Does a Large Loss of Bank Capital Cause *Evergreening*? Evidence from Japan

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Abstract

Using the real estate lending share of the bank's loan portfolios at the peak of the Japanese asset price bubble as an instrument for bank capital, we identify the impact of capital adequacy on the allocation of bank lending between *low quality* and *high quality* borrowers. We find that, in FY 1997, a large loss of capital resulting from the regulator's tougher stance towards banks induced the banks to reallocate their lending portfolios toward *low quality* borrowers.

Keywords: evergreening, flight to quality, bank capital, instrumental variable
JEL classification: C21, G21

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1. Introduction

The purpose of this paper is to provide an answer to the empirical questions "Do banks make adjustments not only in the quantity of the lending supply but also in the *quality* of the lending supply as a response to a large negative capital shock within the BIS risk-based capital regulatory framework? And if so, how?"

The answer to our empirical questions has interesting policy implications. If bank lending is shifted from high-quality borrowers to low-quality borrowers (*evergreening*), an excessively tough regulatory stance that urges banks to write off non-performing loans -- which causes a large loss of capital -- is a bad policy that leads to inefficient financial support of unproductive firms at the cost of profitable investment opportunities in productive firms.[1] If the opposite is the case (*flight to quality*), a tough regulatory stance has the effect of supporting productive firms and of encouraging investment by such firms.

Despite the important implications on modern-day prudential policy and the potentially enormous macroeconomic impact, little has been done to explore the influence of inadequate bank capital on the quality of bank lending supply. We now turn to the second largest economy in the world, Japan, which recently suffered from a staggering non-performing loans (NPLs) problem and a decade long economic stagnation, to discuss our agendas.

In fiscal year 1997 Japanese banks, under strong regulatory pressure, finally recognized a huge amount of non-performing loans and incurred a huge loss of capital. Bank capital, which had already been diminished by a series of negative events during the financial crisis that surfaced in FY 1995, reached a level that was low enough for regulatory intervention to be a real threat. Our previous work (Watanabe [2005]) determined that Japanese banks did reduce lending to relatively healthy industries such as the manufacturing industry but did not examine how capital-constrained banks allocated lending between high quality and low quality borrowers.[2]

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[1] *Evergreening* is sometimes called *forbearance lending* in the literature.

[2] Woo (2003) also points out that inadequate bank capital was a cause of declining bank lending supply in FY

To identify the Japanese banks' lending behavior in the late 1990s, we resort to the strategy developed by Watanabe (2005) that exploits the banks' structural behavioral changes in the 1980s in the face of financial liberalization. Banks shifted their lending portfolios toward the real estate sector because of bullish expectations concerning land prices. In the early 1990s, the land price bubble was burst and a large portion of real estate lending became non-performing. Thus, the higher share of real estate lending in the late 1980s explains the higher non-performing loans and lower bank capital in the late 1990s.

Focusing on the real estate share of lending within the banks' loan portfolios at the end of the 1980s as an instrumental variable for bank capital-- which allows us to distinguish the lending supply function from the possible demand side capital-borrowing relationship -- unveils complexity of the Japanese banks' lending practices. We find that large accounting losses of bank capital in FY 1997 induced banks not only to reduce overall lending supply but also to reallocate lending to unhealthy industries with a higher concentration of non-performing loans.

In FY 1997, under the regulator's request to carry out rigorous assessments of outstanding loans, weakly capitalized banks knew that, because of tougher standards, they would risk falling below the regulatory minimum unless distressed firms managed to repay their debts on time. Thus, banks, in attempt to raise the RBC ratio, while cutting back on lending to healthy firms, they became less willing to cut back on lending to unhealthy firms, since without the banks' financial support, firms in trouble would have failed and the banks would have incurred even further capital losses. From a macroeconomic stand point, while quantitative deterioration of bank credit likely triggered the economic downturn, qualitative deterioration of bank credit favored the inefficient resource allocation in the production sector, and likely prolonged the slump.

This paper is organized as follows. In Section 2, a bank's possible behavioral reactions to a loss of its own capital are discussed, and the relevant literature is reviewed. In Section 3, the

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1997.

data and econometric issues are examined. In Section 4, the empirical results are reported. Section 5 concludes.

2. *Capital crunch, flight to quality,* the *credit crunch,* and *evergreening*: theoretical considerations and literature survey

Japanese banks suffered a substantial loss of capital during the mid 1990's due to such various adverse events as their contribution to the liquidation of *jusen* housing loan companies, declining bank profitability, and distrust of the banking industry by market participants.[3] It was, however, the regulator's adoption of a tougher stance toawrds banks (i.e., its urging them to implement a more rigorous self-assessment of their assets) in FY 1997 that resulted in a loss of bank capital of unprecedented magnitude (the *capital crunch*). Up until that time, most NPLs had been left unrecognized and had not appeared on the banks' financial statements.[4]

The Risk-Based-Capital (RBC) regulatory framework requires banks to satisfy the minimum standard for the ratio of capital to risk weighted assets (riskier assets are assigned the higher weights), the so-called RBC ratio.[5] Corporate lending has been assigned a weight of 100% irrespective of the credit risk of each contract (credit worthiness of each borrower). Introduction of the Prompt Corrective Action framework (PCA) in FY 1997, which allows the regulator to intervene in the management of banks with an RBC capital ratio below the regulatory minimum, made failure to achieve the minimum standard particularly costly for banks.[6]

What can a bank do if a large loss of capital brings down its RBC ratio to a level close to the regulatory minimum? Asymmetric information -- involving investors, banks, and borrowers --

[3] Distrust of the Japanese banking industry by market participants manifested itself as the Japan premium in 1996 and 1997. In the Eurodollar and Euroyen inter-bank markets, lenders charged Japanese banks higher rates than other international banks. See Peek and Rosengren (2001).

[4] Hoshi and Kashyap (2001) provide the best summary source of the chronology of the Japanese financial crisis.

[5] The framework was agreed to in the Basel Accord and in Japan took full effect in fiscal year 1993. All banks publicly reported ratios in accordance with the Japanese Bankers Association (*zenginkyo*) criteria.

[6] The regulatory minimum is the Basel standard of 8 percent for banks that conduct international businesses and 4 percent for those that operate only domestically. It was only major banks that were affected by the PCA in the introductory year of FY 1997. However, other banks must have foreseen the PCA's greater coverage of the banking industry.

makes issuing new equity costly.[7] There are, however, potentially three ways for a bank to raise the RBC ratio without issuing equity. First, if associated operational costs are negligible, the bank may examine individual lending contracts (or at least individual borrowers) and reduce riskier loans while retaining safer loans. This is the bank's *flight to quality* in response to a negative capital shock. Second, if such costs are prohibitively high, banks may cut the supply of loans irrespective of the borrowers' credit worthiness. This is the *credit crunch*. Third, the bank can engage in the so-called *evergreening* for borrowers who have difficulty in servicing their debts. The supply of additional loans to such borrowers not only allows them to fulfill their contractual obligations on previous debts but also helps the lender bank to avoid the appearance of NPLs on its financial statements. This paper sheds light on the banks' adjustment of the quality of their supply of loans in response to a large loss of their own capital; it tests the *evergreening* hypothesis against the *flight to quality* hypothesis by examining shifts in the supply of loans among borrowers of various financial strengths.[8]

The hypotheses have been tested by comparing small business lending with loans to larger firms with various sets of data from both the US and abroad, on the ground that creditors should reduce loans to opaque small firms in times of capital losses (Bernanke and Lown [1991], Peek and Rosengren [1995], Hancock and Wilcox [1998], Berger, Klapper, and Udell [2001]). The results are not very conclusive.[9] Since banks establish long-term relationships with borrowers through rounds of lending contracts, small firms are not necessarily more opaque to banks than larger firms are.[10] Thus, this traditional approach may be misleading.

