equity capital. Similarly, under continuing deflation, if the large part of the 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 instrument. Such instruments should be independent of the supply shock, ε_{it}, and strongly and consistently correlated to the capital asset ratio, K_{it}/A_{it} in equation (2). Almost all contemporaneous variables are endogenous and are not very effective to this end. The commonly used approach is employment of lagged "predetermined" variables as instruments (Peek and Rosengren [1995 a], Ogawa and Kitasaka [2000]).[40] The drawback to this approach is that such predetermined variables lack an economic account of the bank capital and that the strong correlation with capital asset ratios is not guaranteed.

Instrument: structural hypothesis

Ueda (2000) and Hoshi (2001) discuss 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.[41] In response to the loss of long-standing core borrowers, the banks needed to drum up some new customers. As the asset price bubble developed, banks rapidly increased lending to the real estate

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[39] 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. 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. A bank's switch of a regulatory status reflects its capital position. If its capital declines significantly, a bank gives up its international operation, which allows it for the lower minimum standard of the BIS capital ratio. Thus, such a dummy variable is likely to be endogeneous. We find that including it into the regressions does not change the results significantly.

[40] Peek and Rosengren (1995 a) adds the current change in equity capital as one of instruments to lagged variables. The point estimate of the coefficient on the capital 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.

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

industry with the strong and illusory expectations 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 most strongly explains the accumulation of the NPLs more than a decade later. "Riskier" banks piled up more NPLs while less "riskier" banks avoided the deterioration of their balance sheets as the land price bubble busted. Such empirical evidence provides us with the ideal instrument. Such behavioral responses in the mid-1980s are an exogenous factor to the demand-supply system of bank lending in the 1990s, yet, they best explain the development of NPLs in the late 1990s. Consequently, banks with higher NPLs write off more assets against their equity capital, and incur severer 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 asset ratio.[42, 43]

The intuition behind the instrumental variable regression is the following two-step estimation. The first step runs the regression of the capital asset ratio on the banks' lending portfolio shift toward real estate lending. The fitted value of the capital asset ratio represents the structural component of the capital asset ratio that is independent of current borrowers, whereas the demand side influenced by the business cycle fluctuations is absorbed in the residual. Then, the fitted value is 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 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 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. For the "change" instrument we use PORT: each bank's 10-year growth of lending share to the real estate industry since FY 1980.[44]

Target behavior

What is uncertain from the level regression (2) is how a bank changes its lending in response to

[42] 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 foresaw that they would lose money, the ex-ante correlation of two variables would occur. However, this argument may arise from confusion between 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 bubble in land prices. We, however, need to keep in mind that land prices had never significantly fallen before the bubble burst and that the public, including the banks' managements, believed in the "myth of land speculation". (They're not making any more of it.) Banks must have regarded real estate lending as a lucrative, low risk, high return alternative to *keiretsu* lending.

[43] 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 is still zero because riskier investment does not mean a negative expected return but merely a positive variance.

[44] 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 instrument variables. The (one period) lagged deposit growth is excluded from instruments due to a concern about the possible behavioral endogeneity between lending and deposits as described by Diamond and Rajan (2000).

changes in its own capital position. Consider equation (3).

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

The only modification from equation (2) is the replacement of the level of capital asset ratio, *K/A*, with the difference between actual and desired levels of the ratio, $K/A\text{-}(K/A)^{target}$.[45] This specification assumes that each bank has its own target. It cuts 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. More concretely, one computes the average of a product of a point estimate of β and capital shortage (surplus) measured by each bank's $K/A\text{-}(K/A)^{target}$ weighted by asset *A*. By doing so one can extract the component of the aggregate lending growth accounted for by capital constraint.

One needs to estimate the target capital asset ratio, K/A^{target}. As we saw in Figure 3, the aggregate capital asset ratio of domestically licensed banks steadily soars at the beginning of the 1990s up until around the end of FY 1992, then, stays at a high plateau of around 5 percent until FY 1994. Our interpretation that banks set their capital target to move toward the full implementation of the BIS risk based capital regulation framework, leads to the idea of estimating the target from this early period rather than estimating it from the entire sample period. We estimate the target by the data from FY 1992 through FY 1994. This is not only the period when the capital 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 shy 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. Of course, we should not include the data before FY 1988 when the Basel capital regulatory framework had not manifested itself and capital ratios to banks were insignificant.

In estimating, we apply a relatively simple method: we compute the time-series average of each capital asset ratio measure for each bank over the fiscal years of 1992-1994 and use it as a target. Thus the target variable constructed this way varies across banks but is time invariant. A bank's target should be bank specific. It may vary depending on a bank's characteristics such as risk averseness, size and institutional and legal status. The actual internal capital target may vary across fiscal years. For example, banks facing the tougher regulator in certain fiscal years may harden their targets as Hancock and Wilcox (1994) discuss. The FSA/MOF does not explicitly change actual regulatory minimum requirements over time, although it began to base its formal regulatory actions on the BIS capital ratio as the intervention criteria in FY 1997, and we can say that the regulator got tougher that year. Unfortunately it is impossible to measure to what extent banks responded to the regulatory action of raising their capital targets, since it is solely an internal response and is not reported anywhere. Furthermore, such changes in regulatory toughness are likely to accompany changes in the banks'

[45] In fact we subtract the regulatory minimum from the RBC ratio in the level specification until FY 1996, since most "international" banks stay above the 8 percent regulatory minimum whereas "domestic" banks stay around their 4 percent regulatory minimum. The distinction between both regulatory types became less obvious after many "international" banks switched their regulatory status to "domestic".

balance sheets reflecting increases or decreases in NPLs, and therefore should be treated as secular changes of the banks' capital positions rather than changes in targets. On the other hand, in an economic downturn when it is harder to reach the initial capital targets, banks may lower their targets. Under such a circumstance, at the micro level, each bank may reach its internal goal, but from the macroeconomic point of view, we should assume that negative aggregate shocks lowered their capital rather than that the banks lowered their targets in response to negative shocks. In other words, the relative capital position of an individual bank among other banks may not change, but its absolute capital position does. Thus, as a conclusion, it is safer to extract the information regarding the banks' capital targets from publicly observed data in the pre- "credit crunch" years than to make targets vary across time using both past and contemporaneous data.[46] Such a way of constructing the target implicitly assumes the backward looking behavior of banks. This is more appropriate since the banks' constrained behavior has resulted from the legacy of the past and the banks' relatively short-term objective itself is to overcome this legacy, which is regressed by nature.

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

We do not assume that banks are always capital constrained in making decisions on supplying loans. When a bank is adequately capitalized, and its management thinks that the capital position is far from the position that incurs the regulatory intervention or any other adverse effects on the management decisions, their decision is free from the constraint. A bank chooses the optimal size (growth rate) of lending supply derived from its profit maximization criteria. Its lending supply decisions are constrained only when the actual capital asset ratio is approaching the target ratio. 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.

Such a behavioral non-linearity of banks' lending supply advocates use of econometric techniques that allow for the time variation in the coefficient on the capital asset ratio, in particular, use of year-by-year cross section regressions. It also allows us to keep the bank specific target unwashed unlike standard fixed effect estimation techniques. If a negative capital shock is aggregate, all banks move in and out of the constraint region year by year simultaneously.[47] The earlier discussion on the history of regulatory regimes and their impacts on aggregate bank capital justifies the aggregate nature of capital shocks to banks. The regulatory regime switches, such as the introduction of Prompt Corrective Action (PCA) and urging more stringent assessment of assets are aimed at the entire banking industry rather than particular individual banks. The ordering of banks' capitalization does not dramatically change after the regulatory shock. In equations (2) and (3), the coefficient, β, varies

[46] Alternatively one may 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 over FY 1995- FY 2000. In principle, the target would not vary much over the time horizon unless their size or regulatory status changes dramatically. Yet, each individual bank has its own target each year according to its size and institutional characteristics. I estimated the target this way as an experiment. The relationship over 1992-1994 is very inaccurately estimated, and quite a number of banks have negative values for their targets during FY 1997- FY 1999.

[47] If the shock were idiosyncratic, the non-linear specification could be used.

across years. Importantly, in years when banks are making a capital free optimization, the estimate of β should not be statistically significant.

