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How can we effectively resolve the financial crisis: Empirical evidence on the bank rehabilitation plan of the Japanese government

Katsutoshi Shimizu *

Faculty of Economics, Aoyama Gakuin University, Shibuya 4-4-25, Shibuya-ku, Tokyo 150-8366, Japan

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Abstract

When the Japanese economy experienced a serious financial crisis in the late 1990s, the government attempted to promptly resolve this crisis by injecting public funds into bank capital, requiring these banks to compose and implement a rehabilitation plan. This paper empirically investigates whether this plan (the Business Revitalization Plan) worked effectively, emphasizing the inconsistency between strengthening the soundness of the banking industry (preventing bank failures) and expanding credit supply (improving macroeconomy). We present empirical evidence on this inconsistency and argue that the government failed to promptly resolve the serious financial crisis in Japan due to this reason.

JEL classification: G21
Keywords: Financial crisis; Credit rationing; Credit crunch; Non-performing loans; Capital/asset ratio

1. Introduction

The Japanese economy had not been able to overcome the problem of non-performing loans when the Japanese financial system experienced a crisis in the late 1990s. Following the failures of some regional banks and credit cooperatives in 1995, three major banks

* Tel.: +81 3 3409 8111; fax: +81 3 5485 0698.
E-mail address: kshimizu@cc.aoyama.ac.jp.

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(Hokkaido Takushoku Bank, Nippon Credit Bank, and Long-Term Credit Bank of Japan) failed between November 1997 and December 1998. Subsequently, seven regional banks were shut down between 1999 and 2002 (See Hanazaki and Horiuchi (2003) for more details).

In order to enhance the safety and soundness of banking, the Japanese government designed a policy arrangement to inject a large amount of public funds for propping up bank capital from 1998 to 2002. Under this framework, the banks into which capital was injected had to draw up rehabilitation plans called Business Revitalization Plans (BRPs) and were required to implement these.[1] That is, the bank was obliged to set targets for important management variables, such as the BIS capital/asset ratio and the increment in credit loan, and was expected to attain these targets.

This paper empirically investigates whether this plan worked effectively to resolve the financial crisis promptly, emphasizing the inconsistency between strengthening the soundness of the banking industry (preventing bank failures) and expanding credit supply (improving macroeconomy). This is not a problem peculiar to the Japanese government, but a general problem that any government faces in a financial crisis. As argued in Stiglitz and Weiss (1981), the bank finds it optimal to contract loan supply or merely not create new loans because raising the interest rate drives out the good borrowers. Therefore, if the government requires banks to increase the loan supply, the non-performing loans of these banks become larger, impairing the capital/asset ratios. That is, the BRP forcing banks to expand loans fails to ensure the soundness of banks.[2] Fig. 1 shows the recent change in loan supply in Japan. The solid line depicts the growth rate of loans ($\Delta L/L$) and the dotted line depicts the ratio of loan change to nominal GDP ($\Delta L/Y$). Both lines show a dramatically declining trend in loan change. In particular, these have been negative since 1996. Facing such shrinkage, the Japanese government required banks to expand credit supply in the BRP scheme.

Our empirical hypotheses are tested along the following three equations:

(i) Loan supply function
In the financial crisis, the usual banks find it optimal to contract loan supply because the deteriorating quality of the potential borrower increases the real cost of credit intermediation (CCI) (Bernanke (1983)). On the other hand, capital-injected banks are obliged to expand credit because the loan-increment targets are set by the BRP.

(ii) Non-performing loan function
The expansion of credit increases non-performing loans because of the higher CCI. Furthermore, mandatory restructuring, such as reduction of staff costs, which is also

[1] The government did not forcibly inject all banks with capital. Banks voluntarily applied to the government for capital injection and the approved banks were injected with capital.

[2] For example, this issue was reported by the newspaper Nihon Keizai Shimbun, December 26th, 2002:

> "From March, the loans for small- and medium-sized firms that the bank committed to expand, declined by more than nine trillion yen at the end of September. Banks are under heavy pressure to manage this difficulty because they cannot help reducing the loans to small- and medium-sized firms if they accelerate the disposal of non-performing loans... There is a general feeling of unrest because loans to vulnerable small- and medium-sized firms immediately lead to an increase in non-performing loans" (translated by the author).

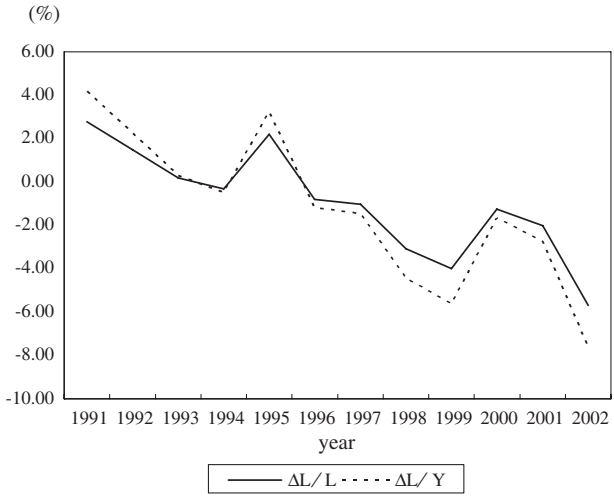

Fig. 1. The change of loans.

required in the BRP scheme, may distort the efficiency of information production, increasing non-performing loans.

