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The effectiveness of bank recapitalization policies in Japan[☆]

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Abstract

This study examines the effectiveness of bank recapitalization policies in Japan. Based on a reading of the “business revitalization plan” submitted by banks requesting government funds, we identify four primary goals for the capital injection plan in Japan: (1) to increase the bank capital ratios; (2) to increase write-offs of non-performing loans; (3) to increase lending, in particular to small and medium enterprises, in order to avoid a “credit crunch”; (4) to encourage restructuring. Using a panel of individual bank data, we empirically estimate the effectiveness of the Japanese government policy of public fund injection in achieving the first three of these stated goals. Our empirical analysis reveals that, in general, the capital injections into the large internationally active banks were more effective than those into the smaller domestic banks in Japan. In addition, the second round capital injection, administered in 1998, was more effective than the first round, administered in 1997. The first capital injection in 1997 mostly served as a stop-gap measure to help the large international banks clear the 8% capital adequacy ratio (BIS ratio) required under the Basel Accord and did not make much contribution to the other policy objectives. The second round of capital injections in 1998 were more effective, boosting capital adequacy ratios for the domestic as well as international banks and supporting other policy objectives as well by stimulating banks to write off bad loans and increase domestic lending, in particular to small and medium enterprises.

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1. Introduction

In recent years, Japanese taxpayers have spent over 10 trillion yen, or 2% of Japan's nominal GDP, in capital injections into the country's troubled banking sector. Were the capital injections effective? Despite widespread skepticism at first, many factors point to the conclusion that the government bailout was a success. Panic and large-scale bank runs were successfully avoided, the banks have finally dealt with almost all of their bad loans, and the preferred stock held by the government as part of the capital injection plan has actually increased in value.

Did the government's capital injections bring about the improvements in Japan's banking industry? There is clear empirical evidence that capitalization affects the behavior of Japanese banks. [Montgomery \(2005\)](#) demonstrates that although both domestic and international banks are insensitive to overall regulatory capital, lending by international banks is highly sensitive to core capital. [Ito and Sasaki \(2002\)](#) show that banks with lower capital ratios tended to issue more subordinated debts and to reduce lending overall and [Peek and Rosengren \(1997\)](#) found evidence of the international transmission of negative capital shocks to U.S. loan markets. In later research, [Peek and Rosengren \(2005\)](#) and [Watanabe \(2004\)](#) found evidence that negative shocks to bank capital result in a shift to lower quality loan portfolios. Recent studies seem to have reached the consensus that a serious industry wide credit crunch occurred in FY1997, the peak of the banking crisis in Japan (see [Motonishi and Yoshikawa, 1999](#); [Woo, 2003](#); [Watanabe, 2005](#)), and that the credit crunch was particularly hard on smaller firms ([Miyajima and Yafeh, 2007](#)).²

Despite the large amounts of money at stake, there has been no quantitative research specifically examining the effectiveness of capital injections. This study aims to inform the policy debate on how best to deal with systemic weakness in the banking sector. Thus, this study holds important policy implications, not only for Japan, but also for other countries facing similar banking sector problems. In the wake of the Asian Crisis of 1997, governments throughout the region have allocated huge amounts of public funds to bail out troubled financial institutions.

Based on a reading of the "business revitalization plan" submitted by banks requesting government funds, we identify four primary goals of the capital injection plan in Japan: (1) to increase the bank capital ratios; (2) to increase write-offs of non-performing loans; (3) to increase lending, in particular to small and medium enterprises, in order to avoid a "credit crunch"; (4) to encourage bank restructuring. Using a panel of individual bank data, we empirically estimate the effectiveness of the Japanese government policy of public fund injection in achieving the first three of these stated goals.

This paper is organized as follows: Section 2 briefly outlines the most recent history of Japan's banking sector crisis and Section 3 catalogues the policy response, focusing on the government's decision to inject public funds into the banking sector. Section 4 explains the mechanisms by which capital injections may influence bank behavior. Section 5 describes the data and empirical specification as well as the results of our regression analysis. Section 6 concludes.

² In addition to the studies cited above, readers may see the following related papers: [Baba \(1995\)](#), [Honda \(2002\)](#), [Ueda \(1993\)](#) and [Yoshikawa and Ike \(1994\)](#).

2. Japan's banking sector in crisis

Although warning signs had been evident much earlier,³ the weakness in the Japanese financial sector reached a crisis in 1997. The first to fail was Sanyo Securities, a mid-sized securities company that folded on November 3, 1997. The next failure was even larger. Hokkaido Takushoku Bank failed on November 17, 1997,⁴ costing the Deposit Insurance Corporation (DIC) 3411 billion yen, more than the 2514 billion yen that had been used in all the DIC's previous history. One week later, on November 24, 1997, Yamaichi Securities, one of Japan's oldest and largest brokerage firms, followed suit. Only 2 days after that, on November 26, 1997, Tokuyo City Bank, a small regional bank, collapsed.

The following year, two other "top 20" banks were nationalized. The Long-Term Credit Bank of Japan was placed under state stewardship on October 23, 1998 and Nippon Credit Bank followed on December 13 of the same year. The DIC acquired all outstanding shares of both banks and provided credit to them to continue operating.⁵

All of these institutions had previously been considered "too big to fail". The three banks were ranked among the nations "top 20" banks, which dominated the lending markets, and Yamaichi was one of the top four securities houses, which together had accounted for over 70% of the securities business. These failures marked the end of the traditional "convoy system" safety net. The news led to a sell off of bank shares on the stock market and the emergence of the so-called "Japan Premium" in overseas lending markets.

3. Policy response: 1998–1999

In February 1998 the Diet responded to the financial crisis with the Financial Function Stabilization Plan⁶ which allocated 30 trillion yen to the DIC. Seventeen trillion yen was for a Special Operations Account, to supplement the already established General Account in order to provide full deposit protection of insolvent banks. The remaining 13 trillion yen went to a newly established Financial Crisis Management Account.

The Financial Crisis Management Account funds were dispersed in a capital injection of all 19 of the top city, trust and long-term credit banks at the close of fiscal year 1997 (March 1998). In total, 1.8 trillion in capital was given out in the form of purchases of preferred stock, subordinated debt, or as a subordinated loan (see Table 1 or Nakaso, 1999, for details). Many banks were reluctant to apply for the funds, fearful of the message it would send to the market, so all banks were pressured to apply for the same amount of capital. Even Tokyo-Mitsubishi bank, which did not want to apply for a capital injection, was pressured to apply for the standard 100 billion yen. Regional banks – Yokohama Bank, Ashikaga Bank and Hokuriku Bank – applied for smaller capital injections. Since subordinated debt, subordinated loans and preferred stock count toward

³ Several small financial institutions failed between 1992 and 1997 and by the end of 1997, 16 credit cooperatives, *shinkin* (open credit union) banks, and regional banks had failed and mergers had been arranged with healthier institutions under the so-called "convoy system". Then, in October 1995 it was reported that all seven of Japan's *jusen* (home mortgage companies) were completely insolvent. Under a controversial resolution scheme, these losses were also largely passed on to large financial institutions.

⁴ Actual grant and asset purchase by the DIC took place in October of 1998.

⁵ Actual grant and asset purchase by the DIC took place in August and October of 1999. LTCB was later re-privatized as Shinsei Bank and NCB as Aozora Bank.

⁶ This included two laws to stabilize the financial system, including the Financial Function Stabilization Law.