6. Results

6.1. Preliminary results: Conventional level specification

Strength of the instrument

As Table 2 shows, REAL89 is negatively correlated to CAPR since FY 1997 and seems to be a reasonably valid instrument over the "credit crunch" years. The strong correlation in FY 1997 suggests that the serious writing off of the NPLs to the real estate industry against equity capital did not begin until the start of a more rigorous self-assessment of bank assets in that year.[48] As with CAPR, CAPRM has been negatively correlated to REAL89 since FY 1997. BIS is not sufficiently negatively correlated to REAL89 in any year except for a modest correlation in the fiscal years 1999 and 2000. It is striking that REAL89 has virtually no correlation to BIS in FY 1997, when a large amount of NPLs were revealed and the strong negative correlation between book capital and lending took place. Large losses in the book capital of real estate concentrated banks may have been wiped off the books by creative accounting techniques.

Regression results

Tables 3 shows coefficients on CAPR in year-by-year regressions from FY 1995 to FY 2000. The first two columns correspond to total domestic non-troubled lending (NOTRB) consisting of consumer, manufacturing, and non-troubled non-manufacturing lending, which is explained below. The third and the fourth columns correspond to lending to the manufacturing industry (MANUF). Finally, the fifth and the sixth correspond to lending to the non-troubled non-manufacturing industries (NOTNM). Industries classified in NOTNM include agriculture, mining, finance and insurance, transportation and telecommunications, and utilities. CAPR takes a one-year lag (Lagged) in the first column of the two columns for each lending category, and is contemporaneous (Cont.) in the second. The first column of each class of lending serves as a testing measure on the persistence of capital shocks to lending as well as the conventional way of avoiding simultaneity bias.

Only two cells report 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 a coefficient of the contemporaneous capital ratio for manufacturing lending is positive and significant. In FY 1999 coefficients, except for manufacturing lending, turn positive and significant again.

The bottom table on 2SLS (two stage least square) regressions implies the 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, none of coefficients on lagged capital is significant. The coefficient on the contemporaneous capital ratio for non-manufacturing lending in FY 1999 is not

[48] An puzzling absence of negative correlation in FY 1996 that marks the liquidation of *jusen* housing loan companies and resulting accounting loses of banks reflects that *jusen* themselves, 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.

statistically significant. On the other hand, the coefficient on the lagged CAPR for total lending is found to be weakly positive at the 10 percent significance level. The capital shock in FY 1997 is short-lived, whereas the shock in FY 1998 could be persistent enough to effect lending in the following year. [49, 50]

6.1. Target behavior specification

Capital "shortage" and "surplus"

Figure 3 plots the estimated target CAPR and the actual CAPR of every individual bank over the three year "credit crunch" period starting in FY 1997. The horizontal axis represents the target CAPR whereas the vertical axis does the actual CAPR. Thus, the actual CAPR 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 CAPR of a bank below the 45-degree line, on the other hand, falls short of the target, and such a bank shows a "shortage" of capital. As we described earlier, a bank specific target is indeed time invariant so that values along the horizontal axis are common to all dates. 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, a 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 regional 2 banks are clustered around the line. The highly concentrated structure of the Japanese bank lending market suggests that Japanese banks are 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 RBC based PCA regulatory oversight, domestic banks raised the level of capital to minimize the likelihood of falling below the regulatory minimum threshold due to any unpredictable negative shocks.

Strength of the instrument

Table 4 shows the correlation coefficients of REAL 89 and the distance measure of each capital asset ratio since FY 1994. All three kinds of distance measures are quite negatively correlated to REAL89 for almost the entire sample period. The correlation coefficient between REAL89 and CAPR is strongly negative from FY 1995, and the value of the coefficient varies from -0.27 to -0.54. Similarly

[49] Caution should be used in interpreting the regression results with the contemporaneous capital asset ratio. Usually, the banks' or regulatory actions negatively affecting bank capital occur at the end of the fiscal year toward the closing of the accounting period. Nevertheless, banks must internally be aware of their accounting actions such as disposal of NPLs in the course of the fiscal year. Banks receive acknowledgement from the regulator regarding their regulatory actions such as the regulator's consultation, research, and ultimately its negotiations with bank management. For example, periodical research meetings, which MOF officials, bank officers, and certified public accountants participated, were held to discuss details of regulatory measures relevant to the PCA until the early FY 1997.

[50] We also estimated equation (2) with BIS and CAPR (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 with the market based CAPRM resemble the results with the book based CAPR.

the coefficient between REAL89 and CAPRM since FY 1994 stays in the large negative range from -0.39 to -0.54. Unlike the "level" of BIS, the distance 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. Thus we can expect somewhat reliable results for the BIS ratio in the "change" regressions. REAL89 appears to serve as a much better instrument for the distance between actual and target capital asset ratios than the ratios themselves. The strong negative correlation of REAL89 to distance measures, with the use of targets constructed above, supports the legitimacy of such estimated targets.[51] We can interpret that the computed capital shortage appropriately reflects loss of capital due to the disposal of structural NPLs attributable to real estate lending of earlier years.

Regression results

Table 5-1 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 distance of a book based capital ratio, CAPR. 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 CAPR are strongly positive and significant for all classes of lending. In FY 1998, unlike the level regression results, the coefficient on the contemporaneous CAPR is positive and significant for all classes of lending. In FY 1999, coefficients on both lagged and contemporaneous CAPR are positive and significant for non-troubled total lending and manufacturing lending.

The 2SLS regression results are the most essential ones, upon which the aggregate implications are drawn. In FY 1997, the coefficient of CAPR is found to be strongly and consistently positive. Coefficients of both lagged and contemporaneous CAPR are positive and significant in all cells except for the cell corresponding to the lagged capital ratio for non-manufacturing lending. Manufacturing lending was more sensitive to the capital shock the year before, whereas non-manufacturing lending was more so to the contemporaneous shock. The point estimate of a larger one is more than twice as large as that of a smaller one for both types of lending. On the other hand, the responsiveness of total lending to capital shock is equalized between lagged and contemporaneous ones, reflecting an averaging out of the differences in the subclasses of lending. The negative capital shock in FY 1997 is found to be temporary. Coefficients of the lagged CAPR in FY 1998 are not significant. The capital shock in FY 1998 is persistent only for total lending. The structural capital - lending relationship does not appear for subclasses of lending in FY 1999. The total non-troubled lending does not respond to the

[51] The negative correlation between capital asset ratios and REAL89 remains unchanged after the injection of large public funds into 13 mostly large banks (12 large and 1 regional banks). 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 stocks purchased by the government and core capital less preferred stocks purchased as of

contemporaneous CAPR unlike in the level regression results.[52] As in the level regression results, point estimates of the statistically significant coefficients are the largest in FY 1997 in most cases.

Against our anticipation, all point estimates of coefficients remaining to be statistically significant with a correct positive sign in 2SLS regressions are much larger than OLS point estimates. One possible 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 the credit crunch claims. 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 the 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 5-2 presents the complete results of the 2SLS regressions over the "credit crunch" period. The lagged dependent variable is positive and significant in FY 1997 (NOTRB) and FY 1999 (NOTRB and MANUF) and their point estimates range from 0.28 to 0.45. The large bank dummy variable is positive and significant in fiscal years 1998 and 1999. One caveat in interpreting the target behavior specification is that the bank specific and time invariant target may capture the institutional effect, and absorb the negative trust bank effect observed in level regressions.

Further discussion on the instrument

Table 5-3 shows the "partial squared correlation coefficient" proposed by Shea (1997) to serve as a goodness of fit test for a capital asset ratio with a set of instruments employed. (Only results with the book ratios are shown.). 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 are greater than 0.1.[53]

Yet another potential problem is a possible correlation between REAL89 and lending supply shock, which causes the biased estimator of the coefficient on CAPR. 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,

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FY 1998 is 0.92.

[52] One possible explanation follows. Banks changed their lending supply in response to a large change in their own capital positions that occurred in the previous year, FY 1998. Bank capital does not change much in the following year, FY 1999. Since the level of the banks' capitalization is almost identical in two consecutive years, in such a case bank lending responds to the level in both years, but does so to the change only in the shock year.

[53] 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.

supplied less loans in the "non-troubled" industries than banks that had not been much dependent on the real estate lending. The resulting correlation is negative. Such a bank may have acted in the opposite manner, and launched more rescue lending programs to poor performing borrowers. This case results in a positive correlation.