A growing number of recent empirical studies are supportive of *evergreening* by Japanese

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[7] See Stein (1998) and Diamond and Rajan (2000) for discussions on the banks' cost of issuing equity.

[8] According to Bernanke and Gertler (1995) and Bernanke, Gertler, and Gilchrist (1998), credit supply to borrowers with higher net worth is greater than to those with lower net worth under the optimal contract, when there is asymmetric information between the lender and the borrower. The allocation of credit supply is accelerated in the wake of a negative shock to creditors such as tightening monetary policy and a loss of bank capital.

[9] Gertler and Gilchrist (1994), Oliner and Rudebusch (1995, 1996), and Lang and Nakamura (1995) support the banks' *flight to quality* in response to tightening monetary policy.

[10] For empirical evidence of banks as relationship lenders, see Berger and Udell (1995), Petersen and Rajan (1994, 2002), Cole (1998), Degryse and Cayseele (2000) and Berger, Klapper, and Udell (2001).

banks. Kobayashi, Saita, and Sekine (2003) document that the growth of loans to highly leveraged firms accelerated. Peek and Rosengren (2005) find that a financially weaker bank, whose risk-based capital to asset ratio is closer to the regulatory minimum, is likely to extend credit to the firm in response to the financial deterioration of the firm[11]

3. Empirical methodology

Empirical model

Consider the following equation. The specification follows Watanabe (2005).

$$\Delta \ln L_{it}^{j} = \alpha_{0}^{j} + \alpha_{1}^{j} \Delta \ln L_{it-1}^{j} + \beta_{t}^{j} \left\{ \frac{K_{it}}{A_{it}} - \left(\frac{K_{i}}{A_{i}} \right)^{*} \right\} + \gamma^{j} X_{i} + \varepsilon_{it}^{j} \qquad (1)$$

The special emphasis is placed on the superscript *j*, which indicates a group of industries. Here, comparisons of the estimation results for a group of "unhealthy" industries with the results for a group of "healthy" industries are our central interest, unlike Watanabe (2005) who investigates lending to "healthy" industries only.

The dependent variable L_{it}^{j} is the lending growth of an individual bank *i* to the *j*'th group of industries at date *t*.[12] Explanatory variables are the lagged dependent variable and the difference between actual and target levels of the capital to asset ratio, $K_{it}/A_{it} - (K_i/A_i)^{*}$, which we call the capital "surplus" ("shortage" if it is negative). [13] X_i is a set of dummy variables (CITY, TRUST, and REGIONAL) that control for an individual bank's institutional characteristics and indicate a city bank, a trust bank, or a regional bank, respectively. These dummy variables are meant to

[11] For an extensive literature review, see Kobayashi, Saita, and Sekine (2002), Caballero, Hoshi, and Kashyap (2005) and Hosono and Sakuragawa (2005).

[12] The use of loan growth as the dependent variable is intended to capture the bank's adjustment of new lending in response to a change in capital. Bernanke and Lown (1991), Berger and Udell (1994), Ogawa and Kitasaka (2000) and Ito and Sasaki (2002) use loan growth in the same spirit. Peek and Rosengren (1997) use the change in loans divided by beginning-of-period assets. Woo (2003) calculates new loans by adding write-offs of non-performing loans to the change in loans. Though Woo's dependent variable is the most preferred, and one should calculate new loans as Woo (2003) does, data on write-offs of NPLs by industry are not available.

[13] Ogawa and Kitasaka (2000) derive a similar specification including a lagged dependent variable as one of the independent variables from the optimization problem of a forward-looking bank. Excluding the lagged dependent variable did not alter the results in the following empirical analysis (the results are not shown.)

control for lending demand as each group of banks has a distinctive customer base.[14] ε^{j}_{it} is the error term.

As Van den Heuvel (2002) shows, when a bank maximizes the expected sum of future dividend payouts under the Basel regulatory framework, it starts to cut back on its lending supply only when its capital to asset ratio is sufficiently close to but above the regulatory minimum. How much earlier the bank acts in response to a loss of capital, which serves as a buffer to the regulatory minimum for a forward-looking bank, depends on the bank's characteristics such as risk averseness, size, and institutional and legal status.[15] The bank's specific target for the capital asset ratio $(K_i/A_i)^*$ is the level that triggers the bank to act.[16] [17]

Data and sample selection

The main data source of bank level data is the Nikkei NEEDS bank financial data bank, which has become standard for recent empirical works on Japanese banks.[18] The data represents a 27 year-long period from FY 1974 to FY 2000. It contains not only the balance sheets and income statements of all domestically licensed banks but also information on bank loans classified by industry, allowing us to compare loans supplied to various sectors.[19]

In order to distinguish the banks' reactions to the loss of their own capital from simultaneous falls in loans and capital by failed banks during the process of liquidation (or during the clean up of NPLs in preparation for a handover to new management), banks affected by bank failures, liquidated or nationalized banks and those experiencing rescue mergers or

[14] Dummy variables are based on the conventional classification of Japanese banks. Regional 2 banks are used as a base group. Long-term credit banks do not survive in the construction of the analyzed sample, which will be discussed later.

[15] See Hancock and Wilcox (1994) for a discussion

[16] Testing on the non-linear effect of bank capital on the lending rate, Hubbard, Kuttner and Palia (2002) find that the price effect is more likely to be linear than to be non-linear. As a bank level interest rate on the flow of loans is unable to extract from the financial statements and the only estimable interest rate is the average rate on the present balance of total loans, the price term is not included in our model. The price effect is negligible since bank lending rates remain mostly unchanged under the Bank of Japan's unusually low interest rate policy.

[17] Using data on Italian banks, Gambacorta and Mistrulli (2003) conduct their empirical tests that are based on the view of Van den Heuvel (2002), which is that the reaction of the banks' lending supply to capital adequacy is non-linear.

[18] Ogawa and Kitasaka (2000), Hoshi and Kashyap (2000), Ueda (2000), Hoshi (2001) and Watanabe (2005)

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

acquisitions of failed banks, were dropped from the sample.[20] A total of 126 banks remained in the sample.