Table 1
Details on capital injections

Bank name	Amount of capital injection (billion yen)	...as a % of bank assets	...of which Tier I	...of which Tier II
1997 (international banks)				
Asahi	100	0.34		100
Chuo Trust	60	1.62	32	28
Daiichi Kangyo	99	0.18	99	
Daiwa	100	0.60		100
Fuji	100	0.20		100
Industrial Bank of Japan	100	0.22		100
Mitsubishi Trust	50	0.28		50
Mitsui Trust	100	0.83		100
Sakura	100	0.19		100
Sanwa	100	0.19		100
Sumitomo	100	0.17		100
Sumitomo Trust	100	0.64		100
Tokai	100	0.31		100
Tokyo Mitsubishi	100	0.12		100
Toyo Trust	50	0.61		50
Yasuda Trust	150	1.83		150
1997 (domestic banks)				
Ashikaga	30	0.51		30
Bank of Yokohama	20	0.18		20
Hokuriku	20	0.30		20
1998 (international banks)				
Asahi	500	1.75	400	100
Chuo Trust	150	2.88	150	
Daiichi Kangyo	900	1.71	700	200
Daiwa	408	2.63	408	
Fuji	1000	2.16	800	200
Industrial Bank of Japan	600	1.43	350	250
Mitsubishi Trust	300	1.77	200	100
Mitsui Trust	400.2	4.24	250.2	150
Sakura	800	1.69	800	
Sanwa	700	1.47	600	100
Sumitomo	501	0.97	501	
Sumitomo Trust	200	1.37	100	100
Tokai	600	1.98	600	
Toyo Trust	200	2.53	200	
1998 (domestic banks)				
Bank of Yokohama	200	1.80	100	100
1999 (domestic banks)				
Ashikaga	105	1.91	105	
Bank of the Ryukyus	40	2.85	40	
Hiroshima Sogo	40	1.93	20	20
Hokuriku	75	1.25	75	
Kumamoto Family	30	2.22	30	

Tier II⁷ capital in calculating the capital to risk weighted asset ratio reported to the Bank for International Settlements (BIS), this helped many banks clear the 8% capital to risk weighted asset ratio required under the Basel Accord.

Even with the capital injection, many banks faced difficulty in meeting the 8% capital requirement, so authorities also implemented several other changes. Accounting standards were relaxed in fiscal year 1997 in order to boost the banks' reported capital.⁸ In April 1998 (the start of fiscal year 1998), the "Law to Ensure the Soundness of Financial Institutions"⁹ – equivalent to the Prompt Corrective Action (PCA) measures in force in the United States since the late 1980s – was introduced. In June 1998, the Financial Supervisory Agency (FSA) was established. The FSA took over the supervision of banks, securities firms and insurance companies from the Ministry of Finance. The FSA also took over the supervision of *shinkin* banks, a type of open credit union, from the Regional Financial Bureaus and the supervision of credit cooperatives from the prefectural governments. In the Fall of 1998 the FSA conducted full-scale on-site bank examinations of all the major banks. The Agency concluded that the self-assessment of asset quality undertaken by the banks in March 1998 was based on overly optimistic assumptions and that both the major banks and regional banks had significantly understated their non-performing loans.

In response to these findings, in October 1998, after months of deliberation in a special "Financial Diet Session", the Diet approved another plan to deal with the problems in the banking sector. The Financial Revitalization Plan¹⁰ doubled the amount of funds allocated to dealing with the crisis to 60 trillion yen. The 60 trillion yen was earmarked for three separate

⁷ Dated (more than 5 years) subordinated debt, subordinated loans and preferred stock count as Tier II capital. Perpetual preferred stock and subordinated debt count as Tier I capital. In recent years, some short term (more than 2 years but less than 5 years) subordinated debt has been counted as Tier III capital.

⁸ Banks were given the option of using either fair value accounting, the lower of book or market value method, or book value. This meant that banks did not necessarily have to report losses on securities held in their trading account on their balance sheets. Secondly, banks were allowed to count 45% of revalued land holdings toward Tier II capital. Although land prices were substantially lower than during the bubble period, most land held on the banks' balance sheets still carried a market value much higher than the historical cost.

⁹ This law has two main components. First, the law defines a self-assessment process whereby banks value assets themselves according to well-defined guidelines. These findings are subject to review by external auditors and bank examiners. These new "risk asset" categories are broader than the non-performing loan categories used by the Japanese Bankers Association since 1993 (see appendix for details). Secondly, the law specifies capital thresholds under which regulators can order banks to take remedial action ranging from a forced reduction in the number of branches to liquidation.

¹⁰ The Financial Revitalization Plan included 4 new laws, two of which were the "Financial Function Reconstruction Law" and the "Early Strengthening Law". The "Financial Function Reconstruction Law" is officially called the Law Concerning Emergency Measures for the Reconstruction of the Function of the Financial System and the "Early Strengthening Law" is officially called the Law Concerning Emergency Measures for the Early Strengthening of the Financial Function. The Financial Revitalization Plan also legislated the merger of the Resolution and Collection Bank (RCB), which had been overseeing the liquidation of the assets of failed credit cooperatives, with the Housing Loan Administration Corporation (HLAC), which had been dealing with the remaining bad assets of the *jusens*, into the Resolution and Collection Corporation (RCC), a public asset management company. The RCC had an expanded mandate allowing it to purchase bad loans from solvent financial institutions as well as failed banks. Under the Financial Revitalization Plan, the Financial Revitalization Commission (FRC) was established under Prime Ministers Office to oversee bank restructuring. Restructuring followed one of two courses: the bridge bank scheme or nationalization. Under the bridge bank scheme, the troubled bank was to be operated by public administrators as a bridge bank until a successor bank could be found. This system was used in closing smaller banks such as the Koufuku Bank, Kokumin Bank, Tokyo Sowa Bank and Namihaya Bank, all of which went into bankruptcy in 1999. The nationalization scheme was used for larger bank failures, such as the Long Term Credit Bank of Japan and Nippon Credit Bank. In these cases, the banks were temporarily nationalized, with the DIC purchasing all shares and operating the bank until it was ready to resume business as a new bank. The FRC was due to complete its task by 2001 and closed on January 6, 2001.

accounts within the DIC. Seventeen trillion yen went to the Special Operations Account to supplement the already established General Account in order to provide full deposit protection of insolvent banks. The Financial Reconstruction Account, which received 18 trillion yen, was to be used for the purchase and collection of assets in liquidating or nationalizing insolvent banks. Finally, the Early Strengthening Account replaced the Financial Crisis Management Account. The Early Strengthening Account, to be used in recapitalizing weak but solvent banks, received the largest endowment of 25 trillion yen.

The early strengthening account funds were used in a second round of capital injections in March of 1999 (the close of fiscal year 1998). Fourteen of the largest city, long term credit and trust banks, as well as Yokohama Bank, received a total of 7.5 trillion yen (US\$ 75 billion), 4 times that of the first capital injection in March of 1998.¹¹ As in 1998, the capital injection took the form of purchases by the DIC of preferred shares or subordinated debts or loans issued by the banks. Unlike the capital injection of 1998, the amount of the capital injection varied by bank and reflected the conditions of individual banks. To qualify for the capital injection, the FRC required each bank to submit a restructuring plan, which would be subject to quarterly review.¹²

In addition to the capital injections, regulations on consolidated balance sheet reporting were tightened in December 1998. Prior to that time, banks were required to consolidate in their financial reporting only those subsidiaries and affiliates in which they had more than a 50% or 20% stake, respectively. Under the new law, subsidiaries of banks and any company of which the bank group (a keiretsu with which the bank is associated) has more than a 40% stake must be consolidated in the financial reporting of the banks on a line by line basis. Thus, affiliation was more determined by influence than just strict share holdings. Bank affiliates and any company of which a bank or bank group has more than a 15% stake and whose decisions are controlled by the bank were required to consolidate using the “equity method” (not line by line). Consolidated reporting requirements applied to non-performing loan estimates as well. Prior to December 1998 banks had been able to use “related companies” to clean up their balance sheets. Banks could set up related companies which were neither subsidiaries nor affiliates, and transfer their non-performing loans to these related companies at above market value. These related companies were jointly owned by the banks (who owned less than 5% each) and the firms in the banks keiretsu with whom the bank also had interlocking shares.

Tightening of financial regulation continued in fiscal year 1999. In April 1999 the FSA extended the Prompt Corrective Action (PCA) framework to purely domestic banks without international operations. The FSA then conducted an inspection of regional banks in the Fall of 1999. As a result of this inspection, the FSA recommended the merger of Hanshin Bank and Midori Bank into Minato Bank. Four other regional banks – Namihaya, Kofuku, Kokumin and Tokyo Sowa – were found to be insolvent. They were operated by public administrators as a bridge bank until successor institutions were found. Two other regional banks, Niigata-Chuo Bank¹³ and Hokkaido Bank, were ordered to increase their capital in order to meet the 4% capital adequacy requirement.

¹¹ The Bank of Tokyo Mitsubishi did not apply for capital injection and instead made public its intention to pay off the subordinated debt issued by the government in March 1998.

¹² The restructuring plan was required to include a plan for raising new capital from the private sector. If, upon review, the FSA was not satisfied with the Banks’ progress, the FSA could convert its holdings of preferred stocks to common stocks after a certain grace period, the length of which is determined by the strength of the bank, and as largest shareholder could put pressure on management.