(iii) Capital/asset ratio function

The extent to which the bank management is sound is measured by the capital/asset ratio. Non-performing loans worsen the soundness of banks, and cost reduction due to restructuring activity improves the capital/asset ratio through the rise in profits.

To empirically study these hypotheses, this paper employs data from 1999 and 2001 for a sample of 125 Japanese banks. Both capital-injected banks and non-capital-injected banks are included in our sample. An estimation of these three equations provided empirical evidence supporting the above hypotheses.

Recently, the Japanese financial crisis has received increasing attention. However, there do not seem to be any exact antecedents of the present paper in previous literature. Spiegel and Yamori (2003) examines the impact of regulatory reforms, one of which is analyzed in this paper, on Japan's financial system through an event study framework. However, they conclude that the impact of the Financial Reconstruction Act on the market value of bank equity is mixed. Peek and Rosengren (2003) indicates the possibility that Japanese banks allocate credit to severely impaired borrowers to avoid the realization of losses on their own balance sheets. In particular, they found evidence that banks with reported capital ratios close to their required ratios are more likely to provide loans to the weakest firms.[3] The contraction of loan supply is investigated in a strand of related literature on regulatory-induced credit crunches. Bernanke and Lown (1991), Berger and Udell (1994), and Peek and Rosengren (1995) study the effect of bank capital on the loan supply.[4] The difference

[3] In addition, see Calomiris and Mason (2003), Claessens et al. (2001), Hoshi and Kashyap (1999), and Kashyap (2002).

[4] Horiuchi and Shimizu (1998) and Ito and Sasaki (1998) investigate lending behavior of the Japanese banks in the early 1990s. Berger et al. (1995) provides useful surveys on the role of bank capital.

between such literature and the present paper lies in the reason due to which the banks contract their loan supplies. We stress the real CCI measured by non-performing loans as the determinant of credit shrinkage, instead of capital adequacy regulation.

While one aspect of this paper is to study the recent shrinkage of loan supply during the financial crisis, the evaluation of the government's policy that intended to resolve the financial crisis serves as a more significant contribution to current literature. As will be argued below, we may interpret the BRPs as extended versions of the prompt corrective action introduced in the U.S. or Japan. We should mention Dahl and Spivey (1995) in this context. They analyzed the determinants of recovery probability of undercapitalized banks. The BRP differs from prompt corrective action in that expansion of credit is required in the former while contraction of credit is required in the latter. This is the important difference to be analyzed.

The paper is organized as follows: In Section 2, we provide the outline of the BRPs and explain the trade-off that the government faces in the financial crisis (enhancing safety of the banking industry and expanding credit). In Section 3, we provide summary statistics of our sample, introduce the econometric model, and report the estimated results. Section 4 concludes this paper.

2. Outline of the BRPs and theoretical backgrounds

2.1. Outline of the BRPs

Facing a serious financial crisis in the late 1990s, the Japanese government introduced a new policy arrangement that allowed adequately capitalized banks to recapitalize with public funds. During the specified duration (March 1999 to March 2001), the banks could be injected with capital by the government if they drew up well-suited BRPs. A capital-injected bank set targets on specified bank performance measures and was required to attain these. Targets were planned over four years and would be modified during these periods, if necessary. For example, there were capital/asset ratio, increment in total loans, increment in loans to small and medium sized firms, number of directors, number of employees, staff costs, property costs, and some profits measure. Among these, this paper primarily focuses on capital/asset ratio and loan increment.

Fifteen major Japanese banks applied for capital injection when the recapitalization program was put into operation in March 1999.[5] Deposit Insurance Corp. purchased preferred stocks of ¥6.2 trillion, subordinated bonds of ¥550 billion, and subordinated loans of ¥750 billion issued by banks that applied for capital injection and were approved. Subsequently, 17 banks, consisting mainly of regional banks, applied for a

[5] Among *City Banks*, all banks except the Bank of Tokyo-Mitsubishi applied for the injection of capital. All *Trust Banks* except the Yasuda Trust & Banking Co. and the Nippon Trust Bank applied. Among *Long-Term Credit Banks*, only the Industrial Bank of Japan applied in March 1999 while two other nationalized banks (Long-Term Credit Bank of Japan and Nippon Credit Bank) applied later. Only Bank of Yokohama applied among the *Regional Banks*.

capital injection of ¥1.1 trillion. The sum of public funds injected into these 32 banks was ¥8.5 trillion from March 1999 to March 2003. Table 1 provides a list of these figures for each bank.