Disaggregating lending data into healthy and troubled industries

Non-performing loans (NPLs) reduce a firm's net worth. Large NPLs suggest that priority for the allocation of a firm's resources is being given to servicing debts and that the firm is being deprived of the opportunity to grow by investing in profitable projects. An industry is considered a "troubled" industry if the share of NPLs to that industry in total NPLs exceeds the share of loans to that industry in total loans as of the end of fiscal year 2000. "Troubled" industries are defined as real estate, construction, wholesale and retail, and service industries. As displayed in Figure 1, they account for three-fourths of the total NPLs, even though only 46 percent of total loans are directed to them.

[Insert Figure 1 about here.]

The "flight to quality" hypothesis is tested against the "ever-greening" hypothesis by comparing the estimation results of the bank lending supply function for "troubled" industries and that for "non-troubled" industries.

The capital measure

The ratio of book capital to total assets (book-based ratio) is used as the capital measure when estimating equation (1) rather than the BIS risk based capital asset ratio or the market-based capital to asset ratio. The book-based ratio is a preferred measure since it captures an exogenous variation in core capital (Tier 1 elements), which is required to be at least

[20] Banks that had experienced non-rescue mergers are treated as single banks in pre-merger dates by adding values of variables for the banks involved in the deals as do Peek and Rosengren (1995) and Kishan and Opiela (2000). One long-term credit bank was dropped because detailed lending data for the 1980s are missing, and one regional 2 bank founded in the 1990s was also dropped.

50 percent of capital to meet the minimum standard under the Basel framework.[21]

Estimation methodology

Following Watanabe (2005), we use as the target the average of each capital to asset ratio measure for each bank for the fiscal year 1992-1994. It seems reasonable to assume that banks had achieved their targets during this period as the aggregate capital to asset ratio stayed high at around 5 percent (Figure 2). The periods before and after the sample period were excluded because (1) the Basel regulatory framework did not take full effect until FY 1992 and (2) banks experienced large losses of bank capital in FY 1995 and in FY 1997.[22]

[Insert Figure 2 about here.]

The target constructed in this way varies across banks but is time invariant. Figure 3 shows that capital shocks are aggregate rather than idiosyncratic in nature and influence an individual bank's capital position in a synchronized manner. In FY 1997 all banks were either short of or just achieved their targets. In FY 1998, by contrast, many banks had drummed up their capital and achieved their targets. By FY 1999, most banks had achieved their targets. The time variant but cross-sectionally invariant reaction coefficient β_t^j is meant to capture the banks' reactions to such aggregate shocks. [23]

[Insert Figure 3 about here.]

[21] The BIS risk based ratio is endogenous for two reasons. First, since it is normalized by risk weighted assets, a feedback effect from the growth of the supply of loans (the dependent variable) to the BIS ratio through the denominator of the ratio likely results. Second, as authors such as Ito and Sasaki (1999) points out, banks can issue supplemental quasi-capital instruments such as subordinate debts and can raise the BIS ratio in the wake of the loss of core capital. See Watanabe (2005) for more discussion on supporting a choice of the book based ratio.

[22] The Basel Accord agreed in 1988 encouraged banks to accumulate adequate capital by the time of its full implementation.

[23] The target may change over time as the regulatory and economic environments change. However, arguably the most important economic influence on the banks' targets, interest rates, stayed low and barely changed in the late 1990s. Watanabe (2005) discusses a potential for an alternative regression based estimation of targets.

We estimate equation (1) using yearly bank panel data and interacting time dummies with the explanatory variables to leave the coefficients including the one on capital "surplus" K_{it}/A_{it} - $(K_i/A_i)^*$ time-variant. [24, 25, 26]

Simultaneity and identification

The OLS estimator of the coefficient of the capital "surplus" measure β in equation (1) may capture not only the banks' behavioral responses but also the potential demand-side relationship. If economic conditions worsen, firms adjust their investments downward, which in turn results in declining borrowing demand. On the other hand, firms' sluggish sales performance may prevent them from earning enough revenues to service their debts on time. Thus, their existing loans become non-performing, which reduces the lender bank's capital. Similarly, in an economic upturn, borrowing demand soars, and the higher bank profits are added to their equity capital.

In order to identify the bank lending supply function from the balance sheet data, we need a valid instrument that is independent of the error term ε_{it}^j and strongly correlated with the capital to asset ratio, K_{it}/A_{it}. Following Watanabe (2005), we use the share of real estate lending in the bank's lending portfolio in FY 1989, which we call REAL89 as a key instrumental variable for bank capital.[27]

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[24] Resulting point estimates are numerically equivalent to those from separate cross sectional regressions. Watanabe (2005) run year by year cross sectional regressions.

[25] We could restrict some of the coefficients to be time invariant if they seemed to be stable over time.

[26] It is possible to interpret $\beta_t^j (K_i/A_i)^*$ obtained by expanding the expression in brackets on the right hand side of equation (1) as the time-variant response of bank lending to the *observed* bank specific fixed effect. Theoretically, one could model the time-variant response of bank lending supply to a standard unobservable fixed effect, which is incorporated in the regression equation as a time dummy, and identify the time-variant response and the fixed effect. One could then test whether the "restricted" model with the estimated target outperforms the "unrestricted" model with the unobserved fixed effect by using, say, the log likelihood principle. In order for us to be able to use standard test statistics to compare the two sets of regression results, instruments have to be shared between the two. Since bank dummies have to be included in the "unrestricted" model to ensure the high dimension of the set of instruments, they have to be in the original model as well, but the inclusion of bank dummies as instruments in the "restricted" model resulted in implausible estimates. Developing a new testing strategy will be an interesting topic for future research.

[27] It effectively overcomes the drawback of the classical approach in the literature of using lagged

Ueda (2000) and Hoshi (2001) find that the tilt in a bank's portfolio toward the real estate industry in the 1980s best accounts for the size of the NPLs of that bank in the late 1990s. In response to the loss as customers of long-standing large *keiretsu* firms -- which were beneficiaries of the financial liberalization (deregulation) and turned to financial markets to raise needed funds -- banks implemented a structural reorganization of their customers giving more weight to real estate companies in the expectation that land prices would keep going up.[28] When the land-price bubble burst, a considerable portion of real estate lending became bad loans and were recognized as NPLs on the bank's financial statements in the late 1990s, thereby reducing their capital.

The banks' behavioral responses to the deregulation of the mid-1980s are exogenous to the demand-supply system of bank lending in the 1990s, and thus REAL89 is independent of the error term in the lending supply function (1). The instrumental variable regression with REAL89, therefore, picks up the banks' responses to the loss of bank capital arising from their structural behavioral change in the 1980s and nets out the effect of concurrent business cycles (demand side) factors.[29] REAL89 is strongly negatively correlated with capital "surpluses" since FY 1995 (Table 1).

[Insert Table 1 about here.]

"predetermined" variables that cannot provide an economic explanation of bank capital and whose correlation with bank capital is not guaranteed. See Peek and Rosengren (1995) and Ogawa and Kitasaka (2000). Peek and Rosengren (1995) adds a current change in equity capital to lagged variables, as instruments.