¹³ Niigata-Chuo Bank later failed and Hokkaido Bank was merged with another troubled regional bank, Hokuriku Bank.

Finally, mark-to-market accounting on all securities, including investment account securities, was introduced in fiscal year 2001. This forced banks to realize any hidden gains or losses on the equities held on their balance sheets and gave banks incentives to sell off unprofitable investments rather than keep the shares as a way to cement business ties.

The most recent trend in the Japanese Banking Sector has been consolidation. The old “top 20” banks have been consolidated into just 3 large groups: the Mizuho Financial Group, Sumitomo-Mitsui Financial Group and Mitsubishi-UFJ Financial Group.¹⁴

4. Capital injections and bank behavior

4.1. Regulation

Although bank managers may care about capital ratios for various reasons, capital ratios affect bank behavior primarily because of regulation. International banks are required to maintain a capital to risk-weighted asset ratio of at least 8%. This ratio, referred to as the “BIS” (Bank of International Settlements) ratio in Japan, is required not only of Japanese banks, but, under the Basel Accord of 1998, of most internationally active banks worldwide.

$$\text{BIS} = \frac{\text{Tier I} + \text{Tier II} + \text{Tier III} - \text{Goodwill}}{\text{RWA}}$$

Tier I, or Core Capital is basically shareholder’s equity, with some adjustment for goodwill. Tier I Capital includes perpetual preferred stock. Tier II Capital in Japan includes up to 45% of the latent capital gains banks hold on equities, 45% of any revaluation of land held on their books,¹⁵ up to 1.25% of General Loan Loss Provisions, Dated Preferred Stock and Dated Subordinated Debt dated at more than 5 years. Dated Preferred Stock and Subordinated Debt are counted at full value up to 50% of the value of Tier I capital. Tier III Capital includes short-term (more than 2 years but less than 5 years) subordinated debt. Risk Weighted Assets (RWA) are calculated as a weighted sum of assets held by the bank. “Riskless” assets such as government bonds, receive a 0% weighting, while “risky” assets such as loans, corporate bonds and equities receive a 100% weighting. Mortgages and local government bonds fall in between.

Domestic banks in Japan face a more lenient requirement of a 4% Ministry of Finance (MOF) ratio.

$$\text{MOF} = \frac{\text{Tier I} + \text{Tier II(MOF)} - \text{Goodwill}}{\text{RWA(MOF)}}$$

¹⁴ DKB, Fuji Bank, IJB and Yasuda Trust formed a holding company in September 2000 and merged into the Mizuho Financial Group in January 2003. The Sumitomo-Mitsui Financial Group, formed by the merger of Sumitomo Bank and Sakura Bank in April 2001, is of particular interest because the two main banks represent different *keiretsu* groups (the Sumitomo and Mitsui *keiretsu*). Mitsubishi-Tokyo Financial Group (MTFG) was established in April 2001 by Tokyo-Mitsubishi Bank and the merger of three trust banks: Mitsubishi, Nippon and Tokyo Trust October of the same year. The UFJ Group also formed a holding company in April 2001 and merged Sanwa, Tokai and Toyo Trust in April 2002. UFJ and Tokyo-Mitsubishi later merged in October 2005 to become the world’s largest bank as measured by assets. Daiwa and Asahi have also merged into Resona Bank in March of 2003, but Resona has since then failed.

¹⁵ Until fiscal year 2001 when the accounting standards were strengthened, land holdings were recorded at book value on the balance sheet and banks were able to choose between the book value or fair value (lower of book or market) method for recording the value investment account equity holdings on their balance sheets. Banks that chose the fair value method could count 45% of unrealized gains toward Tier II Capital.

Most components of the MOF ratio are calculated similarly to the BIS ratio for international banks, but Tier II Capital does not include latent capital gains on securities and short-term subordinated debt is not counted as Tier III capital.

In order to meet the capital adequacy requirements discussed above, banks can either adjust risk-weighted assets (the denominator) or capital (the numerator). It is generally easier and less costly for banks to adjust their risk-weighted assets. Thus, capital constrained banks may be inclined to substitute out of heavily weighted “risky” assets such as loans and equities into lower weighted assets such as government bonds. Or conversely, banks receiving a capital injection from the government may be inclined to shift their portfolios by shifting out of government bonds into loans.

4.2. Theoretical model of bank behavior

Our empirical analysis is motivated by a rational expectations model of bank behavior presented in [Montgomery \(2004\)](#), in which a representative bank maximizes the present discounted value of future profits. In this simplified model, the bank earns revenue on loans net of the costs of obtaining funds in the form of deposits. It is assumed that the bank views itself as a price taker, so interest rates earned on loans or paid on deposits are exogenously given at the prevailing market rate. The bank also earns a benefit for maintaining a high ratio of capital to assets relative to some target level. This benefit may depend upon the regulatory state. The banks’ capital stock is assumed to be exogenously given in each time period, so banks wishing to adjust their capital to asset ratio do so through loans. However, banks face adjustment costs on any changes to the rate of loan growth. A Taylor series approximation of the capitalization term yields an intercept term and a slope term, implying that banks react to changes in regulation or exogenous shocks to capitalization by adjusting the level of the target capital ratio and therefore the sensitivity of loan growth to capitalization. Other operating costs are assumed proportional to total loans and are absorbed in the loan adjustment costs term. Taking these revenues and costs into account, a representative bank chooses loans so as to maximize the expected present discounted value of its future stream of profits. This dynamic maximization yields an Euler equation for loan growth in terms of lagged loan growth, interest rates and capitalization – including injected capital – which will later be empirically estimated.

4.2.1. Revenues

Let a simplified bank balance sheet in which loans are the only asset and deposits the only liability,¹⁶ be represented by the following:

Assets	Liabilities
L	D
	K

where L is Loans, D Deposits, and K is Capital (Shareholders’ Equity), and shareholders’ equity is calculated according to the accounting identity $L - D = K$. Capital, K , and the interest rates on

¹⁶ This simplification incorporates the major elements of the aggregate bank balance sheet: loans, deposits and shareholders’ equity.

loans, r^L , and deposits, r^D , are assumed to be exogenously given in each time period t .¹⁷ The revenue of an individual bank at any given point in time is determined by the gross return on loans minus the amount paid for deposits.

$$R_{i,t} = r_t^L L_{i,t} - r_t^D D_{i,t} \quad (1)$$

or, substituting in the short run capital constraint:

$$R_{i,t} = (r_t^L - r_t^D)L_{i,t} + r_t^D K_{i,t} \quad (2)$$

4.2.2. Costs

There is some benefit, B , to high capitalization (a high capital to asset ratio), which may come in the form of decreased regulatory scrutiny, reputational benefits for existing equity holders, or simply the benefit of being able to make decisions on loan supply independent of capital constraints once the required capital ratio is cleared.

$$B_{i,t} = K_{i,t} h\left(\frac{K_{i,t}}{L_{i,t}}\right) \quad (3)$$

Although bank capital is assumed to be exogenously determined, banks can adjust the capital ratio, and therefore the costs or benefits associated with it, by adjusting loan growth. However, there are some adjustment costs A , associated with any change in loans:

$$A_{i,t} = L_{i,t} f\left(\frac{L_{i,t+1} - L_{i,t}}{L_{i,t}}\right) \quad (4)$$

The source of these costs when banks are increasing the rate of loan growth may seem fairly intuitive: the costs of hiring new staff or seeking out new borrowers. However, there may also be significant costs to cutting back on loans, the phenomenon that was observed during the credit crunch. These are costs associated with altering the time structure of the banks' portfolio, the increased risk of default when loans are called in early, or the costs of damage to a long-term business relationship when existing lines of credit are closed (loans are not rolled over).

As presented here, $h(\cdot)$ and $f(\cdot)$ are general, non-specified concave and convex functions, respectively. As stated above, the bank views the stock of capital, K , and interest rates, r_t^L and r_t^D as exogenously given. Banks select loans at time t in order to maximize expected present discounted value, π_t :

$$\begin{aligned} \max_{i,t} \pi_{i,t} = E_t \sum b^j & \left[(r_{t+j}^L - r_{t+j}^D)L_{i,t+j} + r_{t+j}^D K_{i,t+j} + K_{i,t+j} h\left(\frac{K_{i,t+j}}{L_{i,t+j}}\right) \right. \\ & \left. - L_{i,t+j} f\left(\frac{L_{i,t+j+1} - L_{i,t+j}}{L_{i,t+j}}\right) \right] \end{aligned} \quad (5)$$

where $0 < b < 1$ is the rate of discount.