The amount of injected capital was relatively large. The ratio of public funds to Tier I capital of the 15 major banks as of 1999 was 31.2% on average; the ratio of public funds to Tier II capital was 9.5% on average, and the ratio of public funds to total capital was 22.3%. These public funds of ¥7.5 trillion raised the capital/asset ratio of the 15 major banks by 2.7 basis points on average. This amount is roughly the same as the amount of

Table 1
The amount of capital injection

	Bank	Preferred stocks (billion yen)	Subordinated debt (billion yen)	Subordinated loan (billion yen)	Total amount of capital injection (billion yen)	Year of injection
1	Industrial Bank of Japan	350	250		600	1999 (Mar.)
2	Dai-Ichi Kangyo Bank	700		200	900	1999 (Mar.)
3	Fuji Bank	800	200		1000	1999 (Mar.)
4	Sakura Bank	800			800	1999 (Mar.)
5	Sumitomo Bank	501			501	1999 (Mar.)
6	Sanwa Bank	600	100		700	1999 (Mar.)
7	Tokai Bank	600			600	1999 (Mar.)
8	Toyo Trust and Banking Co.	200			200	1999 (Mar.)
9	Daiwa Bank	408			408	1999 (Mar.)
10	Asahi Bank	400		100	500	1999 (Mar.)
11	Mitsubishi Trust and Banking Corp.	200		100	300	1999 (Mar.)
12	Sumitomo Trust and Banking Co.	100		100	200	1999 (Mar.)
13	Mitsui Trust and Banking Co.	250		150	400	1999 (Mar.)
14	Chuo Trust and Banking Co.	150			150	1999 (Mar.)
15	Bank of Yokohama	100		100	200	1999 (Mar.)
	Subtotal	6159	550	750	7459	
16	Ashikaga Bank	105			105	1999 (Sept.)
17	Hokuriku Bank	75			75	1999 (Sept.)
18	Hiroshima-Sogo Bank	20		20	40	1999 (Sept.)
19	Bank of Ryukyus		40		40	1999 (Sept.)
20	Kumamoto Family Bank	30			30	2000 (Feb.)
21	Hokkaido Bank		45		45	2000 (Mar.)
22	Long-Term Credit Bank of Japan	240			240	2000 (Mar.)
23	Chiba Kogyo Bank	60			60	2000 (Sept.)
24	Yachiyo Bank		35		35	2000 (Sept.)
25	Nippon Credit Bank	260			260	2000 (Oct.)
26	Higashi-Nippon Bank	20			20	2001 (Mar.)
27	Kansai Sawayaka Bank	8	4		12	2001 (Mar.)
28	Gifu Bank	12			12	2001 (Apr.)
29	Kinki Osaka Bank	60			60	2001 (Apr.)
30	Wakayama Bank		12		12	2002 (Jan.)
31	Fukuoka City Bank		7		7	2002 (Jan.)
32	Kyushu Bank		30		30	2002 (Mar.)
	Subtotal	890	173	20	1083	
	Total	7049	723	770	8542	

The name of the bank is as of the year when the bank applied for injection.

disposal of non-performing loans as of 1999 (¥8.3 trillion) or that of the increment in loan supplies (¥6.7 trillion).[6]

Although we do not report detailed results of how well the capital-injected banks achieved the targets, they succeeded in attaining the targets for capital/asset ratio.[7] However, they failed to achieve the targets for increment in total loans and increment in loans to smaller companies. This fact suggests that these banks had difficulty in expanding loan supply. Moreover, non-performing loans of the capital-injected banks increased from ¥17 trillion in 1999 to ¥21 trillion in 2003.

2.2. Theoretical backgrounds: inconsistency in the BRP scheme

In the prompt corrective action scheme, a bank is subject to regulatory sanctions that are based on its capitalization.[8] The BRP has much in common with prompt corrective action. Similar aspects are planning and implementation of recapitalization, restraint or prohibition of dividends or bonus for directors/managers, and contraction of operations of domestic and overseas subsidiaries. The BRP complements prompt corrective action during a financial crisis because it plays a role during the stage earlier than prompt corrective action does. Indeed, as Hanazaki and Horiuchi (2003, p. 321) argues, the BIS capital/asset ratio was unreliable during this period. The BIS capital/asset ratio of the Long-Term Credit Bank of Japan that failed in October 1998 had been 10.32% in March 1998 and 6.32% in September just before the failure. Thus, it was very late for the government to implement prompt corrective action based on the BIS capital standard. Moreover, since the bank has difficulty in collecting funds from the private sector because of the ''lemons'' problem, it is rational for the regulators to replenish the adequately capitalized banks with public funds and impose the BRP on these banks. It can improve the soundness of the capital-injected bank, reducing the expected loss of the Deposit Insurance Corp. or taxpayers.[9]

However, the loan increment target planned in the BRP may worsen the soundness of the management of the capital-injected banks. According to Stiglitz and Weiss (1981), the bank finds it optimal to contract loan supply or merely not create new loans when the quality of borrowers deteriorates (or expected revenue declines) because the bank must collect deposits with a higher deposit interest rate in order to expand credit (See also Stiglitz and Greenwald (2003, Chap. 3), and Williamson (1986)).