[28] For more on the Japanese financial liberalization, see Hoshi and Kashyap (2000)

[29] REAL89 is meant to capture large drops in land prices due to the burst of the bubble that preceded the large loss of bank capital in the late 1990s. A large loss of capital stemming from falls in land prices had occurred in FY 1997 when regulators urged banks to write off NPLs. Changes in land prices in the late 1990s were minor relative to the bust of the land price bubble that had occurred earlier. For instance, land prices in Tokyo fell by 38 percent over the five-year period FY 1991-1995, whereas it fell by only 9 percent over the three-year period FY 1997-1999. Thus, changes in land prices do not cause serious problems when interpreting the results of instrumental variable regressions in different years. One way to take account of changes in land prices in the late 1990s is to use the product of REAL89 and a contemporaneous land price as an instrument. However, REAL89 multiplied by land price, has less explanatory power as an instrument for bank capital.

To REAL89, we also add as an instrument the 10-year growth of each bank's lending share to the real estate industry since FY 1980 to REAL89.[30]

4. Results

Regression results

Table 2 shows the estimates of the coefficient of the contemporaneous capital "surplus", β, from the 2SLS regression of equation (1) based on panel data on banks for the FY 1995-2000 period. The first row presents the results for bank lending to "troubled" industries not closely related to the real estate industry; the industries included are wholesale and retail and service. The second row labeled "non-troubled (2)" presents the results for bank lending to healthy non-manufacturing industries that were little burdened by NPLs (agriculture, mining, financial and insurance, transportation and communications, and utilities). The third row labeled "non-troubled (3)" presents the results for bank lending to healthy non-manufacturing industries excluding the financial and insurance industry (agriculture, mining, transportation and communications, and utilities).[31]

[Insert Table 2 about here.]

The estimated coefficient of the contemporaneous capital "surplus" is positive and weakly significant in the case of "troubled" industries and is not statistically significant in the case of the lending supply to "non-troubled" industries in FY 1996. In FY 1997 the estimated coefficient is

[30] In addition, the following are included as a set of instrumental variables; constant, predetermined variables including lagged and twice lagged loan growths, lagged and twice lagged interest rate differentials constructed as earned interest rates less the prime rate divided by loans, and other lagged variables including twice, three times, and four times lagged deposit growth rates, and lagged and twice lagged growths of the land price of the prefecture in which the headquarters of a bank is located. 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).

[31] Some non-banks are said to have engaged in intensive real estate related lending. Though presence of NPLs to the financial and insurance industry is not outstanding in the data, we present the results on the healthy non-manufacturing industries excluding the industry to check the robustness of the results.

positive and statistically significant for the lending supply to both groups of industries, though the point estimate is substantially larger for "non-troubled" industries than for "troubled" industries.[32] The coefficient is estimated to be larger for "non-troubled" industries than for "troubled" industries in FY 1998, although it is not significant in the case of "non-troubled" industries when the financial and insurance industry (FII) is excluded.[33]

The issue of the timing of events

The regulator's official announcement of the rigorous assessment framework of bank assets was published on March 5th, 1997, about a year before the end of fiscal year 1997. Banks knew a year in advance that a large loss of capital was inevitable at the end of fiscal year 1997. Regression equations with a lagged capital to asset ratio were also examined. Just as the coefficient of the contemporaneous ratio is significant and positive, so generally is the coefficient of the lagged ratio. As the constructed capital "surplus" is a stock of capital less a time invariant target, it is strongly serially correlated. Besides, an overidentification test rejects the null hypothesis at the 10 percent level for the lag specification for troubled lending in fiscal year 1997.

In fact, in regressions with both lagged and contemporaneous ratios, the coefficients of the lagged ratios are not statistically significant in any fiscal year. It is a common regulatory practice to announce actions before the close of the fiscal year so that banks act accordingly toward the fiscal year end. Furthermore, every announcement generally is followed by lengthy parliamentary discussions. Thus, our finding that contemporaneous capital rather than lagged capital influences the supply of loans does not contradict the timing of events.

[32] The OLS estimator provides statistically significant but substantially smaller point estimates of coefficients than does the 2SLS estimator in fiscal years 1996 and 1997 and insignificant estimates in FY 1998. (Results are not shown.)

[33] Regressions that include time effects (time-variant constant) and the time-variant coefficient of the capital "surplus" but that leave other coefficients time invariant result in qualitatively similar results. The LR tests do not reject such restrictions on coefficients. (Results are not shown.)

Aggregate impact of bank capital

Table 3 compares *actual* aggregate growth rates of loans to "troubled" industries and to "non-troubled" industries over a six year period from FY 1995.[34] Loans to "non-troubled" industries excluding the financial and insurance industry kept rising whereas loans to "troubled" industries kept falling until FY 1996.[35] In FY 1997, however, bank loans began to gravitate toward "troubled" industries. In fact, though both loans to "non-troubled" industries excluding the financial and insurance industry and loans to "troubled" industries fell two years in a row in FY 1997 and FY 1998, the percentage drop in the former was slightly larger than the percentage drop in the latter.

[Insert Table 3 about here.]

Table 4 compares the *estimated* aggregate growth rates of the lending supply to "troubled" industries and to "non-troubled" industries induced by the banks' capital positions. Each entry aggregates the third term in (1) $\beta^j_t \{K_{it}/A_{it} - (K_i/A_i)^*\}$. The corresponding point estimate from Table 3 is used for β^j_t and asset size is used as a weight. The number measures the aggregate impact of the banks' capital positions on the bank lending supply in each year.

The actual capital to asset ratio fell short of the target on average (aggregate capital "shortage") in fiscal years for 1995, 1996, and 1997, and the actual ratio exceeded the target (aggregate capital "surplus") thereafter.[36] Therefore, the greater value for "troubled" industries (-4.7 percent) than for "non-troubled" industries (-8.5 percent if they *include* FII, and –7.4 percent if they *exclud*e it) in FY 1997 strongly suggests that the banking industry as a whole

[34] The data are constructed from the micro data of banks included in the sample of the panel data estimation; thereby making them comparable to the aggregate supply side effects of bank capital on lending that are computed based on the estimation of equation (1).

[35] The clean up of loans to *jusen* companies is the most likely cause of a positive growth of loans to "non-troubled" industries *including* the financial and insurance industry and a negative growth of loans to "non-troubled" industries *excluding* it in FY 1995 and FY 1996.

[36] A sign of the aggregated capital "surplus" coincides with the sign of the value in the first row of Table 4 because as shown in the first row of Table 2, the coefficient of the contemporaneous book-based capital asset ratio for lending to "troubled" industries is positive in all fiscal years since FY 1995.

engaged in *evergreening* in response to a large loss of capital. Slightly larger values for "non-troubled" industries than for "troubled" industries in the previous year (FY 1996) could be evidence of the banks' *flight to quality*. Larger values for "non-troubled" industries in FY 1998 could be evidence of a positive allocative effect of the large public capital injection. Compared with Table 3, it is only in FY 1997 that the distribution of loan growth across "troubled" and "non-troubled" industries is strongly attributable to the banks' capital positions.

[Insert Table 4 about here.]