This type of endogeneity can be described as the correlation of an unobservable bank specific fixed effect to REAL89. Our empirical strategy is much less prone to this type of problem. Remember that our main explanatory variable, CAPR, is constructed as the actual capital asset less the bank specific target. The target and included dummy variables on the bank's institutional characteristics could absorb the fixed effect. The data are not suggestive of this possibility, either. Standard statistical tests do not imply endogeneity over the period from FY 1997 to FY 1999. Correlation coefficients of REAL89 and the estimated residual are found to be small in absolute values. Hansen's (1982) overidentification tests do not reject the null hypothesis that instruments are uncorrelated with a set of explanatory variables at least at 10 %.[54] More importantly, the point estimate of the coefficient on CAPR changes inconsistently with the negative correlation, and correcting the bias caused by the positive correlation, if any, would not undermine but rather strengthen our interpretation of the larger reactions by banks in FY 1997. Since CAPR on average is smaller in FY 1997 than in FY 1996 for most of the banks, as Figure 10 shows, a simple analysis of the 2SLS formula demonstrates that the point estimate of the coefficient on CAPR 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 bias would lead to, and hence, it would not cause serious problems in interpreting the results. Similarly, since CAPR is greater in FY 1998 than in FY 1997, the point estimate in FY 1998 must exceed the corresponding estimate in the preceding year.[55] 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.[56]

Fixed effect estimation

Use of such standard techniques as first (time) difference and time demeaning (subtracting the time series average for each bank) allows one to remove the fixed effect. Such an approach, however, would undermine advantages of our empirical strategy. Time demeaning endogenizes lagged explanatory variables and shrinks the number of available instrumental variables, whereas twice or

[54] There are some exceptions. Correlation coefficients are large and negative in FY 1997 and FY 1998 when a capital asset ratio is taken a one-year lag. However, such a negative correlation may be a byproduct of misspecification. Though bank lending supply only responds to a contemporaneous capital shock, a regression of lending on the lagged capital ratio reveals a positive and significant coefficient since the lagged and the contemporaneous capital asset ratios are highly positively correlated. Since REAL89 is negatively correlated with the lagged ratio as well, omitting the contemporaneous ratio leads to a negative correlation of REAL89 and the estimated residual. Indeed regressions with both lagged and contemporaneous ratios erase both a statistical significance of coefficients on the lagged ratio and a correlation of REAL89 and the residual. Overidentification tests reject the null hypothesis at 10 % level for the lag specification for non-troubled lending in fiscal years 1997 and 1998 and both lag and contemporaneous specifications for non-troubled lending in FY 1999.

[55] See Appendix for further discussion with a simple model.

more lagged explanatory variables are predetermined and orthogonal to the first differenced lending supply shock in the absence of any serial correlation. However removing the fixed effect, no matter what technique is used, makes it impossible to identify the level regression model (2), with the target regression model (3) since any transformation aimed at removing the fixed effect washes away the time invariant target capital asset ratio. Indeed any arbitrarily chosen time invariant target would result in the same estimator and the model (2) can be viewed as the special case in which the target is constant over both time and the cross section at zero. Therefore one would not be able to estimate the impact of capital shock on the lending supply with the fixed effect estimator of coefficients.

Having said that, the fixed effect estimation of the lending supply function provides persuasive robust side evidence on how the endogenous fixed effect would bias the cross section estimator of the coefficient on capital adequacy in the general lending supply function nesting the model of our interest. We consider the following model of the lending supply function that factors in the time variation in the coefficient on capital "surplus".

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

This is essentially the same as equation (5) with a major modification in the time subscript attached to β. The time subscript disappears from a set of control variables X as we use the same time invariant dummy variables to indicate the bank's institutional characteristics as in estimating the cross sectional regressions. The residual is further decomposed into the bank fixed effect η_i, the time effect μ_i, and the random error u_{it}. First differencing (4), we obtain,

$$\Delta \ln L_{it} - \Delta \ln L_{it-1} = \alpha_1 \left(\Delta \ln L_{it-1} - \Delta \ln L_{it-2} \right) + \beta_t \frac{K_{it}}{A_{it}} - \beta_{t-1} \frac{K_{it-1}}{A_{it-1}} + \Delta \mu_t + \Delta u_{it}, \; t=2,...,T \qquad (4)'$$

The simple matrix algebra shows that estimating (4)' is equivalent to estimating the following equation that involves interaction terms of time dummy variables D_t's with the history of capital asset ratios stretching over the entire panel.

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

In practice, besides the interaction terms we use time dummy variables as explanatory variables to represent the time effect $\Delta \mu_t$. As the fixed effect estimation is meant to supplement our cross section regressions, the almost identical set of instruments is employed to run the 2SLS regressions with the panel data.[57]

Table 5-4 reports results of the fixed effect estimation for the three year period from FY 1997 to FY 1999.[58] It turns out that the coefficient of the contemporaneous CAPR 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 CAPR are not statistically significant for all but only one model. The

[57] The third lagged dependent variable and time dummy variables are included to make the number of instruments exceed that of explanatory variables.
[58] Longer panels result in imprecise estimates of coefficients.

surviving coefficient of the contemporaneous CAPR for manufacturing lending is significant only at the 10 percent level. Such results are consistent with our conjecture on the possible bias, if any, in the cross section estimation: underestimation of the coefficient in FY 1997 and overestimation in later years.

Alternative capital asset ratio measures

The regression results with alternative capital asset ratio measures support findings in the results with the book based CAPR. Table 6-1 reports results with BIS as a capital ratio measure. Unlike the level regressions, validity of REAL89 as an instrument for BIS helps uncover the way bank lending supply is constrained to BIS in a qualitatively similar fashion to the way it is to CAPR. Coefficients on the lagged BIS are positive and significant for all classes of lending in FY 1997. Coefficients on the contemporaneous BIS are positive and significant for all classes of lending in FY 1998. The capital shock in FY 1998 is somewhat persistent, and effects the total non-troubled lending in the following year, but does not effect the lending subclasses. Table 6-2 reports results with CAPM. The results are largely consistent with the CAPR results. Lending in FY 1997 responds positively to both lagged and contemporaneous CAPRM regardless of the class of lending. Lending in FY 1998 responds positively to only the contemporaneous CAPRM for every class of lending. Only the total lending is constrained to the lagged CAPRM in FY 1999.

Regional and regional 2 banks

In order to check on the robustness of our position, 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 for 2000, and regional 2 banks. Regional banks are limited to "domestic" banks since it is important to control the banks' regulatory status. Banks maintaining an "international" status are willing to accept the higher minimum RBC standard, which suggests that they are less capital constrained than the rest. There are 49 such "domestic" regional banks in the sample. All 48 regional 2 banks surviving the sample selection process mentioned above are registered as "domestic". Thus any further breakdown of regional 2 banks into subgroups is not beneficial and is quite unnecessary.[59]

Table 7-1 reports the 2SLS regression results of equation (3) with CAPR for domestically operating regional banks. All coefficients on CAPR are positive and significant in FY 1997. The capital - lending relationship within regional banks, however, is not robust in the later years of the "credit crunch" period. 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 7-2 reports the 2SLS regression results of equation (3) for regional 2 banks. Both total and manufacturing lending respond to the contemporaneous book based capital asset ratios in FY 1997. [60]

[59] Owing to the small number of observations (15 banks) and even the group being divided into two smaller institutional sub groups, large banks are not analyzed as a single group.

[60] We also estimated equation (3) with alternative capital asset ratio measures for these sub samples. (Results are not

6.3. Macroeconomic implications

Aggregate lending growth

Table 8 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 (TROUB) and real estate lending (REALE) are added to the three "non-troubled" classes of lending analyzed above in order to grasp how the presence of NPLs and their disposal effected the aggregate lending.

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 for 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 had declined until FY 1997. After two years of recovery from FY 1998, it plunged again in FY 2000. Non-manufacturing lending seems to be the most declining class of all. In all years except for FY 1999, it experienced a negative growth. As a consequence, non-manufacturing lending dropped by a little over 15 percent for the six years, whereas manufacturing lending dropped by just 8 percent. Lending to industries fell in the fiscal years 1995, 1996, and 2000 as well as in the "credit crunch" years. Our finding of an absence of any structural capital - lending relationship in these years implies that the fall in lending is mostly due to a decline in lending demand.

Aggregate growth rates of lending to troubled industries and the real estate industry surprise us since they stay almost always higher than those to relatively sound industries. Compared to the sounder counterpart of non-manufacturing industries, though lending to troubled industries had never grown positively, the growth rates of such lending classes were higher for all years except for FY 1999, the only year in which non-troubled and non-manufacturing lending grew. Lending to troubled industries had declined by a little less than 8 percent over the six-year period, about half of the corresponding figure to the sounder counterpart. More surprisingly, real estate lending grew until FY 1997, when all other classes of lending had declined. Afterward, the rate of decline of real estate lending was relatively modest compared to sound non-manufacturing lending. Real estate lending had grown 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 between that given to sound industries and that to troubled industries may be even much starker. [61]

Aggregate impact of capital constraint

Table 9 reports what we consider to be the most important results of this paper, how much either

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reported.) The results with CAPRM are generally consistent with those with CAPR. The results with BIS are hard to interpret because of the weakness of REAL89 as an instrument for BIS in FY 1997.