Fig. 2 represents the bank's equilibrium zero profit condition. Line AB is the bank's initial expected revenue and line OF is the linear deposit supply function. Assuming the simple balance sheet condition that the amount of deposits is equal to the amount of loans, the zero profit equilibrium condition (expected revenue $E\pi_B$ is equal to deposit interest

[6] The target system of the BRP is enforceable because the "Business Improvement Order" by JFSA (Japanese Financial Services Agency) works as a penalty on breaking the promise.

[7] The detailed table will be provided upon request. See Shimizu (2004).

[8] The U.S. regulators introduced prompt corrective action in 1991 by the FDICIA (Federal Deposit Insurance Corporation Improvement Act) and the Japanese regulators introduced prompt corrective action in 1998. See Dahl and Spivey (1995).

[9] In addition, the BRPs work as a screening device distinguishing good banks from bad banks and an incentive scheme preventing the soft budget problem.

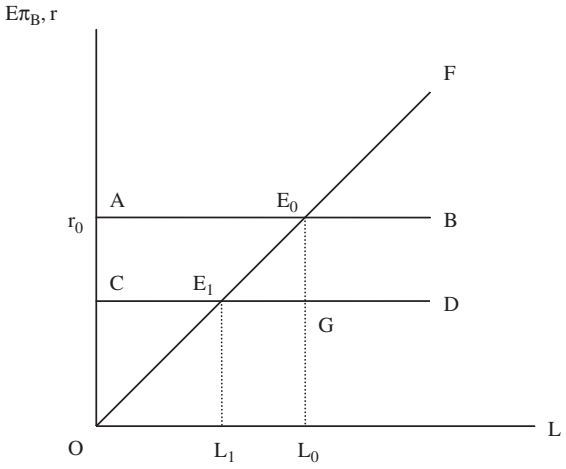

Fig. 2. Credit rationing as an optimal behavior.

rate r) holds at point E_0 and equilibrium loan supply is L_0. Now, suppose that the expected revenue line AB shifts downward to line CD due to the deterioration in the quality of borrowers. The new equilibrium is at point E_1 and the equilibrium loan supply shrinks to L_1. Facing this credit contraction, the government wants banks to expand credit to L_0 in order to improve the macroeconomy. If the government requires the bank to expand credit to L_0 by means of the BRPs, the deposit interest rate returns to r_0 and the bank must incur negative net profit, represented by the rectangle $ACGE_0$.

Thus, there is a crucial inconsistency in the BRP because the sub-optimal loan supply due to the increment target worsens the soundness of the bank, contrary to its purpose. However, the loan increment target is not necessarily inconsistent with bank soundness if we take into account the macroeconomic effects of the loan expansion. As described in Bernanke and Blinder (1988), a downward shock to the credit supply, stemming from the increased riskiness of borrowers, reduces the output of the economy. Therefore, if the government could shift the credit supply function upward, it could recover the fall in GDP, raising banks' profits in the long run. However, even if we can anticipate this effect through the credit channel, since it requires a long time to achieve this economy-wide effect, the financial system becomes unstable in the short run. Thus, the financial regulators face a trade-off between preventing bank failure (enhancing safety of the banking industry) and expanding credit (recovering the output of the economy) in a serious financial crisis.

2.3. Restructuring activity and the CCI

Additionally, the restructuring activity was planned in the BRP. Although these variables are not included as dependent variables in regression equations, they are included as exogenous independent variables because they may also worsen the soundness of the management. Reduction in costs, such as the staff and property costs, by definition strengthen the bank management through an increase in profits. However, this holds true

only if other things are equal. We cannot say a priori whether or not such restructuring activities increase profits because they affect the return and other opportunity costs. In particular, we emphasize the possibility that reductions in the staff and property costs might undermine the information-producing activity of the bank.

Suppose that the bank can at least partly distinguish the good type from the bad or can increase the success probability of the firm project by monitoring activity. Banks can restrain the larger emergence of non-performing loans by expending more resources on information production.[10] For example, banks may shut down branch offices in a neighborhood and integrate them into one branch office. Such restructuring activity can directly reduce the staff and property costs. However, it may weaken the capability of producing information and increase non-performing loans as long as the number of borrowing firms in charge is not reduced. Thus, by reduction in the staff and property costs, banks can save the direct information-production cost while the opportunity cost of credit intermediation increases.[11]

2.4. Empirical hypotheses

The tested hypotheses that we have mentioned in the introduction are summarized with the following three equations:

$$\text{Loan supply function} \qquad \mathrm{LS}_{it} = f\left(\overset{-}{\mathrm{CCI}}_{i,t-1}, \overset{+}{\mathrm{BRP}}_{i,t-1}\right) \tag{1}$$

$$\text{Non}-\text{performing loan function} \qquad \mathrm{NPL}_{it} = g\left(\overset{+}{\mathrm{LS}}_{i,t-1}, \overset{+}{\mathrm{RA}}_{i,t-1}\right) \tag{2}$$

$$\text{Capital/asset ratio function} \qquad \mathrm{CAR}_{it} = h\left(\overset{-}{\mathrm{NPL}}_{i,t-1}, \overset{+}{\mathrm{RA}}_{i,t-1}\right), \tag{3}$$

where the variables are defined as follows: LS: loan supply, CCI: cost of credit intermediation, BRP: Business Revitalization Plan, NPL: non-performing loan, RA: restructuring activity, and CAR: capital/asset ratio. Subscript i and t denote bank and time, respectively. For convenience, we assume that exogenous independent variables at $t-1$ period affect endogenous dependent variable at t in each equation. Banks choose the three dependent variables for period t separately, given the explanatory variables for period $t-1$. Although technical details will be explained in Section 3.2, this assumption facilitates our estimation by avoiding problem of simultaneity.