Testing reallocation of lending portfolio

We attempt a formal statistical test to compare the lending supply to "troubled" industries with that to "non-troubled" industries. The regression equation used is obtained by subtracting equation (1) for "non-troubled" industries ($i=nt$) from that for "troubled" industries ($i=tr$) and is estimated by 2SLS with the set of instrumental variables employed being the union of the instruments used when estimating equation (1) for both "troubled" and "non-troubled" sectors. REAL89 remains to play a key role as an identifier.

$$\Delta \ln L_{1t}^{tr} - \Delta \ln L_{it}^{nt} = (\alpha_0^{tr} - \alpha_0^{nt}) + \alpha_1^{tr} \Delta \ln L_{1t-1}^{tr} - \alpha_1^{nt} \Delta \ln L_{it-1}^{nt} + (\beta^{tr} - \beta^{nt}) \left[\frac{K_{it}}{A_{it}} - \left(\frac{K_i}{A_i} \right)^{target} \right] + (\gamma^{tr} - \gamma^{nt}) X_i + (\varepsilon_{it}^{tr} - \varepsilon_{it}^{nt}) \quad (2)$$

The estimation results are presented in Table 5-1. Our interests are in estimates of β^{tr}-β^{nt} in FY 1996 and FY 1997 when banks failed to achieve their targets as an industry. Though statistically insignificant, the point estimate of β^{tr}-β^{nt} is positive ($\beta^{tr}>\beta^{nt}$) in FY 1996. This may imply the presence of portfolio reorganization toward "non-troubled industries" (*flight to quality*). In FY 1997, in sharp contrast to the result of one year earlier, β^{tr}-β^{n} is estimated to be negative ($\beta^{tr}<\beta^{nt}$). The estimate is statistically significant at the 5 percent significance level when

"non-troubled" industries *exclude* FII. Banks reorganized their lending portfolios from (unquestionably) healthy industries to unhealthy industries. In FY 1998, a year of capital recovery, the coefficient is negative and significant only at the 10 percent level when "non-troubled" industries *include* FII and is insignificant when "non-troubled" industries *exclude* FII.[37, 38] The complete estimation results of equation (2) are presented in Tables 5-2 ("non-troubled" industries *including* FII) and 5-3 ("non-troubled" industries *excluding* FII).[39]

[Insert Tables 5-1, 5-2, and 5-3 about here.]

Only undercapitalized banks practiced *evergreening*

The theory predicts that undercapitalized banks whose actual capital to asset ratio does not meet their target have a strong incentive to *evergreen* firms in "troubled" industries. Adequately capitalized banks, on the other hand, are less likely to have such a perverse incentive.[40] Table 5-4 presents the results of the cross section regressions of equation (2) for banks that are adequately capitalized relative to their target and for banks that are undercapitalized relative to their target in FY 1997. The obtained results strongly support the assertion that *evergreening* was practiced by undercapitalized banks in FY 1997. The estimate of β^{tr}-β^{nt} is negative and statistically significant at the 1 percent level when "non-troubled" industries exclude FII for undercapitalized banks. This significant and positive estimate is much larger than the

[37] In FY 1999, in turn, the coefficient is significant and positive when "non-troubled" industries *exclude* FII. This results from the negative and insignificant coefficient for "non-troubled" industries and the positive and insignificant coefficient for "troubled" industries in FY 1999 on Table 2.

[38] "Partial squared correlation coefficients," developed by Shea (1997) to test the strength of the set of instruments employed to explain a capital "surplus", were high, which build further confidence in the employed instrumental variables.

[39] Regressions are estimated using panel data on banks for the FY 1995-2000 period. Regressions that include time effects (time-variant constant) and the time-variant coefficient of the capital "surplus" but that leave other coefficients time variant result in very high standard errors for coefficients. None of them is statistically significant at the 10 percent level although the LR tests do not reject such restrictions on coefficients. (Results are not shown.)

[40] According to the credit crunch and ever-greening hypotheses we have considered, banks that meet their capital target are not constrained to their capital in supplying loans. If the bank specific target is observed (precisely estimated without an error) and the hypotheses are correct, β^{tr}-β^{nt} would be significant only for banks that are undercapitalized relative to their target.

significant and positive estimate for the entire sample presented in Table 5-1, which makes sense, as the estimate of β^{tr}-β^{nt} is not statistically significant for adequately capitalized banks. These findings strongly support our hypothesis that only undercapitalized banks *evergreened* firms in "troubled" industries in FY 1997.

[Insert Table 5-4 about here.]

Interpretation of empirical results

To our surprise, the banks did not reduce their lending supply to unhealthy industries as much as they did to healthy industries in FY 1997 when the regulator's tougher stance (i.e. their request for a more rigorous assessment of the banks' assets) towards banks resulted in a large loss of bank capital and the banks' lending decisions were constrained to inadequate capital positions. According to our estimates, while the supply of loans to healthy non-manufacturing industries induced by the undercapitalization of banks contracted by 7 to 9 percent, the supply of loans to unhealthy non-manufacturing industries declined by less than 5 percent.[41] The extent that a fall in lending supply to unhealthy industries exceeded a fall in lending supply to healthy industries is statistically significant for banks that failed to achieve their individual target but is insignificant for banks that are adequately capitalized. This is the evidence that not only strengthens the *evergreening* hypothesis but also justifies our method of estimating targets.

Knowing that they would fail to meet their capital targets at the end of the fiscal year, the banks had to depress loans on their balance sheets during the course of FY 1997. In doing so, banks were not as keen on lending to healthy borrowers as they were on unhealthy borrowers, as cutting back on lending to distressed firms would result in more recognized non-performing loans and then further deteriorate the banks' capital positions. Banks responded to the *capital*

[41] Since there are a greater number of write offs of NPLs in "troubled" industries and disposal of NPLs reduces both loans and capital equally, the disparity in *new* lending between "troubled" and "healthy" industries must be even more pronounced.

crunch by continuing to lend to questionable firms at the expense of the financial needs of healthy firms.

In contrast, the results for FY 1996 suggest the opposite of those for FY 1997-- a portfolio shift toward healthy industries in response to a minor capital loss, or a *flight to quality*. It is only when banks lose a large amount of capital and a fall below the regulatory minimum is a real threat does a perverse incentive to *evergreen* unhealthy firms arise. The *positive* capital shock resulting from the infusion of large amounts of public capital into large banks in FY 1998 seems to have assisted these banks in redirecting their lending portfolios toward healthy industries and seems to have had some effect on improving the quality of the lending supply.[42]

Our empirical evidence suggests that poorly capitalized banks intentionally *evergreened* unhealthy firms only in FY 1997. Admittedly, one of the disadvantages of our analysis originates from our advantage, use of REAL89 as an instrumental variable, which does not allow us to analyze the industry with the highest share of non-performing loans, the real estate industry itself. Were real estate lending to be included in our empirical framework, our evidence of *evergreening* in FY 1997 would be strengthened.