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

capital shortage or capital surplus of banks, measured by the three definitions of capital, contribute to the aggregate lending supply by all 126 banks in its percentage growth.

The contemporaneous effect of the negative book capital shock in FY 1997 is large for all classes of lending. It cuts total manufacturing, and non-manufacturing lending by 3.72 percent, 5.70 percent, and 8.54 percent respectively. A positive capital shock in FY 1998 shows a modest recovery in lending in the same year. It raises the total manufacturing, and non-manufacturing lending supply by 1.07 percent, 1.43 percent, and 3.82 percent respectively. It makes the total non-troubled lending supply grow in FY 1999 by a modest 1.05 percent, but failure of the overidentification test casts doubt on such a finding. Besides neither manufacturing nor non-manufacturing lending is effected in the year. Recovery of total non-troubled lending, made possible by the positive shock in FY 1998, in the same year and the following year represents 2.13 percent in percentage growth but 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 -1.67 percent, -4.35 percent, and -5.04 percent respectively in contributing to the percentage growth of the lending supply. Had the Japanese banks not been constrained by the contemporaneous book capital shock of FY 1997, the 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.

The negative risk based BIS capital shock in FY 1996 reduced the non-troubled total, manufacturing, and non-troubled non-manufacturing lending supply by 1.42 percent, 1.22 percent, and 3.77 percent respectively. However, the positive capital shock in FY 1998 increases the non-troubled total lending supply by 2.76 percent and the same class of lending supply by 4.12 percent in FY 1999. The same positive shock increases manufacturing and non-manufacturing lending by 4.85 percent and 7.64 percent. Results with the risk based BIS capital asset ratio cannot be overly exaggerated. Though banks were suffering a severe shortage of core (book) capital, none of the banks failed to satisfy the BIS minimum requirement in FY 1997. The positive shock in FY 1998 was added to the base RBC ratio that was rigged to appear higher by the banks' accounting manipulations. At most, the BIS results give the most optimistic view of the behavior of the bank lending supply during the "credit crunch" period. The negative market based capital shock in FY 1997 reduces these three classes of lending supply even more astonishingly by 7.15 percent, 10.88 percent, and 15.94 percent. Not only the market based capital shock in FY 1997 but also the shock in FY 1998 is negative, and contributes negatively to the lending supply growth in both FY 1998 and FY 1999. This may be an overestimation. It is hard to justify the banks' behavior of targeting the uncontrollable and unrealized gains of their securities. Security prices, mainly stock prices, though post bubble era in the period from FY 1992 to FY 1994, had stayed much higher then than in the "credit crunch" period. At most, the market based capital ratio results give the most pessimistic view of the banks' lending supply behavior during the "credit crunch" period.

Interpretation and policy implications

These findings lead to the following interpretation of the banks' lending behavior during the late 1990s. A rigorous self-assessment of bank assets revealed large non-performing loans that had been covered up years before. 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. Large, newly discovered NPLs coupled with tougher regulations pressuring the banks to dispose of them under the watchful eye of the recently 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 to the neighborhood of their own targets. As a result the banks became capital constrained in making decisions on supplying loans. 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 a fragile economic recovery. Thus, the observed amount of loans supplied in equilibrium ran short of the amount the unconstrained equilibrium would have brought about.

The same mechanism may have worked in reverse in FY 1998 and eased borrowers' borrowing conditions more than the unconstrained equilibrium could have. The positive capital shock represented by the infusion of public capital encouraged the already capital constrained banks. In fact, the amount of injected capital in the form of preferred stocks into the sample of 126 banks totals 58,090 million yen and is equivalent to 0.7627 percent of their assets.[62] Knowing that the industry wide capital asset ratio exceeds the target ratio by just 0.68 percent, injected public funds must have been the positive shock large enough to raise bank capital a little beyond the desired level, which resulted in the banks' positive response to the lending supply. It is certain that without public funds, the banks would have been still severely short of capital into FY 1998. In response to such a positive shock banks may have shifted their lending supply upward.[63] However, the positive impact was too small to offset the negative lending supply shock in the year before if it existed at all. 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 fiscal years 1998 and 1999 or it simply helped banks to escape from their capital constraints. After all the net impact of capital on bank lending supply appeared to be

[62] Nakaso (1999) classifies the public funds injected into those raised in the form of preferred stocks and subordinated debts by individual bank. 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, is the only local bank injected with public funds in FY 1999.

[63] The same regression as equation (3) for FY 1998 and FY 1999 that replaces the gap of actual and target capital asset ratios with the same gap less the public fund to asset ratio and the public fund to asset ratio partially supports this view. The latter variable captures the impact of the public funds. The coefficient on the public fund to asset ratio in FY 1998 is found to be statistically significant for non troubled total lending in FY 1999 at the 10 percent level but it is not so for lending in FY 1998.

substantially negative by all accounts. Particularly, industry lending was hit hard. Banks returned to capital free decision making by FY 2000.

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, if any, would simply 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.

Assuming the importance of bank lending supply on aggregate demand, particularly on business investment, the "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. Conversely, a rise in the lending supply in the subsequent year, brought about mainly 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.

As far as monetary policy is concerned, the BOJ's claim that the banking sector hurts the effectiveness of policy implementation, is not fully convincing. Constrained by capital shortages, banks certainly reduced the lending supply in FY 1997. Funds raised by banks in the extremely loose short term markets under the ultra easing monetary policy were mostly invested in risk free assets such as government bonds rather than financing private, in particular, corporate lending. The expansionary monetary policy, if it was relying heavily for its success on the role of the bank lending channel under the bank centered corporate finance structure, must have been neutralized. On the other hand, in FY 1998 and FY 1999, the capital shock accelerated bank lending growth. The declining quantity of lending simply reflects the weak lending demand due to the worsening macroeconomic performance and disposal of structural NPLs. In this sense, the bank lending channel may have helped in propagating easing monetary policy but did not hurt monetary policy. Some findings could be interpreted as the circumstantial evidence that evergreening of underperforming firms prevent funds from channeling into productive firms and that easing monetary policy had little effect throughout the period.

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 "perhaps no". Further public capital would have changed the structure of the lending supply function sooner and made banks unconstrained as actually happened late. 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 a circumstance of extremely low lending rates. [64]

[64] 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 be 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 the credit crunch from occurring. On the other, public capital injection raises the banks' equity capital. Strictly speaking, the fact that the capital asset ratios of several large banks receiving public funds far exceed their targets is contrary to the idea that

7. Conclusion

It has been already eight years since the ultra loose policy was launched in September 1995. Any positive effect, however, has yet to be seen. Indeed, corporate finance in Japan is still bank centered and the so-called "bank-lending channel" plays an important role in instigating monetary policy shocks. Underperformance of banks damages the bank-lending channel and greatly reduces the effectiveness of monetary policy. A direct testing procedure to assess the banks' response to the monetary policy measure may not be an effective strategy since they must have already been provided with abundant liquidity and may not feel compelled to lend out more in response to further easing policy. It is popularly rumored that the "capital crunch" of banks caused the negative bank lending supply shocks under the RBC regulation framework. Following the conventional wisdom of abundant credit crunch literature using micro data, the lending growth is regressed on measures of capital asset ratio.

The first methodological contribution of this paper is its use of a unique and strong instrument for capital asset ratio. The literature's testing results are mixed, largely because of lack of a convincing identification strategy of the supply side capital - lending causal relationship with the demand side. 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 over the 1980s, we employ the within bank share of real estate lending in the late 1980s as an instrument. It turns out that the constructed variable is very negatively correlated to the capital asset ratio and can be an effective instrument.

The second methodological contribution is the measurement of the aggregate impact of capital shortage or surplus on lending growth. The bank specific target capital asset ratio is estimated as a time-series average in the three year period from FY 1992 to FY 1994, based on the assumption that the banking behavior of the banks was to meet their targets right after the full implementation of the BIS capital regulation framework. Lending growth is regressed on the gap between the actual and the estimated target capital asset ratios. Averaging the individual impacts of the banks gives the aggregate lending supply shock caused by capital constraint.