[10] Boot and Greenbaum (1993) argues that monitoring expenditure reduces the failure probability of the bank. See also Sharpe (1990) and Rajan (1992). Such considerations allow us to postulate that the bank's capability of producing information is determined by the resources expended on it.

[11] Indeed, the statistical data of "Bank Profitability" (OECD, 2002) reveals that the ratio of staff costs to total assets and that of property costs of the Japanese banks are the lowest among the G7 countries. In this sense, the targets for restructuring activity in the BRP may increase the non-performing loans.

The notion of CCI is emphasized in Bernanke (1983, pp. 263–264) in the context of the U.S. Great Depression. It is defined to be composed of the expected loss from loans to bad borrowers as well as the mere screening, monitoring, and auditing costs. Non-performing loans can be interpreted as the real CCI because it is the opportunity cost caused due to the impossibility of distinguishing the quality of the borrowers. The amount of non-performing loan from a unit of credit increases when the quality of borrowers deteriorates. The argument in Section 2.2 implies that the CCI has a negative effect and the BRP dummy has a positive effect on the loan supply in Eq. (1). As the variable LS, we select the loans to small- and medium-sized firms as well as total loans since the credit crunch is considered to be more serious for smaller firms than large corporations.[12] This is because, as explained in Diamond (1991), the bank's role of information production is more important for smaller firms since they have very few other sources of funds, due to informational asymmetry.

Next, the effect of loan supply on non-performing loans is examined in Eq. (2). We predict that the loan supply LS has a positive effect on the NPL because the loan increment target distorts the optimal bank lending decision. It is not trivial that credit expansion increases non-performing loans. It may reduce non-performing loans if the banks must lower the loan interest rate in order not to drive out good borrowers. Rather, in such a situation, expanding loans reduces non-performing loans.

Also in Eq. (2), the bank restructuring has a positive effect on NPL because the cost reduction may worsen the capability of information production. We should note that, in our empirical analysis, non-performing loans have dual meanings. CCI is defined to be the non-performing loans for the previous period NPL_{it-1} while NPL_{it} in Eq. (2) is that of the current period, NPL_t. The former manifests the exogenous risk of borrowers (e.g., proportion of bad borrowers or their failure probabilities). The loan increment and restructuring variables affect the latter. In other words, the risk of borrowers for the current period is determined by the bank's information-producing activity as well as the CCI. Banks could reduce non-performing loans for the current period by expending more resources for information-producing activity, given the CCI at the end of the last period. Last, the cost reduction by definition improves the soundness of the bank through the rise in profits in Eq. (3). We also include NPL as an explanatory variable because it has a definite negative effect on the capital/asset ratio through the decline in profit.

3. Empirical analysis

This section empirically investigates how effectively the BRP works, using the "Nikkei Needs Data" for all the banks in Japan. In particular, we emphasize the inconsistency

[12] For example, the newspaper *Nihon Keizai Shimbun* reported on October 15th, 1998:

> "Corporate insolvency due to a credit crunch rapidly increases. These firms become insolvent because the financial institutions squeeze their credit. In particular, the number of insolvencies of smaller companies strikingly increases. The fact that the smaller firms were hit severely by the credit squeeze is brought into sharp relief" (translated by the author).

Table 2
Summary statistics

	All banks		Non-capital-injected banks		Capital-injected banks		
	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.	
BRP	0.15	0.36	0.00	0.00	1.00	0.00	
LS	68.52	7.37	69.18	6.63	64.80	9.91	*
SLS	57.12	11.57	58.50	10.48	49.38	14.27	*
NEM	0.09	0.03	0.10	0.03	0.05	0.03	*
SC	0.74	0.20	0.78	0.16	0.51	0.24	*
PC	0.59	0.12	0.60	0.11	0.53	0.17	
CAR	9.34	1.92	9.13	1.90	10.48	1.65	*
NPL	5.02	2.20	4.91	2.05	5.67	2.88	
LIR	2.56	0.34	2.60	0.31	2.29	0.38	*
Number of sample	246		209		37		

Unit is % except for BRP. * denotes that the null hypothesis testing the difference of the mean is significant at 5% level.

between preventing bank failure (i.e., strengthening the soundness) and credit expansion aiming at recovery from the depression.