Our finding does not necessarily undermine the commonly held view by such authors as Peek and Rosengren (2005) and Caballero, Hoshi and Kashyap (2005) that misallocation of bank credit was a persistent problem during the post bubble period. Real estate loans grew steadily until FY 1997 when "non-troubled" non-manufacturing loans continued to fall.[43] Since bank capital was not seriously inadequate before FY 1997, banks must have had less incentive to assist firms with difficulties servicing their bank loans. Our guess is that banks kept up their real estate lending based on the ex-post false expectation that land prices would recover sooner or later.

[42] Public funds injected into the banking system amounted to 58,090 million yen. Funds were selectively supplied to larger banks, most of which were severely undercapitalized at the time of this action, and were effective in restoring the aggregate lending growth in the highly concentrated Japanese banking industry.

[43] Real estate loans from 126 banks in our sample grew 1.30 percent, 2.32 percent, and 3.12 percent in FY 1995, FY 1996 and FY 1997, respectively.

Policy implications

Our findings imply that under the current BIS regulatory framework known as Basel I, banks that fail to meet their individual capital target have a strong incentive to rebalance their lending portfolio toward unhealthy industries so that they are not forced to recognize and write off non-performing loans, which would further deteriorate their capital position. Under the revised regulatory framework known as Basel II, which will come into full effect at the end of fiscal year 2007, non-performing loans with a higher coverage of loan loss provisions are assigned lower risk weights than under the Basel I in order to encourage banks to (indirectly) write off NPLs.

Therefore, under the Basel II, greater loan loss provisions for recognized NPLs are compensated for by a reduction in the risk weighted assets, which should partially but not entirely offset the negative effect of recognizing NPLs in the BIS capital to asset ratio. Thus, an excessively tough regulatory stance to urge banks to conduct strict assessment of their assets remains to cause a negative shock to banks' regulatory capital adequacy. In our view, therefore, a bank's incentive to *evergreen* underperforming firms in response to a large capital loss will to some degree remain. In sum, a tougher policy should be accompanied by a simultaneous accommodating policy that would infuse public capital into banks. If large amounts of public capital infusion and tougher assessment of bank assets had been executed simultaneously in FY 1997, banks would not have engaged in *evergreening*.

5. Conclusion

In this paper, we estimated a bank lending supply function that is consistent with the dynamic optimization behavior regulated by the Basel framework using a valid instrument constructed by Watanabe (2005). We found that a large loss of bank capital caused by the regulator's tougher policy towards banks in FY 1997 not only caused the contraction of the bank lending supply but, more importantly, caused the banks' reallocation of their lending supply to

unhealthy industries with a higher concentration of non-performing loans (*evergreening*). This behavior is in sharp contrast to that of the same banks in the previous year, when they increased the weight of healthier industries upon finding themselves slightly short of their targets. Our empirical findings show that an excessively tough policy that causes a large loss of capital leads to inefficient financial support of unproductive firms and appears to be very harmful to the real sector as a whole.

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Figure 1. Non-performing loans and total loans by industry

Source: the BOJ (2001)

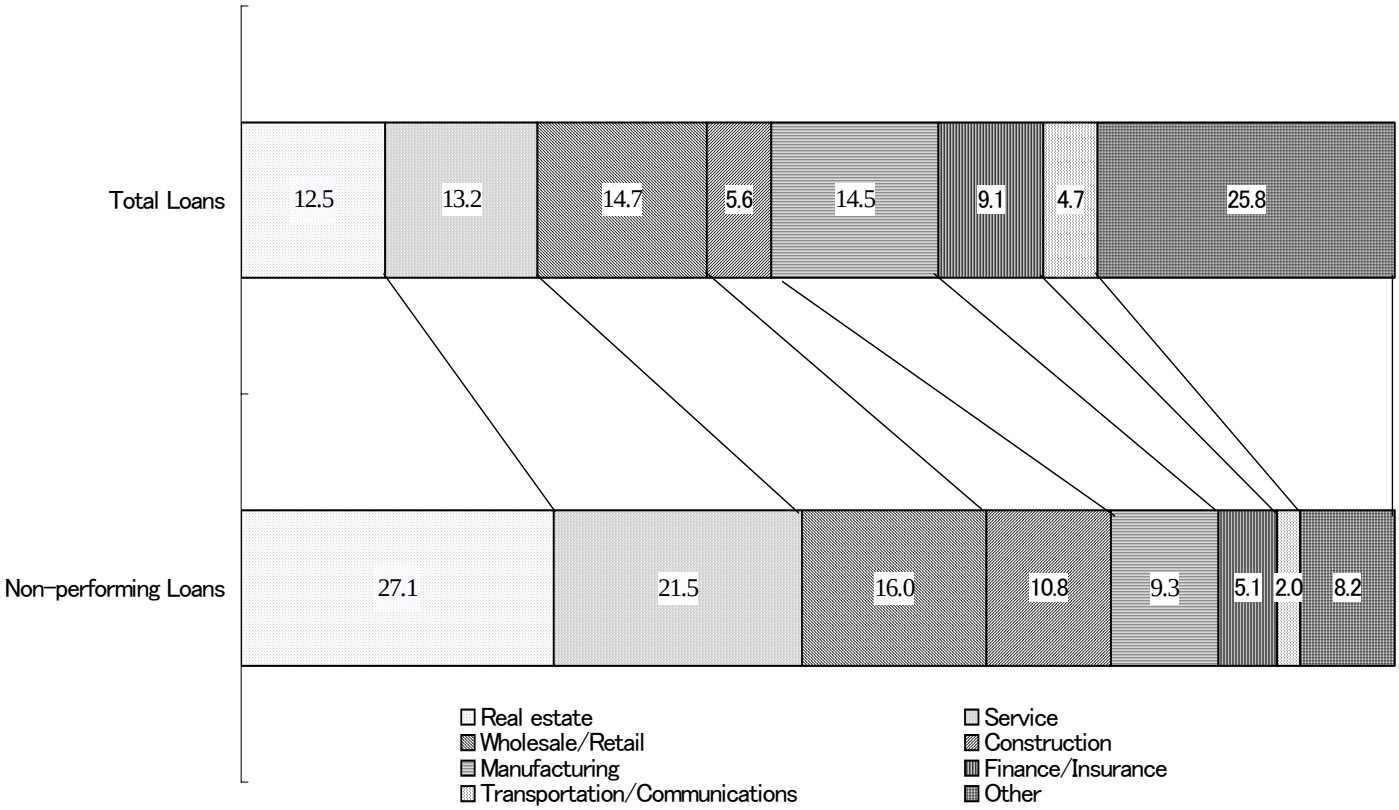


Figure 2. Domestic loan growth and capital asset ratio of domestically licensed banks

