Theoretical and Empirical Assessments of the Program for Financial Revival of the Japanese Banks

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Abstract

This paper provides a theoretical model to assess the Program for Financial Revival of the Japanese banks. To achieve the goal of maximizing banks' profits under the budget constraint, the government can inject capital and reduce bad loans. From the model, we conclude that the government can achieve the Program's goal only in areas where BIS capital ratio regulations are binding. The government should stop attempting to reduce bad loans when the cost of doing so increases. It is not possible to maximize depositors' or borrowers' surpluses as well as maximizing banks' profits. The Basel II Framework enhances banks' profits under the Program. The empirical evidence indicates that the necessary condition for achieving the Program's goal is satisfied.

Keywords*:* Japanese banks; Program for Financial Revival; theoretical and empirical framework; assessments.

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1. Introduction

The Japanese government injected a total of 12 trillion yen into many major and medium-sized banks between May 1998 and March 2004. In March 2004, the outstanding balance from the capital injections was about 10 trillion yen[1] The government made these injections of capital by purchasing preferred stocks and subordinated bonds through the Resolution and Collection Corporation of Japan (RCCJ). In addition, in order to reduce bad loans, the government intended to purchase bad loans from the 25 big companies approved for assistance by the Industrial Revitalization Corporation of Japan (IRCJ) from April 2003 until September 2004.[2]

The Financial Service Agency of Japan (FSAJ) publicly announced what is referred to as the Program for Financial Revival (PFR) in October 2002, but the Program had begun operating before that date. The two policy instruments of this Program are capital injections into banks and purchases of banks' bad loans. The goal of the Program is to maximize banks' profits, subject to the government budget constraint. The government must ensure that the PFR is not disturbed by the amendment of the 1988 Basel Agreement, commonly known as the Basel II Framework, which will come into effect at the end of 2006. In addition, it must ensure that people receive sufficient loan and deposit services without facing a credit crunch. Finally, the government has to deal carefully with the reduction of bad loans when the cost of doing so is high, because the government has stressed that reducing the bad loans is an urgent task. It is necessary to evaluate the Program because it has not yet been revealed as a complete success.[3]

The purpose of this paper is to assess the Program for Financial Revival of the Japanese banks, both theoretically and empirically. The paper proposes a model, incorporating bank and government behavior, and the BIS bank capital regulations, to

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[1] See the "List of Capital Injections", a document issued by the Deposit Insurance Corporation of Japan (DICJ) in 2004.
[2] See the home page of the IRCJ at http://www.ircj.co.jp/shien/index.html
[3] There is a strong relationship between the Japanese banking slump and the country's economic slump, as pointed out by Ito (2000), Ogawa and Kitasaka (2000), and Miyakoshi and Tsukuda (2004).

describe how the PFR works. The model provides a theoretical market equilibrium framework to enhance policy analysis. The analysis of the model reveals that: (i) the government can achieve the Program's goal only on the binding region of the BIS bank capital regulation under the budget constraint; (ii) the government should stop attempting to reduce bad loans when the cost of doing so increases; (iii) the government's profit-maximization procedure cannot lead to a maximum surplus for either depositors or borrowers as long as the government remains within the budget constraint. However, if a higher level of surplus is required than that obtained by the government's maximization procedure, the capital injections and the expected bad loan ratio should be increased within the budget constraint; (iv) the Basel II Framework is favorable to the PFR as it enhances the profits of the banks; and (v) using data for the Japanese banks during the fiscal years 2001–2003, the empirical evidence reveals that the necessary condition for achieving the goal of the PFR is satisfied.

First, we provide a brief survey of research in this field. Although there are many policy assessments of previous programs, there is very little research based on theoretically and empirically solid ground. Ito and Sasaki (2002) found a close relationship between the Japanese bank slump and the 1993 adoption of the bank capital regulations of the 1988 Basel agreement. Spiegel and Yamori (2003) empirically evaluated the effects on the bank slump of the 1998 Financial Reconstruction Act and the 1998 Rapid Recapitalization Act, and suggested that the two Acts worked against reform of the banking system. However, each of these policy assessments was based on empirical findings, without the support of theory. There has never been any research conducted on the efficacy of the PFR.

According to the findings of Ito and Sasaki (2002), we should incorporate the bank capital regulations in our research framework. Research on bank capital regulations has concentrated mainly on the relationship between the regulatory capital requirement and the probability of bank failures, or the portfolio choice in a subjective equilibrium—see Blum (1999), Chiuri et al. (2002), Kamoike (2003), Kopecky and VanHoose (2003), and Milne (2002), or Berger, Herring, and Szegö (1995) for a review of the literature. However, to our knowledge, there is no theoretical framework based on a market equilibrium that would enable an analysis of the policy effects on market participants.

This paper extends the framework of previous research to a model with a solid theoretical and empirical basis for assessing the PFR.

Section 2 briefly states the legal and institutional implications of the PFR. Section 3 sketches the basic model and outlines the Program. Section 4 evaluates the Program, and Section 5 provides conclusions.