¹⁷ The assumption that capital is exogenous is a short run simplifying assumption. Given the accounting identity, the assumption that capital is exogenously given in each time period amounts to an assumption that banks decide upon loans and then are able to obtain the necessary deposits to fund those loans at the prevailing market interest rate. Although there were fears of a flight to postal savings from bank deposits in response to the failure of several small credit cooperatives in the early 1990s, in 1995 the government announced a complete deposit guarantee through March 2001. Regarding exogenous interest rates: although banks' may in fact hold market power, it is assumed that they view themselves as price takers, and offer loans and deposits at prevailing market rates.

Maximization with respect to L_t yields the Euler equation:

$$\begin{aligned} E_t \left[(r_{t+j}^L - r_{t+j}^D) + h' \left(\frac{K_{i,t+j}}{L_{i,t+j}} \right) - L_{i,t+j-1} f' \left(\frac{L_{i,t+j} - L_{i,t+j-1}}{L_{i,t+j-1}} \right) \right] \\ = E_t \left[-b L_{i,t+j} f' \left(\frac{L_{i,t+j+1} - L_{i,t+j}}{L_{i,t+j}} \right) - b f \left(\frac{L_{i,t+j+1} - L_{i,t+j}}{L_{i,t+j}} \right) \right] \end{aligned} \quad (6)$$

If we let

$$h' \left(\frac{K_{i,t+j}}{L_{i,t+j}} \right) = \Phi \left(\frac{K_{i,t+j}}{L_{i,t+j}} \right) \quad (7)$$

$$-L_{i,t+j-1} f' \left(\frac{L_{i,t+j} - L_{i,t+j-1}}{L_{i,t+j-1}} \right) = \Psi(\Delta \log(L_{i,t+j})) \quad (8)$$

$$-b L_{i,t+j} f' \left(\frac{L_{i,t+j+1} - L_{i,t+j}}{L_{i,t+j}} \right) - b f \left(\frac{L_{i,t+j+1} - L_{i,t+j}}{L_{i,t+j}} \right) = Y(\Delta \log(L_{i,t+j+1})) \quad (9)$$

the Euler equation can be represented in the following log-linearized form:

$$E_t[\Delta \log(L_{i,t+j+1})] = E_t \left[\beta_1 \Delta \log(L_{i,t+j}) + \beta_2 (r_{t+j}^L - r_{t+j}^D) + \beta_3 \left(\frac{K_{i,t+j}}{L_{i,t+j}} \right) \right] \quad (10)$$

Replacing conditional expectations in the log-linearized Euler Eq. (10) with actual values yields an equation of the form:

$$\Delta \log(L_{i,t+j+1}) = \alpha_0 + \alpha_1 \Delta \log(L_{i,t+j}) + \beta \left(\frac{K_{i,t+j}}{L_{i,t+j}} \right) + \gamma (r_{t+j}^L - r_{t+j}^D) + \varepsilon_{i,t+j+1} \quad (11)$$

$\varepsilon_{i,t+j+1}$ is a rational expectations error term, which is serially uncorrelated and orthogonal to information available at time t . The expectation conditional on time t information, I_t , is, $E[\varepsilon_{i,t+1}|I_t] = 0$ suggesting that period t instruments are valid.

5. Empirical analysis

To evaluate the effectiveness of the capital injections made to banks in achieving the first three targets set out in the “business revitalization plans” – (1) to increase the bank capital ratios; (2) to increase write-offs of non-performing loans; (3) to increase lending, in particular to small and medium enterprises – we first empirically estimate an accounting identity for the regulatory capital ratio and then use the reduced form equation suggested by our model to estimate the impact of the capital injections on loan supply and the write-off of non-performing loans.

5.1. Empirical specification

The effectiveness of the capital injections on regulatory capital ratios is examined by estimating an accounting identity whereby capital in the current period is determined by capital in the last period, plus operating profits, minus bad loan write-offs. The effectiveness of the capital injections on the other policy variables is estimated using

the following reduced-form empirical specification, as suggested by the model presented above.

$$Y_{i,t+1} = K + AY_{i,t} + BX_{i,t} + \Gamma Z_{i,t} + \varepsilon_{i,t+1} \quad (12)$$

In Eq. (12), $Y_{i,t+1}$ represents the dependent variable: the log change in the amount of bad loan write-offs to total assets, total lending or lending to small and medium enterprises at time $t + 1$ for bank i .

Vector $X_{i,t}$ includes the banks' regulatory capital ratios, as well as the variable of interest, the capital injection as a percent of total bank assets. This variable takes the value of zero for those banks which did not receive a capital injection. As described in Section 3, the capital injections of 1997 and 1998/1999 were handled quite differently, and thus may well have had different effects on bank behavior. Ito and Harada (2004) find aggregate evidence of this in their note on the disappearance of the Japan premium in March 1999. To investigate the hypothesis that the capital injections of 1997 and 1998/1999 had differential impact, we look at the rounds of injections separately in our regression analysis.¹⁸

Vector $Z_{i,t}$ denotes a vector of control variables that control for bank specific factors such as the banks' loan to deposit interest rate spread. Since the model presented in Section 4 only incorporates loan supply, there may be other omitted variables such as macroeconomic events or loan demand conditions, which affect loan growth in each time period. To account for these variables, we also include time dummies for each year to control for macroeconomic effects such as business cycles. $\varepsilon_{i,t+1}$ is an error term that in most specifications is assumed to take the form of a general time specific error term plus a bank-specific error term: $\varepsilon_{i,t+1} = \varepsilon_{i,t+1} + \mu_i$.

5.1.1. Regulatory capital ratio

Before moving on to empirical estimation of the effectiveness of the other policy objectives, we first confirm that the capital injections did boost regulatory capital ratios contemporaneously by estimating an accounting identity whereby growth in capital in the current period is determined by capital in the last period, plus operating profits, minus bad loan write-offs: $\text{Capital}_t = \text{Capital}_{t-1} + \text{Operating profits}_t - \text{Loan write-offs}_t$. In addition, we include the variable of interest, the amount of capital injected for each bank in each of the rounds of capital injection as a percent of total bank assets (again, separately for each injection, as explained above).

$$\begin{aligned} \text{BIS}_{i,t+1} = & \alpha_0 + \beta_0 X_{i,t}^{\text{BIS}_t} + \beta_1 X_{i,t+1}^{97} + \beta_2 X_{i,t+1}^{98} + \beta_3 X_{i,t+1}^{99} + \gamma_0 T + \gamma_1 Z_{i,t+1}^{\text{profits}} \\ & + \gamma_2 Z_{i,t+1}^{\text{write-offs}} + \varepsilon_{i,t+1} \end{aligned} \quad (13)$$

Although Eq. (13) is not based directly upon the model presented in Section 4, including the capital injection amounts contemporaneously is consistent with the assumption that capital is exogenous in the short-run and is a realistic representation of actual bank behavior. Although the capital injections were discussed in advance, they actually took place right at the close of the fiscal year. Given both the timing of the actual injections and the fact that

¹⁸ The authors thank participants at the NBER Japan Project Meetings in Tokyo September 2004, in particular Takatoshi Ito and Takeo Hoshi, for this suggestion.

banks view capital as exogenous in the short-run, we expect that the capital injections would have affected banks' regulatory capital ratios contemporaneously, within the same period.¹⁹

Coefficient estimates for profits and lagged regulatory capital ratios in the accounting identity are expected to be positive, while the coefficient estimate on bad loan write-offs would negatively affect capital ratios. Coefficient estimates on the capital injections for 1997, 1998 and 1999 are expected to be positive.

5.1.2. Loan write-offs

Next, we turn to the effectiveness of the capital injections in encouraging banks to write-off non-performing loans. Recent studies demonstrate that inadequately capitalized banks are actually *more* likely to keep non-performing loans on their books than are healthy banks (see Peek and Rosengren, 2005) through forbearance lending (Sekine et al., 2003) or taking advantage of accounting discretion (Hosono and Sakuragawa, 2005). One important aim of the recapitalization program was to mitigate this tendency.