3.1. Summary statistics

Table 2 provides summary statistics of our sample data. There are 125 banks (at maximum) for each year from 1999 to 2001. As will be explained shortly, we construct the data set consisting of data for two years from the original data for three years. Excluding non-available data, we have 246 bank-year data in total.[13] Among these, 37 banks are capital-injected and the remaining 209 banks are not. The proportion of capital-injected banks is approximately 17%.

The variables are defined as follows: BRP: BRP dummy (assumes the value of 1 if the bank is injected with capital and zero otherwise), LS: ratio of total loans to total assets, SLS: ratio of loans to smaller firms to total assets, NPL: ratio of non-performing loans to total assets, NEM: ratio of the number of employees to total assets, SC: ratio of staff costs to total assets, PC: ratio of property costs to total assets, CAR: capital/asset ratio, and LIR: loan interest rate. We define variables other than BRP, CAR, and LIR as the ratio to total assets, in order to exclude the scale effect. CAR is the capital/asset ratio based on the BIS standard. LIR is calculated as the ratio of interest revenue to total loans.

The difference of the mean is tested and the results are reported in Table 2. An asterisk (*) is placed on the right side of the table if the null hypothesis is significant at the 5% level. We found significant difference in LS, SLS, NEM, SC, CAR, and LIR. The mean of the capital/asset ratio is 10.48 for the capital-injected banks and 9.13 for their counterparts, which implies that the capital-injected banks are healthier than their counterparts. Although one might consider that this success is because of the capital injection and the BRP target, this may not necessarily be the only reason. The capital-

[13] Six bank-year data are excluded from the sample because the data are not partially available. The list of banks will be provided upon request.

injected banks consist mainly of major Japanese banks that are subject to the capital adequacy standard of the BIS (8%), while the non-injected banks consist mainly of small regional banks subject to the domestic standard (4%). Therefore, we cannot conclude that capital injection and the BRP contribute to the rise in the capital/asset ratios only based on the descriptive statistics.

On average, the NEM, SC, and PC of the capital-injected banks are lower than their counterparts. In particular, the difference is significant for NEM and SC. Although it can be favorably interpreted that the capital-injected banks accelerated restructuring efforts, the composition of the capital-injected banks may affect these results similarly as stated above. In other words, capital-injected banks mainly consist of large banks; therefore, the average cost may be lower due to certain fixed costs. Capital-injected banks have significantly lower means for LS and SLS than their counterparts. Although the mean of NPL is higher for the capital-injected banks than their counterparts, the difference is not significant. The mean of LIR is significantly higher for the non-capital-injected banks than the capital-injected banks.

In sum, as long as we ignore the composition of the capital-injected banks, we can conclude from the summary statistics that they performed better in terms of CAR, NEM, and SC while their performance in terms of LS and SLS is worse from the viewpoint of the BRP. In order to obtain the correct conclusion, we should estimate the relationship among variables in a more sophisticated manner.

3.2. Method of estimation

We estimate the following equations corresponding to Eqs. (1)–(3) by the ordinary least squares (OLS) method.

Loan supply function:

$$\mathrm{LS}_{i.t+1} = \alpha_{11}\mathrm{LS}_{it} + \alpha_{12}\mathrm{SLS}_{it} + \beta_{11}\mathrm{NPL}_{it} + \beta_{12}\mathrm{NPL}_{it}\mathrm{BRP}_{it} + \xi_1\mathrm{BRP}_{it} + \eta_1\boldsymbol{X}_{1it} + u_{1it+1} \tag{1'}$$

$$\mathrm{LS}_{i.t+1} = \alpha_{21}\mathrm{LS}_{it} + \alpha_{22}\mathrm{SLS}_{it} + \beta_{21}\mathrm{NPL}_{it} + \beta_{22}\mathrm{NPL}_{it}\mathrm{BRP}_{it} + \xi_2\mathrm{BRP}_{it} + \eta_2\boldsymbol{X}_{2it} + u_{2it+1} \tag{1''}$$

Bad loan function:

$$\begin{aligned}\mathrm{NPL}_{i.t+1} = {} & \alpha_{31}\mathrm{LS}_{it} + \alpha_{32}\mathrm{SLS}_{it} + \alpha_{33}\mathrm{LS}_{it}\mathrm{BRP}_{it} + \alpha_{34}\mathrm{SLS}_{it}\mathrm{BRP}_{it} + \beta_{31}\mathrm{NPL}_{it} \\ & + \gamma_{31}\mathrm{NEM}_{it} + \gamma_{32}\mathrm{SC}_{it} + \gamma_{33}\mathrm{PC}_{it} + \gamma_{34}\mathrm{NEM}_{it}\mathrm{BRP}_{it} + \gamma_{35}\mathrm{SC}_{it}\mathrm{BRP}_{it} \\ & + \gamma_{36}\mathrm{PC}_{it}\mathrm{BRP}_{it} + \eta_3\boldsymbol{X}_{3it} + u_{3it+1}\end{aligned} \tag{2'}$$