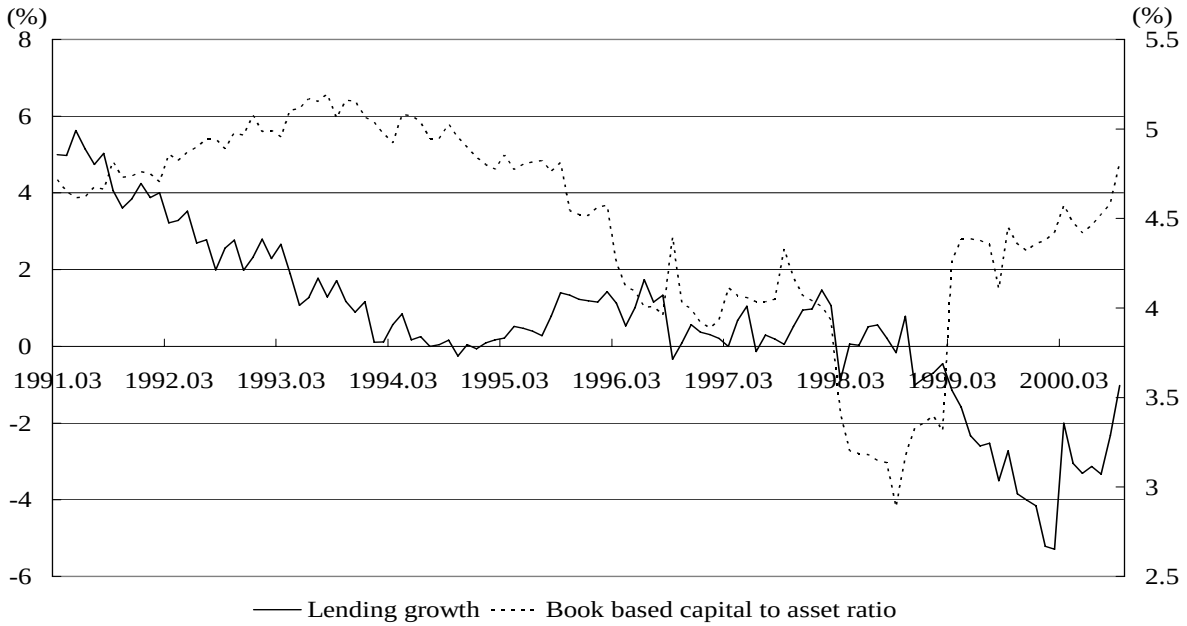
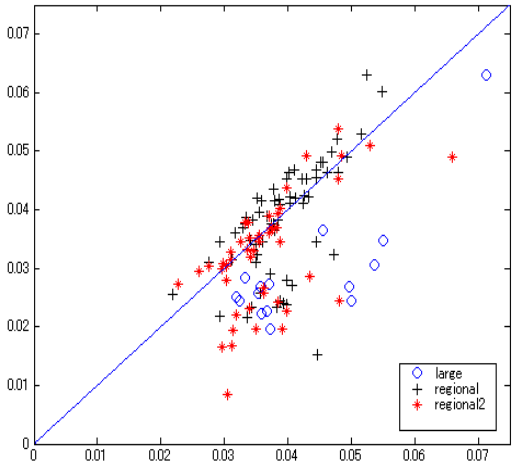
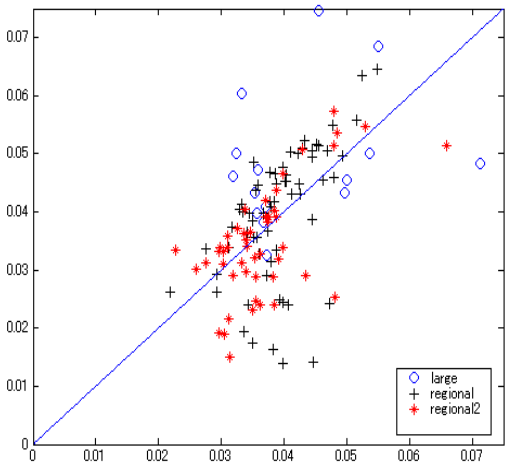


Figure 3 Target and actual capital asset ratios

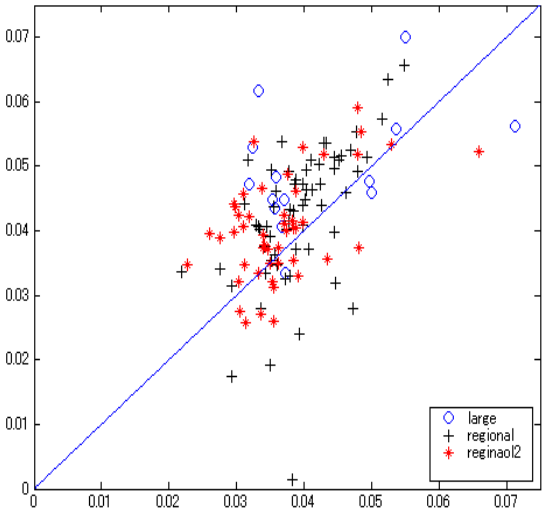
FY 1997



FY 1998



FY 1999



Note: The vertical axis represents the actual capital to asset ratio, and the horizontal axis represents the target ratio. Thus, banks above the 45-degree line are in shortage of actual capital relative to its target, whereas those below the 45-degree line are in surplus of actual capital relative to its target.
Blue circles, black crosses, and red crosses are large banks, regional banks, and regional 2 banks, respectively.

Table 1 Correlation coefficients of REAL89 and the capital "surplus"

1995	1996	1997	1998	1999	2000
-0.4607	-0.2767	-0.5345	-0.3443	-0.3214	-0.4358

Table 2 Year by year coefficients on the capital "surplus" for loan supply to "troubled" and "non-troubled" industries, all 126 banks

Group of industries	1995	1996	1997	1998	1999	2000
Troubled (1)	3.3626	2.5416	4.9944***	2.5271*	1.1473	1.3214
	(1.3375)	(1.6331)	(3.0530)	(1.8663)	(0.6810)	(1.3082)
Non- troubled (2)	3.5128	-2.0894	9.1686***	9.6862**	-2.7237	4.4350
	(0.4978)	(-0.4231)	(3.2830)	(2.3555)	(-0.7116)	(1.6671)
Non- troubled (3)	3.6581	2.1016	7.9786***	4.0622	-4.9156	0.9873
	(0.5396)	(0.5103)	(3.1913)	(0.9252)	(-1.4343)	(0.6455)

Note: *** shows 1%, **, 5%, and *, 10%, respectively, and t statistics computed with a robust standard error are in parentheses.
The financial and insurance industry is included in the "non-troubled" industries in the second row and is excluded in the third row.

Table 3 Aggregate lending growths to "troubled" and "non-troubled" industries, all 126 banks

Group of industries	1995	1996	1997	1998	1999	2000
Troubled (1)	-0.43	-1.51	-2.12	-2.61	-2.98	-2.56
Non- troubled (2)	-1.10	-4.65	-3.92	-5.41	4.08	-5.00
Non- troubled (3)	3.24	0.79	-2.56	-3.95	2.13	-3.57

Note: The financial and insurance industry is included in the "non-troubled" industries in the second row and is excluded in the third row.