Regression results suggest that the severest "capital crunch" occurred in FY 1997. Banks were not only capital constrained but the aggregate actual capital asset ratio ran short of the aggregate target ratio. We interpret that this is largely attributable to the large accounting losses caused by the rigorous asset assessment that accompanied the new formal action based PCA regulatory framework. The reduced bank capital made banks constrain capital in their decision making on lending policy, which eventually lead to the "credit crunch". Constrained banks are also found to respond to their concurrent capital position in FY 1998. This suggests that the bank lending channel of monetary policy transmission was severely damaged in FY 1997 by the credit crunch, but not in later years. Though the positive capital shock in FY 1998 was large enough to allow banks to avoid any capital constraint, the net impact of

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"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 to be the supply shock even if this alternative is true.

capital shocks during the fiscal years of 1997, 1998 and 1999 on lending is unambiguously negative, suggesting that the "credit crunch" was a major factor behind the recession. Indeed the cross section empirical approach, which validates the bank specific target, inevitably has an unobservable and possibly endogenous fixed effect. Results of the cross section and the auxiliary fixed effect regressions consistently imply that the bias, if any, would be caused by the banks' evergreening behavior that ties them to underperforming borrowers. It turns out that such a bias would not undermine our conclusions.

There are possible extensions to this paper and relevant future research areas. There are two interesting extensions from the methodological point of view. First, by applying the same instrumental variable strategy to financially unhealthier industries and comparing the results with our results for the healthy industries, one can show whether banks reorganized their lending portfolio to the specific direction. The direction of the bank finance in response to negative capital shocks suggests how efficient and effective use of financial resources is. Second, if we find that some structural behavioral change years before explains capital shortages in the 1990 - 1991 period of the U.S. credit crunch, it is 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 healthier lenders. As Bernanke (1983) and Calomiris and Mason (2002) explore in the context of the U.S. Great Depression, financial distress itself could be the negative lending supply shock. Though the "capital crunch" may not have occurred in the fiscal years of 1998 and 1999, the financial distress represented by increasing bank failures may have been the negative financial shock to bank dependent borrowers and blocked the monetary policy transmission. This would be an interesting research project from the macroeconomic point of view.

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Appendix: The Fixed Effect

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

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

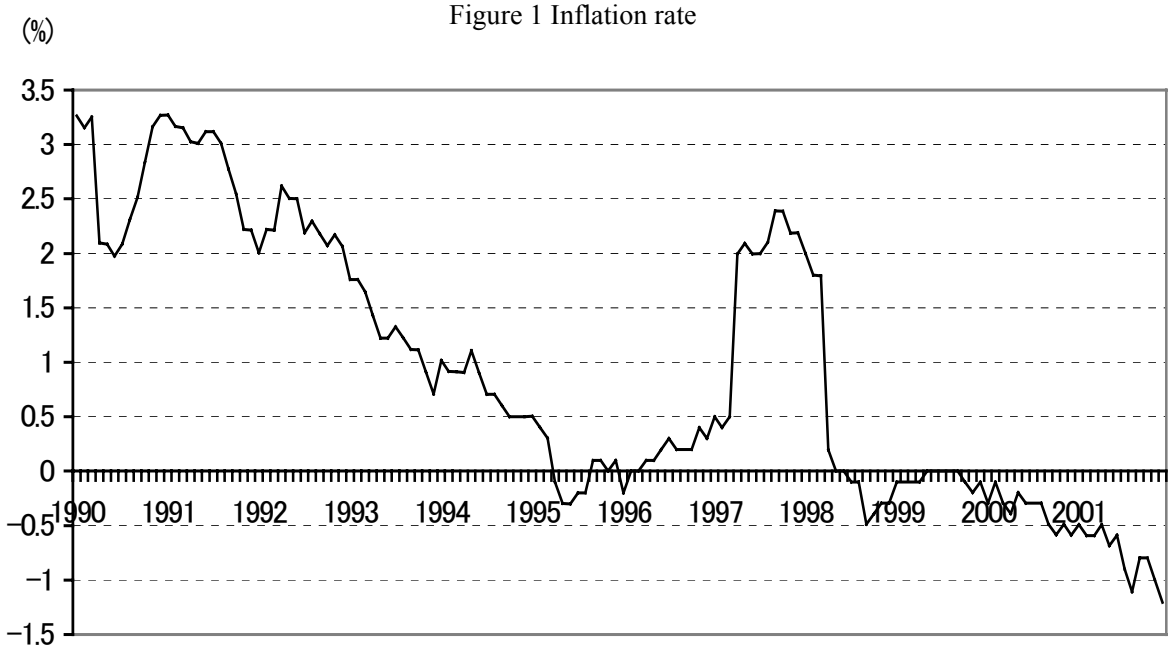
We assume that u_{it} is independent of z_i.

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.

Figure 1 Inflation rate



The price measure is the consumer price index (excluding perishables) on nationwide statistics.

Figure 2 Domestic loan growth and capital asset ratio of domestically licensed

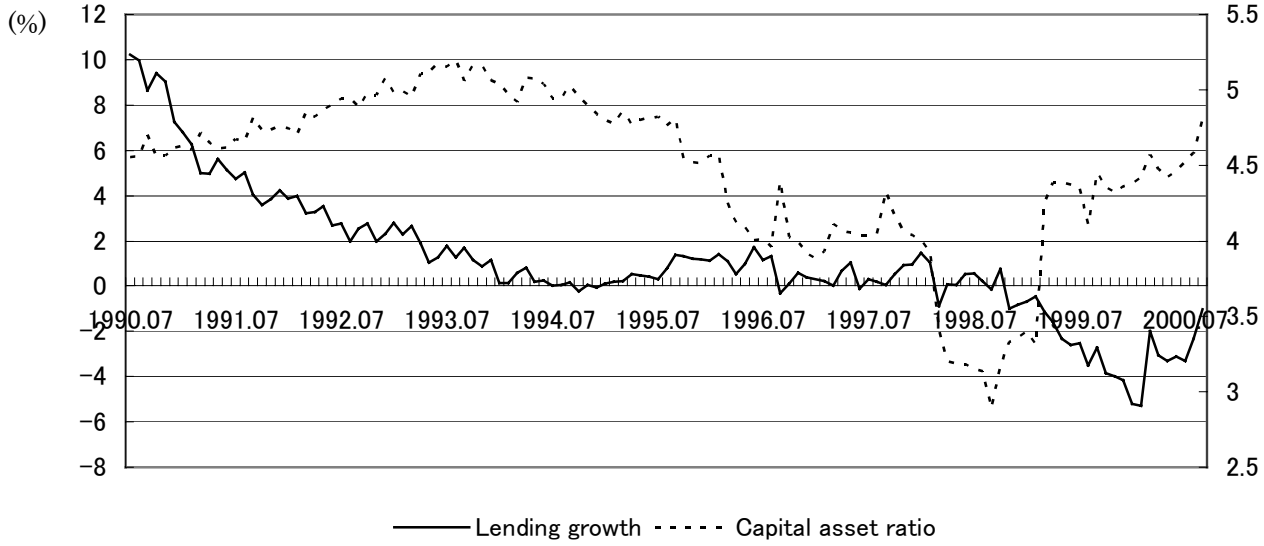
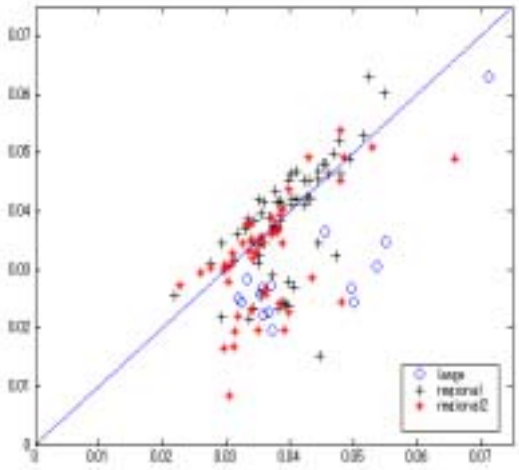
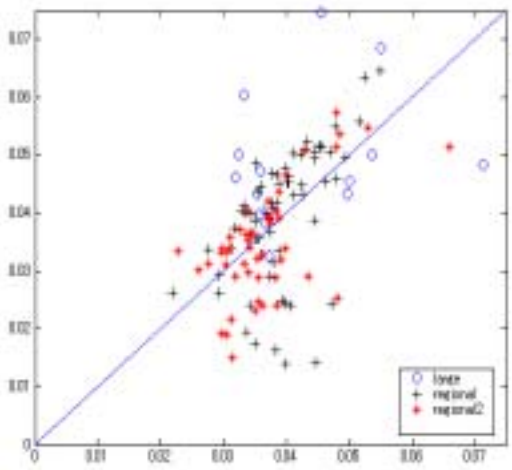