Capital/asset ratio function:

$$\begin{aligned}\mathrm{CAR}_{i.t+1} = {} & \beta_{41}\mathrm{NPL}_{it} + \beta_{42}\mathrm{NPL}_{it}\mathrm{BRP}_{it} + \gamma_{41}\mathrm{NEM}_{it} + \gamma_{42}\mathrm{SC}_{it} + \gamma_{43}\mathrm{PC}_{it} \\ & + \gamma_{44}\mathrm{NEM}_{it}\mathrm{BRP}_{it} + \gamma_{45}\mathrm{SC}_{it}\mathrm{BRP}_{it} + \gamma_{46}\mathrm{PC}_{it}\mathrm{BRP}_{it} + \eta_4\boldsymbol{X}_{4it} + \xi_4\mathrm{BRP}_{it} \\ & + u_{4it+1}.\end{aligned} \tag{3'}$$

Eqs. (1′) and (1″) correspond to the loan supply function given by Eq. (1). The only difference between (1′) and (1″) is the dependent variable. Eq. (2′) corresponds to the non-performing loans function of Eq. (2), and Eq. (3′) corresponds to the capital/asset ratio function of Eq. (3). As previously written, these equations are constructed to avoid problem of simultaneity. That is, it is assumed that Cov (u_{kit+1}, u_{jit+1})=0 for all j and k ($j \neq k$) equations. We estimate these equations by OLS instead of panel data estimation because the sample period is short and the cross-sectional effect is considered to be more significant than the time effect. In each equation, each α is a coefficient of LS or SLS, each β is that of NPL, and each γ is that of the three restructuring variables. $\boldsymbol{X}_{kit}$ for k-th equation is a vector consisting of other appropriate variables (constant term, CAR_{it}, LIR_{it}, or bank-type dummy). As the Japanese banks are categorized into four types (*City Banks*, *Regional Banks I*, *Regional Banks II*, and *Trust Banks*), we have three bank-type dummies.[14]

We allow the coefficient of NPL for capital-injected banks to be different from that of their counterparts in loan supply function because those banks may respond to the increasing CCI differently due to the obligation of credit expansion (the effect ξ of the dummy BRP). We also include the coefficient dummies (cross-term with BRP) in both Eqs. (2′) and (3′). The BRP dummy is added in Eq. (3′) because some capital-injected banks acquired external equity from the capital market to prop up their capital. Therefore, $\xi_4 > 0$ is predicted.

3.3. Results of estimation

Table 3 shows the estimation results of Eqs. (1′) and (1″). The estimated coefficients of bank-type dummy variables are omitted. The adjusted R^2 of Eq. (1′) is 0.89, but neither NPL and NPL·BRP nor BRP have a significant effect on the dependent variable LS. Therefore, our prediction is not supported by Eq. (1′). In other words, higher CCI does not decrease the total loans of either the capital-injected banks or their counterparts and the BRP does not affect the total loan supply.

However, the estimated results for the dependent variable SLS are remarkably different. The adjusted R^2 is high and the coefficient dummy term NPL·BRP is significantly negative. Furthermore, the dummy BRP has a significantly positive effect on the SLS. Therefore, our prediction is supported in Eq. (1″). The capital-injected banks expand credit through the dummy BRP. However, when the CCI becomes higher, they tend to contract the loan further.

Table 4 indicates the results of estimating Eqs. (2′) and (3′). In the left column, SLS has a significantly positive effect on the dependent variable NPL and the cross-term of SLS and BRP has a significantly positive effect, as we predicted. However, the cross-term of LS and BRP has a negative effect on NPL, which contradicts our prediction. Furthermore,

[14] We may have to include a dummy variable distinguishing whether the standard on which the capital regulation is based is the BIS standard or the domestic one. However, since most regional banks are based on the domestic standard and major banks are based on the BIS standard, such a dummy variable is thought to be correlated with the bank-type dummy variable. To avoid the multicollinearity problem, we did not include such a dummy variable.

Table 3
Estimated regression results of loan supply

Dependent variable	LS_{t+1}				SLS_{t+1}			
Equation number	(1′)				(1″)			
Number of sample	246				246			
Mean of dependent variable	67.86				56.04			
Std. dev. of dependent variable	7.60							
Sum of squared residuals	1537.13				1065.26			
Variance of residuals	6.54				4.53			
Std. error of regression	2.56				2.13			
R^2	0.89				0.97			
Adjusted R^2	0.89				0.97			
	Estimated				Estimated			
Variable	Coefficient	*t*-statistic	*P*-value		Coefficient	*t*-statistic	*P*-value	
C	11.07	3.56	[.000]	*	−2.848	−1.101	[.272]	
LS_t	0.76	13.71	[.000]	*	−0.068	−1.466	[.144]	
SLS_t	0.05	0.99	[.322]		0.978	25.841	[.000]	*
NPL_t	0.06	0.57	[.569]		0.058	0.617	[.538]	
$NPL_t \cdot BRP_t$	−0.01	−0.04	[.969]		−0.579	−3.420	[.001]	*
BRP_t	1.72	1.13	[.258]		5.886	4.665	[.000]	*
CAR_t	−0.35	−2.58	[.011]	*	−0.225	−1.975	[.049]	*
LIR_t	0.99	1.20	[.233]		2.018	2.927	[.004]	*