To investigate the program's effectiveness in achieving this goal, we look at the effect of the capital injections on the log change in amount of loan write-offs in the given period. The empirical specification used is based on Eq. (12) so the variable of interest, the amount of capital injected for each bank in each of the rounds of capital injection as a percent of total bank assets, is lagged one period. Although regulators encouraged banks to quickly write off non-performing loans that had been left on their books for years, we assume that there are some adjustment costs to writing-off bad loans so that the decision as to the amount of loans to write down are based upon the bank's capital position in the previous period. In addition, although public recapitalization policies were openly discussed well in advance, actual implementation came at the very close of the fiscal year in March, making it difficult for the banks' to apply the funds toward write-offs in the same year.

Other right-hand side variables include the log change in bad loan write-offs in the previous period, the interest rate spread, the regulatory capital ratio, and time effects to control for macroeconomic conditions.²⁰

$$Y_{i,t+1}^{\Delta \log(\text{WOBD})} = \alpha_0 + \alpha_1 Y_{i,t}^{\Delta \log(\text{WOBD})} + \beta_0 X_{i,t}^{\text{BIS}} + \beta_1 X_{i,t}^{97} + \beta_2 X_{i,t}^{98} + \beta_3 X_{i,t}^{99} + \gamma_0 T + \gamma_1 Z_{i,t}^{(r^L - r^D)} + \varepsilon_{i,t+1} \quad (14)$$

5.1.3. Lending

Finally, we turn to examine the effectiveness of the capital injections on loan growth. Probably the biggest concern of policy makers around the time of Japan's banking crisis was the development of a "credit crunch". The fear was that under-capitalized banks would be forced to cut back on heavily risk-weighted loans, leaving unmet demand for new investment financing,

¹⁹ As a robustness check, we also looked at a specification including lagged capital injections. The coefficient estimates on contemporaneous injections were largely unchanged and coefficient estimates on lagged capital injections were statistically insignificantly different from zero.

²⁰ As a robustness check, we also looked at a specification for loan write-offs which included operating profits as a percent of bank assets and non-performing loans as a percent of bank assets as control variables. Coefficient estimates on those variables were statistically insignificantly different from zero and other coefficient estimates were not qualitatively changed.

which would eventually cripple economic growth. Stimulating bank lending, in particular lending to the more bank-dependent and credit-constrained small and medium business sector, was arguably the highest priority for policy makers.

To look at the effect of the capital injections on bank lending, we estimate two specifications in which the dependent variable is either the log change in total loans or lending to small or medium enterprises (SME lending). The empirical specification is again based upon the model presented in Section 4, so right hand side variables include the lagged log change in lending, the banks' individual loan to deposit interest rate spread and regulatory capital ratio as well as the variable of interest, the amount of capital injected into each bank as a percent of total bank assets in the previous period. Again, other macroeconomic effects are controlled for by including time dummies.

$$Y_{i,t+1}^{\Delta \log(L)} = \alpha_0 + \alpha_1 Y_{i,t}^{\Delta \log(L)} + \beta_0 X_{i,t}^{\text{BIS}} + \beta_1 X_{i,t}^{97} + \beta_2 X_{i,t}^{98} + \beta_3 X_{i,t}^{99} + \gamma_0 T + \gamma_1 Z_{i,t}^{(r^L - r^D)} + \varepsilon_{i,t+1} \quad (15)$$

5.2. Data

A panel of data from 109 banks' balance sheets and income statements for fiscal years 1990–1999²¹ is used to estimate the effectiveness of the capital injections. Domestic and international banks²² are analyzed separately to preserve the homogeneity of the sample. Several banks are excluded from the analysis due to nationalization, failure, or because they were established mid-sample (see Appendix A for details). Mergers are accounted for by treating the merged bank as one entity for the entire sample period.

The dependent variable used in the first specification is an adjusted measure of the official regulatory capital ratio: the BIS ratio for internationally active banks (*jikoshihon hiritsu*). Written-off bad debt, the dependent variable in the second specification described above, is measured as direct write-offs against the bank's income (*kashidashikin kyuufukin shoukyaku*). Direct write-offs include only non-performing assets that are completely removed from the balance sheet by either write-off or selling the loan at a loss to the Cooperative Credit Purchasing Company (CCPC). A more accurate measure of total loan write-offs would include indirect write-offs that are covered by loan loss reserves (*kashidaorehikiatekin*) or provisions (*kashidaorehikiatekin kuriiregaku*), but discontinuity in the data on reserves makes it impossible to construct a consistent data series covering the dates of our sample.²³ The dependent variable in the remaining specifications, total loan growth and growth in lending to small and medium enterprises, is taken from the banks' balance sheet data as reported at book value and on an unconsolidated basis. In fiscal year 1997 many large banks began reporting on a consolidated basis and all banks are now required to do so, but

²¹ Although longer time series data is available, the sharp consolidation of Japan's banking sector described above means that a consistent panel of data is not available after 2000.

²² Banks which at first opted to pursue the 8% BIS requirement required under the Basel Accord but then later reverted to the domestic 4% MOF requirement are categorized as domestic banks in our sample split (see Montgomery, 2005 for details).

²³ We also looked at a specification using the broader measure of total loan write-offs, both direct and indirect, and controlling for lagged reserves through fiscal year 1998. Results using the more complete definition of write-offs seems to be qualitatively and quantitatively similar to those that we find using only direct write-offs, perhaps because although the two measures are not the same, they are proportionate within banks.

unconsolidated data is used in order to construct a continuous time series. Total loans (*kashidashikin goukei*) are the sum of domestic loans to all industries plus international loans and trust account loans as reported in the banks' annual financial statements (*yukashoken hokokusho*) reports.

The independent variable of interest, the capital injection as a percent of total bank assets, is constructed from the amount of capital injection as reported by the Deposit Insurance Corporation and total bank assets as reported in the banks' annual balance sheets, or *yukashoken hokokusho* reports. This variable is zero in all years other than the years in which capital was injected and even in the years of the capital injections takes the value of zero for those banks which did not receive a capital injection.

In the specification looking at the effect of the capital injections on bad loan write-offs, non-performing loans are also included as a control variable on the right hand side as a robustness check. We looked at two measures of non-performing loans: total non-performing loans and loans to bankrupt borrowers (*hatansaki*).²⁴ This category is the strictest definition of non-performing loans and thus underestimates total non-performing assets, but it is the only measure of non-performing loans that has been reported by all banks since reporting was required in 1993 and the definition of this category of loans has not changed substantially as is the case for other classes of bad assets. However, coefficient estimates on these other control variables were statistically insignificantly different from zero and parameter estimates on other variables were largely unchanged, so those results are not reported here.

The estimates of the impact of the capital injections on regulatory capital ratios also include profits as a control variable on the right hand side. Our measure of profits is operating profits (*gyoumu jyuneki*). In order to cover bad debt write-offs, banks have taken large hits to their post-provision operating profits.²⁵ All the major banks have reported negative post-provision operating profits every year since fiscal year 1994. They have been able to compensate for this to some extent by selling off equity holdings (realizing their latent gains on equities), allowing them to report positive pre-tax profits in some years.²⁶ However, operating profits, which are calculated before provisions, write-offs, latent capital gains realizations and taxes, are the best measure of a banks current performance.

Most specifications include a proxy for the banks' individual loan to deposit interest rate spread, which is simply the spread between each bank's ratio of loan interest income to total loans and deposit interest payments to total deposits.

Finally, all specifications include time dummies to control for macroeconomic effects such as business cycles.

Data was compiled from the Nikkei Needs Company data set, Bureau Van Dijk Electronic Publishing Bankscope data set and publicly available data from the Deposit Insurance Corporation on the amount of capital injections. Tables 2 and 3 report the summary statistics of the data for international and domestic banks, respectively. Comparing the two groups of banks, we note that, as expected, the large international banks have higher regulatory capital ratios. In

²⁴ Appendix B provides a detailed description of the various measures of non-performing assets according to definitions provided by the Japanese Bankers Association.

²⁵ Post-provision operating profits include deductions for other kinds of provisioning as well, such as write-down of sovereign risk loans or transfers to reserve for other credit losses, but these figures are much smaller than the sum of transfer to reserve for loan losses, loan charge-offs and losses on sales of loans to the CCPC.