Figure 3 Target and actual CAPR

FY 1997



FY 1998



FY 1999

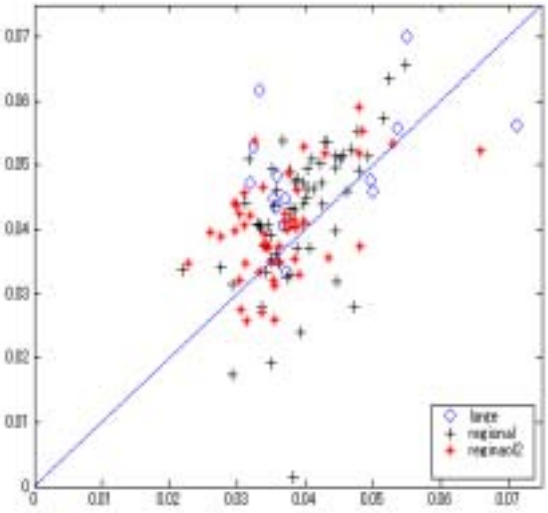


Table 1 The influence of reserves on lending, regression results with the industry level data

Variable	1994Q2 - 2001Q2		1996Q1 - 2001Q2	
	Random effect (MLE)	Fixed effect	Random effect (MLE)	Fixed effect
y	-0.11751	-0.17515	-0.21764	-0.26415
	(-0.71)	(-0.96)	(-1.04)	(-1.16)
y(-1)	0.17635	0.07958	0.15228	0.07778
	(1.41)	(0.48)	(0.95)	(0.39)
y(-2)	-0.24158**	-0.33700**	-0.36063 **	-0.43128**
	(-1.96)	(-2.09)	(-2.27)	(-2.19)
y(-3)	0.15284	0.05969	0.19521	0.12410
	(1.24)	(0.37)	(1.24)	(0.63)
y(-4)	0.08275	0.04086	0.06689	0.03635
	(0.49)	(0.23)	(0.32)	(0.16)
m	0.10118	0.10133	0.135378*	0.13592*
	(1.61)	(1.57)	(1.87)	(1.80)
m(-1)	-0.05060	-0.04086	-0.05223	-0.05144
	(-0.82)	(-0.78)	(-0.74)	(-0.70)
m(-2)	0.10168	0.10454	0.12694	0.12925
	(1.37)	(1.37)	(1.49)	(1.45)
m(-3)	0.00670	0.00816	0.00558	0.00678
	(0.11)	(0.13)	(0.08)	(0.09)
m(-4)	0.08289	0.08671	0.12251	0.12600
	(1.28)	(1.30)	(1.64)	(1.61)
F test (p value)	0.1675	0.1654	0.0915	0.0999

The null hypothesis of F test is $\sum_{j=0}^{4} m_{t-j} = 0$

Table 2 Correlation coefficients of REAL89 and capital asset ratios (level variables)

	1994	1995	1996	1997	1998	1999	2000
CAPR	0.2447	-0.0511	0.0281	-0.2515	-0.1230	-0.0951	-0.2485
BIS	0.0186	-0.0816	-0.0434	0.0371	-0.0326	-0.1230	-0.0868
CAPRM	0.0375	-0.0247	-0.0980	-0.3475	-0.2867	-0.1614	-0.3236

Table 3 Year by year coefficients on CAPR since the FY 1995

OLS

	NOTRB		MANUF		NOTNM	
	Lag	Cont.	Lag	Cont.	Lag	Cont.
1995	0.3893	05941*	-0.1951	0.1435	-0.3124	0.2765
	(1.0341)	(1.6789)	(-0.2956)	(0.2304)	(-0.3907)	(0.3629)
1996	-0.2313	-0.1532	0.0144	0.0426	1.7939**	0.7447
	(-0.7457)	(-0.6206)	(0.0281)	(0.1043)	(2.0859)	(1.0707)
1997	0.9555***	1.7049***	2.3082***	2.7782***	2.5863*	4.5159***
	(2.6852)	(5.4598)	(4.0023)	(5.2731)	(2.4724)	(4.8534)
1998	-0.1897	0.3077	0.3952	1.1540***	-1.3191	-0.1037
	(-0.4758)	(0.8738)	(0.7722)	(2.7028)	(-1.2806)	(-0.1142)
1999	0.6771*	0.9870*	0.4868	0.6909	2.8447***	3.2006***
	(1.7099)	(2.3161)	(1.0816)	(1.4113)	(2.7903)	(2.8519)
2000	-0.2630	0.1072	0.0095	0.5745	0.2977	0.3301
	(-0.6102)	(0.2824)	(0.0210)	(1.4252)	(0.2192)	(0.2814)

2SLS

	NOTRB		MANUF		NOTNM	
	Lag	Cont.	Lag	Cont.	Lag	Cont.
1995	0.7001	0.4822	2.0398	0.9884	-0.2592	2.2223
	(0.3769)	(0.2269)	(0.6426)	(0.2589)	(-0.0676)	(0.4579)
1996	-0.1836	0.7890	-2.9265	-0.2012	1.6175	0.0678
	(-0.0885)	(0.5754)	(-0.6928)	(-0.1080)	(0.2351)	(0.0168)
1997	0.2842	*2.7925****	4.8777**	*5.5042****	-0.8185	*6.3679***
	(0.2550)	*(2.9852)*	(2.5641)	*(3.3538)*	(-0.2344)	*(2.4373)*
1998	*1.7687*	*3.5250**	*6.6540*	*4.7152***	*-4.8418*	*6.7106*
	(0.8320)	*(1.9824)*	*(1.5832)*	*(2.6393)*	*(-0.9486)*	*(1.3928)*
1999	*3.6444***	*4.6037**	*0.9267*	*1.5397*	*5.7412**	*2.2697*
	(2.4546)	*(1.9803)*	*(0.7089)*	*(0.7805)*	*(1.8948)*	*(0.5252)*
2000	*0.3414*	*0.9119*	*0.4476*	*0.9016*	*2.4911*	*6.1826**
	(0.2667)	*(0.9136)*	*(0.3394)*	*(0.7887)*	*(0.6569)*	*(1.8882)*

Cells at the bottom table with italic letters indicate that CAPR is negatively and significantly correlated with REAL89.
Cells at the bottom table with italic letters indicate that CAPR is negatively and significantly correlated with REAL89.
*** shows 1%, **, 5%, and *, 10%, respectively.

Table 4 Correlation coefficients of REAL89 and the distance between actual and desired capital ratios

	1994	1995	1996	1997	1998	1999	2000
CAPR	-0.0096	-0.4607	-0.2767	-0.5345	-0.3443	-0.3214	-0.4358
BIS	-0.2551	-0.2321	-0.2139	-0.1055	-0.1568	-0.2340	-0.1933
CAPRM	-0.3940	-0.3255	-0.3740	-0.5392	-0.5105	-0.3149	-0.5102

Table 5-1 Year by year coefficients on the distance between actual and target CAPR ratios

OLS

	NOTRB		MANUF		NOTNM	
	Lag	Cont.	Lag	Cont.	Lag	Cont.
1995	3.1117	1.8926**	5.9431	2.7331*	6.3877	4.3631**
	(1.4425)	(2.2517)	(1.6053)	(1.8689)	(1.3920)	(2.4024)
1996	0.1630	0.0299	1.5339	0.5644	3.9105*	0.0629
	(0.2164)	(0.0720)	(1.2443)	(0.8242)	(1.8615)	(0.0534)
1997	2.5916***	2.7034***	4.6387***	3.5159***	5.0866***	6.1439***
	(4.5467)	(7.3160)	(4.9095)	(5.2271)	(2.9315)	(5.2850)
1998	0.6116	0.9486**	0.8160	1.5017***	1.2395	1.8368*
	(1.1238)	(2.3796)	(1.2681)	(3.2350)	(0.9289)	(1.8395)
1999	1.2463***	1.5436***	0.8764*	1.0820**	1.8688	1.7384
	(2.7560)	(3.3693)	(1.7262)	(2.0559)	(1.5700)	(1.3953)
2000	-0.0807	0.2924	0.8442*	1.2409	0.9464	0.7719
	(-0.1668)	(0.7292)	(1.7278)	(3.0320)	(0.6653)	(0.6493)