* denotes that the coefficient is significant at less than 10% level.

the cross-term of NEM and BRP has a significantly negative effect on the NPL. That is, cost reduction due to the restructuring activity increases the non-performing loans.[15] However, the estimated coefficient of SC contradicts our prediction and that of PC has no significant effect on NPL. Thus, our prediction regarding NPL function is partially supported by our estimation. The right column of Table 4 shows the estimated results of Eq. (3′). NPL and PC have significantly negative coefficients as expected. Surprisingly, the BRP dummy has a negative effect on CAR_{t+1}, contrary to our prediction that the BRP would increase the capital/asset ratio because those banks have eagerly acquired external capital from the market. This result of the negative coefficient implies that the BRP has effects other than those involved in our model that adversely influence the capital/asset ratio.

In sum, our main results are:

- Capital-injected banks contracted their loan supply when the CCI became higher.
- The BRP succeeded in inducing the capital-injected banks to expand their credit. However, it failed to raise their capital/asset ratio because the expansion of credit increased the non-performing loans.
- The BRP succeeded in raising the capital/asset ratio of the capital-injected banks through the direct effect of reducing property costs. However, it partly exacerbated the

[15] However, it may be possible that adverse causality leads to this result. In other words, the banks accelerate the restructuring activity because they will go through a more serious crisis due to the rise in non-performing loans.

Table 4
Estimated regression results of non-performing loans and capital/asset ratio

Dependent variable	NPL_{t+1}				CAR_{t+1}			
Equation number	(2′)				(3′)			
Number of sample	246				246			
Mean of dependent variable	5.83				9.27			
Std. dev. of dependent variable	2.84				1.72			
Sum of squared residuals	768.88				239.34			
Variance of residuals	3.33				1.03			
Std. error of regression	1.82				1.02			
R^2	0.61				0.67			
Adjusted R^2	0.59				0.65			
	Estimated				Estimated			
Variable	Coefficient	*t*-statistic	*P*-value		Coefficient	*t*-statistic	*P*-value	
C	2.13	1.24	[.217]		7.04	6.30	[.000]	*
LS_t	−0.06	−1.50	[.136]					
SLS_t	0.07	2.20	[.029]	*				
$LS_t \cdot BRP_t$	−0.13	−2.20	[.028]	*				
$SLS_t \cdot BRP_t$	0.17	1.96	[.051]	*				
NPL_t	0.81	12.13	[.000]	*	−0.08	−1.84	[.066]	*
$NPL_t \cdot BRP_t$					−0.02	−0.15	[.884]	
NEM_t	14.07	1.33	[.185]		2.87	0.49	[.626]	
SC_t	−2.41	−1.41	[.160]		−0.78	−0.83	[.407]	
PC_t	1.17	0.85	[.398]		−1.69	−2.14	[.033]	*
$NEM_t \cdot BRP_t$	−118.53	−2.50	[.013]	*	16.57	0.82	[.414]	
$SC_t \cdot BRP_t$	16.10	2.88	[.004]	*	−1.79	−0.62	[.538]	
$PC_t \cdot BRP_t$	−3.15	−0.80	[.423]		2.74	1.19	[.236]	
BRP_t					−1.54	−1.87	[.063]	*
CAR_t					0.51	9.16	[.000]	*

* denotes that the coefficient is significant at less than 10% level.

capital/asset ratio because reducing the number of employees increases the non-performing loans.

Thus, the BRP could only play a limited role through the direct effect of raising profits by some restructuring activity. However, it considerably undermined the safety and soundness of banking through the obliged credit expansion and distorted restructuring activities.

4. Conclusions

This paper empirically investigates whether the BRP, by the means of which the Japanese financial regulators attempted to resolve the financial crisis, worked effectively. We report the inconsistency between preventing bank failures (strengthening the soundness of the banking industry) and expanding credit supply (improving macro-economy), which the government is generally considered to face during the financial crisis. Can the government achieve these two distinct goals simultaneously? A proper government policy is that of subsidizing the bank loan, as argued in Mankiw (1986). A

subsidy for bank loans can allow the banks to raise the loan interest rate, without driving out the good borrowers, and induce them to voluntarily expand credit. With subsidy $ACGE_0$ in Fig. 2, the government can induce banks to expand credit to L_0, without sacrificing the soundness of the banking industry.

As is well known, the Japanese government arranged some macro policy together with micro-based policy such as BRP scheme. One is zero-interest rate monetary policy by Bank of Japan from 1999 and another is expansion of credit guarantee by ¥5.9 trillion (including expansion of credit supply by Development Bank of Japan). Although not only capital-injected banks but also other banks benefit from such macro-based policy, it might work partly as a subsidy for capital-injected banks. The zero interest rate policy improved interest spread by decreasing deposit interest rate more than lending interest rate so that it might substitute for subsidy to capital-injected banks. In the latter, small and medium sized firms that were rejected loans by private banks could be provided funds from DBJ so that it might mitigate the lemon's problem facing banks. However, they were not enough to promptly resolve the financial crisis.

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