²⁶ Pre-tax profits are also adjusted for profits and losses on investments in trusts, write-offs of equity securities and profits and losses on disposal of fixed assets, but these items are much smaller than the profits on sales of equity securities.

Table 2
Summary statistics for international banks (1990–1999)

	Mean	Standard deviation	Minimum	Maximum
Adjusted BIS-MOF capital ratio	10.007	1.456	7.100	15.400
$\Delta \log$ (bad loan write offs)	0.551	1.648	-4.062	5.476
$\Delta \log$ (total loans)	0.003	0.088	-0.268	0.656
$\Delta \log$ (SME loans)	-0.008	0.092	-0.492	0.618
Loan-deposit interest rate spread	0.906	0.722	-2.000	2.200
Operating profits/assets	0.583	0.393	-0.336	2.499
Loan write-offs/assets	0.181	0.303	0.00004	2.271
Capital injection 97/assets	0.045	0.208	0	1.829
Capital injection 98/assets	0.154	0.584	0	4.240
Capital injection 99/assets	0	0	0	0

Table 3
Summary statistics for domestic banks (1990–1999)

	Mean	Standard deviation	Minimum	Maximum
Adjusted BIS-MOF capital ratio	8.205	2.270	0.400	14.000
$\Delta \log$ (bad loan write offs)	0.143	1.645	-7.471	6.760
$\Delta \log$ (total loans)	0.019	0.048	-0.109	0.779
$\Delta \log$ (SME loans)	0.023	0.097	-1.793	1.836
Loan-deposit interest rate spread	2.218	0.360	1.200	3.400
Operating profits/assets	0.594	0.232	-0.181	1.736
Loan write-offs/assets	0.041	0.126	0.00003	2.008
Capital injection 97/assets	0.001	0.019	0	0.506
Capital injection 98/assets	0.002	0.057	0	1.797
Capital injection 99/assets	0.012	0.160	0	2.850

fact there are several cases where domestic banks slipped below the required 4% MOF ratio but continued to operate. And, as reported above, the international banks received larger injections of capital, not only in terms of the gross amount, but also when measured as a percent of their total assets. International banks wrote off more bad loans than the domestic banks: they show higher growth in loan write-offs and have higher loan write-offs as a percent of their overall assets. But the large international banks show *lower* loan growth than the domestic banks and in fact average growth in lending to small and medium enterprises was slightly negative for the sample period. Domestic banks show relatively higher loan growth over the sample period, and they seem to make more money off those loans, as indicated by the relatively large spread between loan and deposit rates. For the international banks, in fact, there are a few observations where our proxy for spread was actually negative. Despite their lower spreads, international banks report about the same ratio of operating profits to total assets as the domestic banks, indicating that they are perhaps earning more income through fees and other non-interest income.

5.3. Results

All empirical results are presented in Tables 4 and 5, for the international and domestic banks, respectively. We report the results using either a fixed or random effects model, as suggested by a Hausman test.

5.3.1. Regulatory capital ratio

First, we examine the effect of public capital injection on the regulatory capital ratio by estimating the accounting identity of Eq. (13). The estimates are reported in column one of Tables 4 and 5 for international and domestic banks respectively.

The coefficient estimate on lagged regulatory capital ratio is positive and highly statistically significant as would be expected for both bank groups. For the internationally active banks, neither profits nor bad loan write offs as a percent of bank assets weigh in as statistically significantly different from zero. For the domestic banks however, coefficient estimates on both profits and bad loan write offs as a percent of total bank assets are statistically significant and have the expected signs. This simply confirms that the regulatory capital of domestic banks with relatively higher profits tended to be relatively higher in the following period and that, as the accounting identity would predict, having to write off more bad loans is a negative shock to bank capital.

Turning to the variables of interest, the capital injections in 1997, 1998 and 1999, we note from column one of Table 4 that coefficient estimates on both rounds of capital injections into the international banks in 1997 and 1998 are positive and highly statistically significant. The coefficient estimate for 1997 is quantitatively quite large at 1.85, indicating that a 1% increase in the amount of capital injected (as a ratio to bank assets) in 1997 boosted the international banks' capital adequacy ratios by nearly 2% on average. The coefficient estimate on the 1998 round of capital injections is also highly statistically significant and closer to our expected value of 1, indicating that a 1% increase in the amount of capital injected (as a ratio to bank assets) in 1998 boosted the international banks' capital adequacy ratios by 1.21%. For the domestic banks, we note from column one of Table 5 that coefficient estimates of the impact of the capital injections on regulatory capital (the MOF ratio) are smaller. Although the coefficient estimates on the capital injections in all three rounds are positive, they are not statistically significantly different from zero in either 1997 or 1999. The injection in fiscal year 1998, however, is highly statistically significant, indicating that a 1% increase in the amount of capital injected (as a ratio to bank assets) in 1998 boosted the domestic banks' capital adequacy ratios by 0.60%.²⁷

5.3.2. Bad loan write-offs

The remaining empirical results, which look more closely at the other policy objectives of the capital injections, are presented in Tables 4 and 5 for the group of internationally active banks and domestic banks respectively.

The second column of both Tables 4 and 5 reports the effect of public capital injections on the log change in loan write-offs for international and domestic banks. Results are strikingly similar for both bank groups. First, signs of coefficient estimates for most control variables – the interest rate spread and regulatory capital ratio in the previous period – are as would be expected, but are not statistically significant at the 5% level.²⁸ However, lagged bad loan write offs are negative

²⁷ One reason coefficient estimates may differ from the expected value of 1 (which would imply that, at least in the short-run, the capital injections were passed on one-for-one to regulatory capital ratios) is that the capital injections are measured as a ratio to the banks' total assets, which is slightly different than the banks' risk-weighted assets as used in calculating actual regulatory capital. In addition, we do not differentiate between core capital and near capital, which may have different effects on regulatory capital depending upon the banks' current levels.

²⁸ As a robustness check, we also estimated a specification including profits and non-performing loans as control variables in the specification for bad loan write-offs. Coefficient estimates on those variables were also statistically insignificantly different from zero.

Table 4
Statistical results for international banks

	Adjusted BIS-MOF capital ratio (1)	$\Delta\log$ (bad loan write-offs) (2)	$\Delta\log$ (total loan) (3)	$\Delta\log$ (SME loan) (4)
Capital injection 97/ assets (<i>t</i>)	1.853 [0.430]***			
Capital injection 98/ assets (<i>t</i>)	1.212 [0.412]***			
Operating profits/ assets (<i>t</i>)	−0.166 [0.231]			
Loan write-offs/ Assets (<i>t</i>)	0.547 [0.395]			
Capital injection 97/ assets (<i>t</i> − 1)		0.503 [0.771]	0.110 [0.077]	0.052 [0.067]
Capital Injection 98/ assets (<i>t</i> − 1)		1.034 [0.362]***	0.044 [0.020]**	0.045 [0.015]***
Loan-deposit interest rate spread (<i>t</i>)		−0.343 [0.276]	−0.004 [0.006]	−0.021 [0.010]*
Adjusted BIS-MOF capital ratio (<i>t</i> − 1)	0.380 [0.119]***	−0.031 [0.127]	0.003 [0.004]	−0.001 [0.005]
$\Delta\log$ (bad loan write offs) (<i>t</i> − 1)		−0.413 [0.053]***		
$\Delta\log$ (total loans) (<i>t</i> − 1)			0.197 [0.097]**	
$\Delta\log$ (SME loans) (<i>t</i> − 1)				0.262 [0.160]
Constant	6.397 [1.007]***	1.424 [1.353]	−0.107 [0.026]***	0.023 [0.061]
Specification as implied by Hausman Test	FE	FE	RE	FE
Observations	168	150	151	151
Number of banks	17	17	17	17

Notes: Robust standard errors in brackets.

* Significant at 10%.

** Significant at 5%.

*** Significant at 1%.

and statistically significant, suggesting that banks which increased bad loan write offs in the previous period tended to have smaller growth in bad loan write offs in the current period.

Secondly, for both bank groups, the main variables of interest, the capital injections, have a highly statistically significant impact on bad loan write-offs only after the second round of capital injections in 1998. On average a 1% increase in the amount of capital injected as a percent of bank assets in the second round capital injection in 1998 stimulated a 1.03% higher ratio of bad loan write offs to bank assets for the internationally active banks. The impact on write-offs for the domestic banks is even higher: on average a 1% increase in the amount of capital injected as a percent of bank assets stimulated a 1.69% higher ratio of bad loan write offs to bank assets for the internationally active banks. We find no evidence of any statistically significant impact from the other rounds of capital injections – neither the first round of capital injections in 1997 into the international banks or the final round in 1999 into the domestic banks – on bad loan write offs.