2SLS

	NOTRB		MANUF		NOTNM	
	Lag	Cont.	Lag	Cont.	Lag	Cont.
1995	-4.6343	*-0.7305*	16.3497	*-1.6173*	-4.0994	*3.5128*
	(-0.3864)	*(-0.3051)*	(0.9723)	*(-0.3794)*	(-0.2480)	*(0.6069)*
1996	*-1.6159*	*0.3448*	*5.5886*	*3.0451*	*-3.5591*	*-2.0894*
	(-0.7352)	*(0.2271)*	*(1.4239)*	*(1.2147)*	*(-0.6131)*	*(-0.5302)*
1997	*4.5115***	*3.9885****	*12.3775****	*6.1146****	*4.3003*	*9.1686****
	(2.3562)	*(4.4082)*	*(3.5254)*	*(3.5618)*	*(0.7476)*	*(3.2906)*
1998	*2.1365*	*2.7277***	*3.6816*	*3.6378***	*5.7499*	*9.6862***
	(1.2144)	*(2.2862)*	*(1.4249)*	*(2.5574)*	*(1.0688)*	*(2.3266)*
1999	*2.5871***	*1.8600*	*0.7608*	*0.8394*	*2.3607*	*-2.7237*
	(2.3899)	*(1.5108)*	*(0.6374)*	*(0.5741)*	*(0.8584)*	*(-0.7951)*
2000	*-0.2664*	*-0.4044*	*0.5946*	*0.8883*	*1.4006*	*2.3445*
	(-0.2126)	*(-0.2152)*	*(0.6582)*	*(0.8919)*	*(0.4863)*	*(0.8027)*

Cells at the bottom table with italic letters indicate that CAPR is negatively and significantly correlated with REAL89.
*** shows 1%, **, 5%, and *, 10%, respectively.

Table 5-2 Regression results of equation (3) with CAPR

FY 1997

	NOTRB		MANUF		NOTNM	
	Lag	Cont.	Lag	Cont.	Lag	Cont.
Constant	0.0130**	0.0257***	-0.0238*	-0.0068	0.0304	0.0611***
	(2.0194)	(3.8910)	(-1.9634)	(-0.5798)	(1.6762)	(3.1000)
Lagged dependent variable	0.4196***	0.4440***	-0.2420	-0.2101	-0.1234	-0.0432
	(3.3086)	(3.8621)	(-1.5482)	(-1.5989)	(-0.9206)	(-0.3325)
CAPR	4.5115**	3.9885***	12.3775***	6.1146***	4.3003	9.1686***
	(2.3562)	(4.4082)	(3.5254)	(3.5618)	(0.7476)	(3.2906)
Large bank dummy	0.0231	0.0342	0.0723	0.0609	-0.0962	0.0151
	(0.7120)	(1.3259)	(1.2353)	(1.2083)	(-0.9348)	(0.1736)
Trust bank dummy	-0.0202	-0.0006	0.1096*	0.0585	-0.1113	0.0051
	(-0.5802)	(-0.0218)	(1.7326)	(1.2141)	(-1.1242)	(0.0619)
Regional bank dummy	0.0018	-0.0028	0.0082	0.0138	-0.0122	-0.0356
	(0.1846)	(-0.3238)	(0.4225)	(0.8429)	(-0.4062)	(-1.2931)
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

	NOTRB		MANUF		NOTNM	
	Lag	Cont.	Lag	Cont.	Lag	Cont.
Constant	0.0197	0.0182**	-0.0136	-0.0203**	0.0566*	0.0567**
	(1.5729)	(2.0735)	(-1.0113)	(-1.9903)	(1.7041)	(2.2252)
Lagged dependent variable	0.1594	0.1138	-0.1299	-0.0886	-0.0540	-0.1346
	(0.9242)	(0.8049)	(-0.9724)	(-0.9710)	(-0.3448)	(-0.9512)
CAPR	2.1365	2.7277**	3.6816	3.6378**	5.7499	9.6862*:
	(1.2144)	(2.2862)	(1.4249)	(2.5574)	(1.0688)	(2.3266)
Large bank dummy	0.0493	0.0015	0.1294**	0.0582**	-0.0202	-0.1457**
	(1.6558)	(0.0637)	(2.6618)	(2.0610)	(-0.2053)	(-2.0903)
Trust bank dummy	-0.0607*	-0.0930***	0.0766	0.0260	-0.0800	-0.1567**
	(-1.9643)	(-3.5970)	(1.3073)	(0.8505)	(-0.7709)	(-2.2588)
Regional bank dummy	-0.0225	-0.0251*	-0.0094	-0.0093	-0.0884**	-0.1077**
	(-1.6171)	(-1.9535)	(-0.5038)	(-0.5726)	(-2.0862)	(-2.6449)
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)

FY 1999

	NOTRB		MANUF		NOTNM	
	Lag	Cont.	Lag	Cont.	Lag	Cont.
Constant	0.0028	-0.0114	-0.0255**	-0.0299**	-0.0098	-0.0081
	(0.2957)	(-1.2344)	(-2.4243)	(-2.3611)	(-0.3873)	(-0.2993)
Lagged dependent variable	0.2765**	0.3669**	0.3332**	0.3427***	-0.1316	-0.0783
	(2.0841)	(3.1410)	(2.5925)	(2.7769)	(-1.0556)	(-0.6259)
CAPR	2.5871**	1.8600	0.7608	0.8394	2.3607	-2.7237
	(2.3899)	(1.5108)	(0.6374)	(0.5741)	(0.8584)	(-0.7951)
Large bank dummy	0.0233	0.0253	0.0815**	0.0808**	0.1060	0.1196
	(0.7728)	(0.8908)	(2.3191)	(2.3140)	(1.2323)	(1.3415)
Trust bank dummy	-0.0419	-0.0315	0.0038	0.0062	-0.0109	-0.0289
	(-1.3789)	(-1.0903)	(0.1280)	(0.1950)	(-0.1475)	(-0.3698)
Regional bank dummy	-0.0195	-0.0073	-0.0364**	-0.0338**	-0.0401	-0.0194
	(-1.3366)	(-0.5851)	(-2.3747)	(-2.3563)	(-1.0130)	(-0.5066)
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)

Cells at the bottom table with italic letters indicate that CAPR is negatively and significantly correlated with REAL89.
*** shows 1%, **, 5%, and *, 10%, respectively, and numbers shown in parentheses below J statistics are p-values.

Table 5-3 Partial squared correlation coefficients

	NOTRB		MANUF		NOTNM	
	Lag	Cont.	Lag	Cont.	Lag	Cont.
1995	0.0505	0.1223	0.0368	0.1359	0.0781	0.0961
1996	0.1127	0.0864	0.1292	0.0774	0.1514	0.0986
1997	0.1087	0.1683	0.0953	0.1812	0.0887	0.1763
1998	0.0776	0.1349	0.1037	0.1346	0.0649	0.0871
1999	0.0989	0.0434	0.1159	0.0569	0.1091	0.0589
2000	0.2648	0.1938	0.2611	0.2276	0.3217	0.2899

Table 5-4 Results of the fixed effect estimation of equation (7)

	NOTRB		MANUF		NOTNM	
	Lag	Cont.	Lag	Cont.	Lag	Cont.
Lagged dependent variable	-0.1086	0.1335	0.0156	-0.1468	-0.0950	-0.0278
	(-0.4843)	(0.5532)	(0.0945)	(-1.5675)	(-0.7085)	(-0.1583)
D_{97}CAPR	6.5261**	5.6670***	10.4791*	10.4689***	4.9835	16.6790**
	(2.1715)	(2.7599)	(1.7283)	(3.6998)	(0.5393)	(2.4302)
D_{98}CAPR	1.2446	-0.1310	-4.5492	5.8631*	-3.9959	-0.9960
	(0.4626)	(-0.0563)	(-0.8789)	(1.7362)	(-0.6675)	(-0.1173)
D_{99}CAPR	0.8230	-0.3415	-4.8133	4.6860	-3.8177	-1.1888
	(0.3466)	(-0.1629)	(-1.0344)	(1.5133)	(-0.7148)	(-0.1537)
D_{98}	0.1946**	0.1906*	0.5471**	0.1318	0.3052	0.5956
	(2.0493)	(1.8159)	(2.1780)	(0.8041)	(0.9081)	(1.4031)
Observations	252	252	252	252	252	252
J statistics	6.0354	1.8178	5.8431	7.4343	2.6548	3.1713
	0.3028	0.8737	0.3218	0.1903	0.7530	0.6736

Table 6-1 Year by year coefficients on the distance between actual and desired BIS ratios