Table 4 Estimated aggregate lending growths to "troubled" and "non-troubled" industries induced by the bank's capital positions, all 126 banks

Group of industries	1995	1996	1997	1998	1999	2000
Troubled (1)	-1.61	-1.06	-4.65***	1.00**	0.78	0.68*
Non- troubled (2)	-1.68	0.87	-8.54***	3.82**	-1.85	2.29**
Non- troubled (3)	-1.75	-0.88	-7.43**	1.60	-3.34	0.51

Note: *** shows 1%, **, 5%, and *, 10%, respectively, and t statistics computed with a robust standard error are in parentheses.
The financial and insurance industry is included in the "non-troubled" industries in the second row and is excluded in the third row.

Table 5-1 Year by year coefficients on the capital "surplus" in equation (2), all 126 banks

"Non-troubled"	1995	1996	1997	1998	1999	2000
Includes financial and insurance	4.2215	6.4602	-4.3578	-7.7444*	3.1321	-2.1843
	(0.5536)	(1.0336)	(-1.5255)	(-1.7897)	(0.8845)	(-0.8180)
Excludes financial and insurance	0.6162	4.1433	-5.7656**	-1.4617	6.9203**	2.5125
	(0.0873)	(1.1704)	(-2.1631)	(-0.3676)	(1.8522)	(1.0903)

Note: The financial and insurance industry is included in the "non-troubled" industries in the first row and is excluded in the second row.
*** shows 1%, **, 5%, and *, 10%, respectively, and t statistics computed with a robust standard error are in parentheses.

Table 5-2 Regression results of equation (2), "non-troubled" industries include the financial and insurance industry

Independent variable	1995	1996	1997	1998	1999	2000
Constant	0.0027	-0.0195	-0.0366	-0.0523**	-0.0284	-0.0218
	(0.2097)	(-1.3691)	(-1.4946)	(-2.0529)	(-1.1254)	(-0.8123)
Lagged growth of "troubled" lending	-0.1793	0.3056	-0.4372	0.2261	-0.0402	-0.1179
	(-0.6590)	(1.0215)	(-1.2020)	(0.5514)	(-0.1269)	(-0.3454)
Lagged growth of "non-troubled" lending	-0.0197	-0.2663***	-0.0791	0.1542	0.1145	0.1815
	(-0.1466)	(-2.1136)	(-0.5696)	(0.9934)	(0.7083)	(1.5539)
Capital "surplus"	4.2215	6.4602	-4.3578	-7.7444*	3.1321	-2.1843
	(0.5536)	(1.0336)	(-1.5255)	(-1.7897)	(0.8845)	(-0.8180)
CITY	-0.0077	0.1721*	-0.0536	0.1603**	-0.0897	0.1121
	(-0.1484)	(1.8732)	(-0.8778)	(1.9972)	(-0.9925)	(1.6738)
TRUST	0.0922	0.0529	-0.0226	0.0247	-0.0290	-0.0562
	(0.6402)	(0.5541)	(-0.2582)	(0.3891)	(-0.3707)	(-1.0030)
REGIONAL	0.0094	0.0307	0.0171	0.0687*	-0.0064	0.0030
	(0.5109)	(1.1062)	(0.6640)	(1.6331)	(-0.1968)	(0.0810)
J statistics 48.3256 (0.2326)	Number of observations 756					

Note: *** shows 1%, **, 5%, and *, 10%, respectively *** shows 1%, **, 5%, and *, 10%, respectively, and t statistics computed with a robust standard error are in parentheses.
The number shown in parentheses below J statistics is a p-value

Table 5-3 Regression results of equation (2), "non-troubled" industries exclude the financial and insurance industry

Independent variable	1995	1996	1997	1998	1999	2000
Constant	-0.0004	-0.0043	-0.0297	-0.0295	-0.0373*	-0.0370
	(-0.0248)	(-0.2744)	(-1.4925)	(-1.3663)	(-1.6910)	(-1.6122)
Lagged growth of "troubled" lending	0.1982	0.6163**	-0.0130	0.2369	-0.3788	-0.7806**
	(0.7567)	(2.4682)	(-0.0488)	(0.7412)	(-1.6655)	(-1.0565)
Lagged growth of "non-troubled" lending	-0.1152	-0.3039**	0.1441	0.0220	0.3836**	0.4366*
	(-0.8724)	(-2.5468)	(1.4241)	(0.1414)	(3.0214)	(1.7249)
Capital "surplus"	0.6162	4.1433	-5.7656**	-1.4617	6.9203*	2.5125
	(0.0873)	(1.1704)	(-2.1631)	(-0.3676)	(1.8522)	(1.0903)
CITY	-0.0697	0.0822	-0.0246	0.0877	-0.0193	0.1470**
	(-1.2851)	(1.1196)	(-0.4328)	(1.3150)	(-0.2439)	(0.5870)
TRUST	0.0534	-0.0294	-0.1272*	0.0084	-0.0162	-0.0665
	(0.3649)	(-0.6540)	(-1.9050)	(0.1351)	(-0.3040)	(-1.2221)
REGIONAL	-0.0416**	-0.0568**	-0.0325	0.0173	-0.0192	-0.0191
	(-1.9922)	(-2.6011)	(-1.4452)	(0.4724)	(-0.6985)	(-0.3633)
J statistics	38.1291 (0.6416)	Number of observations	756			

Note: *** shows 1%, **, 5%, and *, 10%, respectively *** shows 1%, **, 5%, and *, 10%, respectively, and t statistics computed with a robust standard error are in parentheses.
The number shown in parentheses below J statistics is a p-value

Table 5-4 Regression results of equation (2) for adequately capitalized and undercapitalized banks in FY 1997

"Non-troubled"	Includes financial and insurance		Excludes financial and insurance	
Capital position	Above the target	Below the target	Above the target	Below the target
Constant	-0.0085	-0.0577	0.0415	-0.0825***
	(-0.1644)	(-1.0098)	(1.0755)	(-2.8399)
Lagged growth of "troubled" lending	-0.4217	-0.4358	-0.5815	0.1738
	(-0.7253)	(-1.0036)	(-1.5349)	(0.4402)
Lagged growth of "non- troubled" lending	0.0941	0.2389	0.6044	0.1706*
	(0.4484)	(1.1853)	(4.0666)	(1.8227)
Capital "surplus"	-9.8230	-3.9658	-12.3342	-9.3051**
	(-0.5738)	(-0.6886)	(-0.8836)	(-2.4681)
CITY		0.0378		0.0149
		(-0.5613)		(0.3229)
TRUST		0.0804		-0.1021*
		(0.8760)		(-1.8084)
REGIONAL	0.0017	0.0505*	-0.0986***	-0.0421*
	(0.0420)	(1.7423)	(-2.8237)	(-1.7593)
J statistics	9.6132	5.6419	5.8910	4.1440
	(0.3827)	(0.5821)	(0.7508)	(0.7631)
Number of observations	57	69	57	69

Note: *** shows 1%, **, 5%, and *, 10%, respectively *** shows 1%, **, 5%, and *, 10%, respectively, and t statistics computed with a robust standard error are in parentheses.
The number shown in parentheses below J statistics is a p-value
CITY and TRUST are dropped for banks whose capital to asset ratio is above the target, since all such adequately capitalized banks are regional banks or regional 2 banks