Table 5
Statistical results for domestic banks

	Adjusted BIS-MOF capital ratio (1)	$\Delta\log$ (bad loan write-offs) (2)	$\Delta\log$ (total loan) (3)	$\Delta\log$ (SME loan) (4)
Capital injection 97/ assets (t)	0.160 [0.997]			
Capital injection 98/ assets (t)	0.597 [0.071]***			
Operating profits/ assets (t)	0.511 [0.405]			
Loan write-offs/ Assets (t)	0.836 [0.226]***			
Capital injection 97/ assets ($t - 1$)	-1.446 [0.611]**			
Capital Injection 98/ assets ($t - 1$)		0.502 [2.457]	0.055 [0.027]**	0.041 [0.031]
Loan-deposit interest rate spread (t)		1.693 [0.123]***	0.022 [0.005]***	0.024 [0.004]***
Adjusted BIS-MOF capital ratio ($t - 1$)		0.183 [0.534]	0.003 [0.012]	0.009 [0.017]
$\Delta\log$ (bad loan write offs) ($t - 1$)		-0.076 [0.134]	-0.045 [0.037]	-0.046 [0.043]
$\Delta\log$ (total loans) ($t - 1$)	0.567 [0.078]***	0.008 [0.021]	-0.001 [0.003]	-0.003 [0.003]
$\Delta\log$ (SME loans) ($t - 1$)		-0.427 [0.041]***		
Constant			-0.032 [0.017]*	
Specification as implied by Hausman Test				-0.418 [0.073]***
Observations	3.242 [0.558]***	0.486 [0.515]	0.110 [0.102]	0.187 [0.115]
Number of banks	FE	RE	FE	FE
Observations	900	792	827	825
Number of Banks	92	92	92	92

Notes: Robust standard errors in brackets.

* Significant at 10%.

** Significant at 5%.

*** Significant at 1%.

5.3.3. Lending

The last two columns of Tables 4 and 5 present the results of our empirical estimates of the effect of the capital injections on various measures of loan growth (approximated by the log change in lending). Column three of Tables 4 and 5 reports the effect of the capital injections on total aggregate loan growth; column four on lending to small and medium enterprises.

For both international and domestic banks, once time effects are controlled for, coefficient estimates on most of the other control variables – the loan to deposit interest rate spread, lagged regulatory capital ratios and lagged loan growth – are often insignificantly different from zero at the 5% level.

Turning to the variables of interest, the amount of capital injected in each round as a percent of banks' total assets, note that we find no evidence of a statistically significant impact on lending behavior by the international banks from the first round of capital injections in 1997. Domestic banks show some sensitivity in aggregate lending to the capital injection of 1997, but, as with the

international banks, domestic bank lending to SMEs was unaffected by the first round capital injection.²⁹ However, both bank groups show highly statistically significant coefficient estimates for both aggregate lending and lending to SMEs with the second round of injections in 1998.

Coefficient estimates on the impact from the second round capital injection are quantitatively significant as well, and particularly large for the international bank group. The coefficient estimates on the 1998 capital injection for domestic bank lending on aggregate and to SMEs are, at 0.022 and 0.024, slightly higher than the mean growth rates for those series over the period of our study (see [Table 3](#)). For the international banks, the impact of the capital injections on lending was even greater. At 0.044 and 0.045, the coefficient estimates on the 1998 round of capital injections for both aggregate and SME lending are more than 10 times larger than the mean growth rates for those series over the period of our study (see [Table 2](#)).

In summary, our empirical analysis confirms that the recapitalization policy did indeed help banks to boost their regulatory capital ratios. For international banks, both of the first two rounds of capital injections in 1997 and 1998 boosted regulatory BIS ratios and domestic banks saw a substantial impact on their regulatory MOF ratios with the second round of capital injections in 1998. But in examining the broader policy objectives, we find the greatest impact clearly came from the second round of capital injections in 1998. The capital injections of 1998 effectively encouraged both international and domestic banks to write off their bad loans and increase lending, in particular to small and medium enterprises. We find little evidence of a significant impact on these broader policy objectives from the other rounds of capital injections.

6. Conclusions

This study examines the effectiveness of bank recapitalization policies on achieving the goals laid out by the banks themselves in their “business revitalization plan” submitted in application to receive the funds from the government. Those goals were four: (1) to increase the bank capital ratios (2) to increase write-offs of non-performing loans (3) to increase lending, in particular to small and medium enterprises, in order to avoid a “credit crunch” and (4) to encourage restructuring. Using a panel of individual bank data, we empirically estimate the effectiveness of the Japanese government policy of public fund injection in achieving the first three of these stated goals.

In general, we find that the second round of capital injections in 1998 had the most impact on these policy objectives. The first round of capital injections in 1997 does seem to have raised regulatory capital ratios for international banks (the BIS ratio), but had no statistically significant effect on most other policy objectives for either domestic or international banks. The second round of injections, on the other hand, were effective in raising capital ratios for both bank groups – international and domestic banks – and also significantly impacted other policy objectives as well. We find that the second round of capital injections also encouraged

²⁹ The sensitivity of domestic bank lending to the first round capital injection seems to be influenced mostly by a small amount of international loans made by a couple of the larger domestic banks. Looking at purely domestic lending, which makes up almost all lending by domestic banks in Japan, we find no change in the coefficient estimate for the 1998 capital injection, but coefficient estimates for the 1997 round become statistically insignificantly different from zero.

banks to write off more of their bad loans and stimulated loan growth, both in aggregate and to small and medium enterprises. This finding holds for both international and domestic banks.

In addition, we generally find the capital injections to have had more effect on the behavior of internationally active banks than on banks with a domestic focus. As with the international banks, we find that the second round capital injection in 1998 helped domestic banks by boosting their regulatory capital ratios, encouraging bad loan write-offs and stimulating lending, in particular to small and medium enterprises. But only one recipient of the 1998 capital injection – Bank of Yokohama – was a domestic bank. The Bank of Yokohama is unusually large and well capitalized for a domestic bank and in fact, despite only being required to maintain 4%, kept its regulatory capital ratio above 8% through the entire sample period. Other than the positive effect of the capital injection in 1998 to the Bank of Yokohama, we find no evidence of any impact on the domestic banks. Neither the first round of capital in 1997, nor a third round which went exclusively to domestic banks, seems to have had any significant impact on the stated policy objectives.

We attribute the finding that capital injections into the internationally active banks were more effective than those into the domestic banks primarily to the large differential in the amount of capital allocated to the injections into the international banks as compared to the domestic banks (the international banks received up to 50 times as much as that allocated to domestic banks). The relatively modest amounts of capital injected into the domestic banks may not have been enough on their own to directly impact the stated policy objectives. In addition to the difference in the size of the policy response taken, some of the difference observed in the effectiveness of the capital injections on international as compared to domestic banks may be attributed to regulatory differences. Domestic banks in Japan are not bound by the international standard of an 8% BIS ratio and regulators have shown relative leniency toward domestic banks failing to meet even the lower domestic capital standard. There is evidence that these regulatory differences render domestic bank portfolios less sensitive to capital positions (Montgomery, 2004), which would result in domestic banks being less sensitive to any injections of public funds in the form of capital as well.

Why the observed difference in the impact of the capital injections into the international banks and Bank of Yokohama in 1997 and 1998? We believe the answer is in the way the capital injections were administered. The first round capital injection was uniformly handed out regardless of the condition of the recipient banks and the banks' proposed use of the injected capital, which is perhaps why it seems to have had little effect other than as a "band-aid" to keep the big international banks above the required minimum regulatory capital ratio. The amount of capital administered during the second round, however, was much larger and varied by bank to reflect conditions at the individual banks. To qualify, banks were required to submit a restructuring plan that outlined how the capital would be used. This approach seems to have been more effective in achieving broader policy objectives.