	NOTRB		MANUF		NOTNM	
	Lag	Cont.	Lag	Cont.	Lag	Cont.
1995	*-1.2880*	*-0.8611*	*23.7172*	*-1.8901*	*-23.2494*	*-5.0820*
	(-0.1159)	*(-0.6101)*	*(1.3874)*	*(-0.7430)*	*(-0.9051)*	*(-1.5475)*
1996	*-0.9350*	*-0.8996*	*1.7597*	*1.1874*	*-5.2090*	*-2.8174*
	(-0.7037)	*(-0.8908)*	*(0.8153)*	*(0.8757)*	*(-1.3123)*	*(-1.0099)*
1997	*6.4798**	*1.8096*	*5.5378***	*1.5959*	*17.1556**	*9.8893*
	(1.9544)	*(1.6077)*	*(2.0093)*	*(0.6043)*	*(1.7993)*	*(1.5864)*
1998	*2.0713*	*1.5393***	*7.6596*	*2.7031****	*0.2987*	*4.2528***
	(0.9602)	*(2.2372)*	*(1.4958)*	*(3.0631)*	*(0.0501)*	*(1.9868)*
1999	*2.2806****	*1.3485*	*1.3096*	*0.7898*	*1.1858*	*-1.8280*
	(2.6681)	*(1.5545)*	*(1.3157)*	*(0.7867)*	*(0.6348)*	*(-0.8435)*
2000	*0.2275*	*0.6818*	*0.3312*	*0.6767*	*2.1014*	*4.0075**
	(0.4057)	*(0.8314)*	*(0.6369)*	*(0.8727)*	*(1.4518)*	*(1.9191)*

Table 6-2 Year by year coefficients on the distance between actual and desired CAPRM ratios

	NOTRB		MANUF		NOTNM	
	Lag	Cont.	Lag	Cont.	Lag	Cont.
1995	*-5.1154*	*-2.3156**	*-4.0616*	*-0.8450*	*-10.1156*	*-5.9153***
	(-1.2992)	*(-1.7200)*	*(-0.7338)*	*(-0.4627)*	*(-1.3233)*	*(-2.0892)*
1996	*-0.2959*	*-0.2054*	*-0.2571*	*1.6414*	*-3.2084*	*-3.0940*
	(-0.4065)	*(-0.2581)*	*(-0.2144)*	*(1.18169)*	*(-1.3994)*	*(-1.2890)*
1997	*4.1685****	*2.6700****	*7.2309****	*4.0634****	*7.0660**	*5.9576****
	(3.3564)	*(4.5396)*	*(3.5457)*	*(3.6669)*	*(1.9178)*	*(3.1200)*
1998	*1.0551*	*1.4821***	*0.9333*	*1.6617***	*2.3332*	*5.1633***
	(1.0516)	*(2.0453)*	*(0.7674)*	*(2.0213)*	*(0.9766)*	*(2.5024)*
1999	*1.5086***	0.9799	*0.3140*	-0.0859	*0.3895*	-0.7325
	(2.1586)	(1.4708)	*(0.4133)*	(-0.1261)	*(0.2166)*	(-0.4268)
2000	0.2742	*0.2781*	0.4375	*0.3904*	2.6039	*2.1791*
	(0.4015)	*(0.4863)*	(0.6195)	*(0.6233)*	(1.2131)	*(1.2319)*

Cells with italic letters indicate that differences between capital asset ratio and its desired levels are negatively and significantly correlated with REAL89.
*** shows 1%, **, 5%, and *, 10%, respectively.

Table 7-1 Year by year coefficients on the book based capital surplus measure, regional banks

	NOTRB		MANUF		NOTNM	
	Lag	Cont.	Lag	Cont.	Lag	Cont.
1995	*4.5859*	*3.0071**	*24.0536**	*1.3794*	*2.2662*	*7.4764***
	(0.6001)	*(1.8341)*	*(1.8561)*	*(0.4697)*	*(0.1647)*	*(2.1618)*
1996	*-1.1297*	*-0.5654*	*0.2344*	*0.6303*	*5.4119*	*0.9829*
	(-0.7345)	*(-0.6241)*	*(0.1068)*	*(0.4490)*	*(1.4886)*	*(0.3823)*
1997	*4.5970****	*3.3836****	*5.8640****	*4.0976****	*7.7449***	*6.4116****
	(6.0502)	*(7.2131)*	*(3.8921)*	*(3.9628)*	*(2.4217)*	*(3.1778)*
1998	*2.1982*	*2.8101**	*-0.5405*	*-0.0835*	*11.3092****	*8.4511****
	(1.2290)	*(1.7629)*	*(-0.3952)*	*(-0.0756)*	*(3.0981)*	*(3.3579)*
1999	*1.1228*	*0.8013*	*1.7190**	*2.5032***	*3.5083*	*2.1911*
	(1.6798)	*(1.0729)*	*(1.8978)*	*(2.5473)*	*(1.4816)*	*(0.8130)*
2000	*-0.9152*	*-0.4589*	*-0.2561*	*0.6860*	*1.8227*	*3.7935*
	(-0.9170)	*(-0.4144)*	*(-0.2994)*	*(0.6919)*	*(0.4674)*	*(0.8397)*

Table 7-2 Year by year coefficients on the book based capital surplus measures, regional 2 banks

	NOTRB		MANUF		NOTNM	
	Lag	Cont.	Lag	Cont.	Lag	Cont.
1995	*-1.5858*	*-0.1850*	*-3.9529*	*-2.9487*	*24.6967*	*-0.4540*
	(-0.1518)	*(-0.0509)*	*(-0.2302)*	*(-0.4718)*	*(1.0757)*	*(-0.0519)*
1996	*0.3169*	*0.5489*	*4.0102*	*1.0068*	*1.6216*	*1.4291*
	(0.1253)	*(0.5132)*	*(0.7660)*	*(0.4421)*	*(0.1749)*	*(0.3664)*
1997	*2.6622*	*2.1666***	*2.2299*	*4.3635****	*-3.3035*	*1.8580*
	(0.9549)	*(2.4839)*	*(0.5693)*	*(2.9290)*	*(-0.4264)*	*(0.5451)*
1998	*0.3388*	*0.0868*	*0.0630*	*0.0485*	*-1.1813*	*-0.5111*
	(0.3326)	*(0.0924)*	*(0.0549)*	*(0.0381)*	*(-0.4533)*	*(-0.1994)*
1999	*-0.9611*	*0.3129*	*0.1421*	*1.1614*	*-4.5208*	*-7.1490*
	(-0.9471)	*(0.2427)*	*(0.1118)*	*(0.7213)*	*(-1.5053)*	*(-1.5584)*
2000	*-0.1649*	*0.1458*	*1.5281*	*1.2129*	*-0.6743*	*-0.1052*
	(-0.1475)	*(0.2190)*	*(0.9814)*	*(1.2431)*	*(-0.2400)*	*(-0.0633)*

Cells with italic letters indicate that differences between capital asset ratio and its desired levels are negatively and significantly correlated with REAL89. *** shows 1%, **, 5%, and *, 10%, respectively.

Table 8 Aggregate lending growth, all banks

	NOTRB	MANUF	NOTNM	TROUB	REALE
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

Table 9 Aggregate capital shocks to bank lending supply (all 126 banks)

CAPR

	NOTRB		MANUF		NOTNM	
	Lag	Cont.	Lag	Cont.	Lag	Cont.
1997	*-1.87***	*-3.72****	*-5.13****	*-5.70****	*-1.78*	*-8.54****
1998	*-1.94*	*1.07***	*-3.34*	*1.43****	*-5.22*	*3.82***
1999	*1.05***	*1.27**	*0.31*	*0.57*	*0.96*	*-1.85*

BIS

	NOTRB		MANUF		NOTNM	
	Lag	Cont.	Lag	Cont.	Lag	Cont.
1997	*-1.42**	*0.37*	*-1.22***	*0.33*	*-3.77**	*2.02*
1998	*0.45*	*2.76***	*1.67*	*4.85****	*0.07*	*7.64***
1999	*4.12****	*3.04*	*2.37*	*1.78*	*2.14*	*-4.12*

CAPRM

	NOTRB		MANUF		NOTNM	
	Lag	Cont.	Lag	Cont.	Lag	Cont.
1997	*-5.18****	*-7.15****	*-8.98****	*-10.88****	*-8.77**	*-15.94****
1998	*-2.79*	*-2.08***	*-2.46*	*-2.33***	*-6.16*	*-7.23***
1999	*-2.10***	-0.30	*-0.44*	0.03	*-0.54*	0.23