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Appendix A. Banks included in the analysis

Regional banks FY1990–FY2002

77

Aichi

Akita

Aomori

Ashikaga

Awa

Bank of Fukuoka

Bank of Ikeda

Bank of Iwate

Bank of Kansai

Bank of Kinki³⁰

Bank of Kyoto

Bank of Nagoya

Bank of Okinawa

Bank of Saga

Bank of the Ryukyus

Biwako

Chiba

Chiba Kogyo

Chikuho

Chugoku

Chukyo

Daisan

Daishi

Daito

Ehime

Eighteenth Bank

Fukui

Fukuoka Chuo

Fukuoka City

Fukushima

Gifu

Gunma

Hachijuni

Higashi-Nippon

Higo

Hiroshima

Hiroshima Sogo

Hokkaido

Hokkoku

Hokuetsu

Hokuriku

Howa

Hyakugo

Hyakujushi

Iyo

Joyo

Juroku

Kagawa

Kagoshima

³⁰ Bank of Kinki data available through FY1999.

Appendix A. (Continued)

Kanto
Keiyo
Kita Nippon
Kiyō
Kumamoto Family
Kyūshū
Michinoku
Mie
Minami-Nippon
Miyazaki
Miyazaki-Taiyō
Musashino
Nagano
Nanto
Nishi-Nippon
North Pacific
Ogaki Kyoritsu
Oita
San-in Godō
Sapporo
Senshu
Setouchi
Shiga
Shikoku
Shimizu
Shinwa
Shizuoka
Shokusan
Suruga
Taiko
Tochigi
Toho
Tohoku
Tokushima
Tokyo Tomin
Tomato
Towa
Toyama
Yamagata
Yamaguchi
Yamanashi Chuo

International Banks FY1990–FY1999

Asahi
Bank of Tokyo Mitsubishi
Daiichi Kangyo
Daiwa
Fuji
Industrial Bank of Japan
Mitsubishi Trust
Mitsui Trust
Nippon Trust
Sakura
Sanwa
Sumitomo

Appendix A. (Continued)

Sumitomo Trust
Tokai
Toyo Trust
Yasuda Trust

The following banks are excluded from the analysis because they were closed or nationalized during the sample period between FY1982–FY1999. Hokkaido Takushoku Bank failed on October 17, 1997. The Nippon Credit Bank³¹ was nationalized on December 13, 1998 and in January 2001 reopened as Aozora Bank. The Long Term Credit Bank of Japan was nationalized on October 23, 1998 and reopened on June 5, 2000 as Shinsei Bank. Namihaya Bank, which was formed on October 1, 1998 from the merger of Bank of Naniwa and Fukutoku Bank, was closed on August 6, 1999.³²

Hanwa Bank failed in November 1996. Kofuku Bank, which absorbed Kyoto Kyoie Bank on October 26, 1998, closed on May 21, 1999. Kokumin Bank³³ failed on April 11, 1999, and was absorbed by Yachiyo Bank³⁴ on August 14, 2000. Minato Bank³⁵ was established toward the end of the sample on September 1, 1999. Niigata-Chuo Bank³⁶ failed in October 1999. Tokuyo City Bank failed on November 26, 1997, and was absorbed by Sendai Bank³⁷ on November 24, 1998. Tokyo Sowa Bank, established in 1950 as a “sogo” bank,³⁸ was closed on June 11, 1999. In addition, Hokuto Bank is excluded because it was established mid-sample in 1993. The Bank was first established in 1895 as Masuda Bank and changed its name to Hokuto Bank after absorbing Akita Akebono Bank on April 1, 1993.

Data for Asahi Bank,³⁹ which was formed by the merger of Kyowa Bank and Saitama Bank on April 1, 1991, is backdated by combining data from the two bank balance sheets. The same technique is used to backdate data for Tokyo-Mitsubishi Bank, which was formed by the merger of Bank of Tokyo Bank and Mitsubishi Bank on April 1, 1996 and for Sakura Bank, which was established on April 1990 through the merger of Mitsui Bank Ltd. and Taiyo Kobe Bank Ltd. In order to include Sendai Bank in the sample, the last fiscal year of data is not used.

Several other banks in the sample—Dai-Ichi Kangyo Bank, Joyo Bank, Minami-Nippon Bank and Tokai Bank were also formed as the result of mergers, although they occurred before the sample period so no data adjustment was necessary. Dai-Ichi Kangyo was established on October 1, 1971 (pre-sample) through the merger of the Dai-Ichi Bank Ltd. and The Nippon Kangyo Bank Ltd. Joyo Bank Ltd. was established on July 30, 1935 following merger of Tokiwa Bank and

³¹ Established on April 1, 1957 as Hypotec Bank of Japan, Ltd. In 1970, its name changed to Nippon Fudosan Bank and to Nippon Credit Bank Ltd. in 1977.

³² In February 2001 the failed Namihaya Bank was absorbed by Daiwa Bank and Kinki Osaka Bank.

³³ The bank was established in 1926 as Kofuku Sogo Bank Ltd. In February 1, 1989, upon converting to a regional II bank, its name changed to Kofuku Bank, Ltd. After being closed, Kofuku Bank was purchased by the Asia Recovery Fund and reopened on February 26, 2001 as Kansai Sawayaka Bank, Ltd.

³⁴ Yachiyo was originally established in 1924 as Credit Union. In 1991, its name changed to Yachiyo Bank.

³⁵ Minato Bank was formed from the merger of Midori Bank and Hanshin Bank on April 1, 1999.

³⁶ Niigata Chuo was eventually absorbed by six other regional banks: Higashi-Nippon, Gunma Bank, Towa Bank, Taiko Bank, Daishi Bank and Hyakujushi Bank.

³⁷ Sendai Bank was originally established on July 5, 1951.

³⁸ Tokyo Sogo Bank converted to a regional II bank in 1989 and its name changed to Tokyo Sowa Bank.

³⁹ The merged bank was first named the Kyowa Saitama Bank. The bank name was changed to Asahi Bank on September 21, 1992.

Goyu Bank. Tokai Bank was established in 1941 as the result of the merger between Aichi Bank, Nagoya Bank and Ito Bank. Minami-Nippon Bank, a domestic bank, was established in 1943 through the merger of two local banking institutes in Kagoshima prefecture.

Recent mergers forming the Mizuho Financial Group (a holding company of Dai-Ichi Kangyo Bank, Fuji Bank and Industrial Bank of Japan), the Sumitomo Mitsui Banking Corporation (formed by the merger of Sumitomo Bank and Sakura Bank in April 2001), Chuo Mitsui Trust Bank (formed by the merger of Chuo Trust and Mitsui Trust in April 2000), and the Mitsubishi Tokyo Financial Group (formed in April 2001 by Tokyo Mitsubishi Bank and Mitsubishi Trust; soon to be joined by Nippon Trust and Toyo Trust) occurred post-sample and thus do not require any data adjustments.

Appendix B. Japanese Bankers Association—risk management loans

Risk management loans as defined by the Japanese Bankers Association have been reported by individual banks since fiscal year 1993. The categories used by the JBA include:

- (a) *Restructured loans*: The least dangerous category of loans, restructured loans were originally defined only as loans for which the interest rate had been lowered, but in fiscal year 1997 the definition was expanded to include loans for which any contract condition has been amended and loans to corporations undergoing reorganization. Restructured loans were reported by the largest banks beginning in 1994 and reporting requirements were extended to regional banks in 1996.
- (b) *Three month overdue loans*: 3 month overdue loans, or 3PDL (3 month past due loans), are defined as loans in arrears by more than 3 months but less than 6 months. Overdue loans originally included loans on which interest payments are past due by more than six months (see below), but in fiscal year 1997 this stricter category of overdue loans, loans on which interest payments are past-due by more than 90 days, was added. Reporting of 3 month overdue loans has been required of all banks only since fiscal year 1998.
- (c) *Overdue loans*: Overdue loans, or PDL (Past Due Loans), are loans on which interest payments are past due by more than 6 months. These loans have been reported by the largest banks since 1993, but the regional banks only began reporting this category of loans in 1996.
- (d) *Defaulted loans*: Defaulted loans, or LBB (Loans to Borrowers in Legal Bankruptcy), carry the strictest definition. These are loans to companies in the legal process of declaring bankruptcy. This category of loans has been reported by all banks (City, Trust, Long-Term Credit and Regional) since fiscal year 1993. In March 1999, the definition of defaulted loans was expanded to include loans for which principal or interest payments have not been made in a “long time” and for which repayment is judged “unlikely”.

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