2. The RCCJ, the IRCJ, the Basel II Framework and the Japanese banks

This section provides a historical and institutional background to enhance understanding of the Program for Financial Revival and explains the motivation for formulating the theoretical model in the next section. The RCCJ provides government funds as capital to troubled but not insolvent banks by purchasing preferred stocks and subordinated bonds.[4] When their revitalization is supported by the IRCJ, the IRCJ purchases the claims of entrepreneurs from financial institutions, other than the entrepreneurs' main banks, at a proper market price. It does so in order to collect and organize the debts-and-credits of the financial institutions.[5] The Deposit Insurance Corporation of Japan (DICJ) virtually supervises the management and financing of the RCCJ and the IRCJ. Thus, the DICJ plays the role of the main executive organ for the FSAJ, which represents the government. In fact, the DICJ is under the control of the FSAJ. Thus, when we refer to the government from now on, we mean the DICJ. It

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[4] In responding to the amendment to the Deposit Insurance Law in October 1998, the Deposit Insurance Corporation of Japan (DICJ) established the Resolution and Collection Corporation of Japan (RCCJ) as a 100% subsidiary (a company limited by shares) on April 1, 1999. The DICJ has made efforts to collect non-performing loans by providing the RCCJ with guidance and advice for the recovery of loans, cooperating with the RCCJ in pursuing the criminal and/or civil liabilities of the parties concerned, and investigating the hidden assets of debtors.

[5] The DICJ established the Industrial Revitalization Corporation of Japan (IRCJ) on April 16, 2003 as a fully owned subsidiary based on the Industrial Revitalization Corporation Law. Then, the DICJ increased the capital of the IRCJ on May 20, 2003. Currently, the DICJ and the Norinchukin Bank are the shareholders of the IRCJ.

seems that the capital injections made by the RCCJ to the banks and the purchases of entrepreneurs' claims have been forcibly implemented without the approval of banks and entrepreneurs. Therefore, we perceive these as variables controlled by the government.

In order to construct a model for analyzing the Program, we simplify these detailed institutional facts and the instruments and the goal of the Program. We assume that the two instruments managed by the government are the injections of capital to the banks and the purchasing of bad bank loans, and that the government's goal is to maximize the profit of banks, subject to its budget constraint. Hence, the theoretical questions to ask in assessing this Program are: how can the instruments maximize the banks' profits? Does the Basel II Framework theoretically disturb this Program? Can the government theoretically attain a maximum surplus for both borrowers and depositors, subject to its budget constraint? The empirical question for assessment is: have the banks' profits actually been maximized?

We briefly explain the Basel II Framework here. The International Convergence of Capital Measurement and Capital Standards: a Revised Framework, known as the Basel II Framework, was published by the Basel Committee and amends the 1988 Basel agreement. It offers a new set of standards for establishing minimum capital requirements of banking organizations.[6] While the goal of the Basel II Framework will be accomplished through the introduction of "three pillars", [7] this paper focuses only on the "standardized approach" in the first pillar, with emphasis on the changes in comparison with the 1988 Accord. The standardized approach is

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[6] The Basel II framework was prepared by the Basel Committee on Banking Supervision, a group of central banks, and bank supervisory authorities in the G10 countries, which developed the first standard in 1988. The overarching goal for the Basel II Framework is to promote the adequate capitalization of banks and to encourage improvements in risk management, thereby strengthening the stability of the financial system.

[7] The three pillars reinforce each other and create incentives for banks to enhance the quality of their control processes. The first pillar represents a significant amendment of the minimum requirements set out in the 1988 Accord, whereas the second and third pillars represent innovative additions to capital supervision. "Pillar 1" of the new capital framework revises the 1988 Accord's guidelines by aligning the minimum capital requirements more closely to each bank's actual risk of economic loss. Three options are available to allow banks and supervisors to choose an approach that seems most appropriate for the sophistication of a bank's activities and internal controls.

similar to the approaches of the 1988 Accord's guidelines. Under this approach, banks that engage in less complex forms of lending and credit underwriting, and that have simpler control structures, may use external measures of credit risk to assess the credit quality of their borrowers for regulatory capital purposes. This standardized approach is simpler than the other two approaches and the banks seem to have favored it.[8] The weighting given to risky assets under this new approach will be less than the present level. We perceive that the Basel II Framework reduces the risk weighting on assets.

The number of Japanese bank and credit cooperative failures has rapidly increased during the 1990s. In the 2000s, the bank slump has continued and worsened, as shown in Table 1. In addition, claims against the credit crunch do not seem to have decreased, as revealed by the records of the FSAJ's claims hotline, shown in Table 2. Thus, the PRF has not yet been successful, and it is necessary to evaluate this Program.

The Japanese banking system is characterized by restrictions on market entry and competition between banks and other financial institutions. Limited theoretical research has suggested that Japanese banks are competitive in deposit and lending markets. However, Molyneux et al. (1996) conducted an empirical assessment of competitiveness in the Japanese banking market using the Panzar–Rosse methodology, and concluded that the hypothesis could not be rejected that bank revenues in 1986 behaved as if they were earned under monopoly. The assumption of a monopoly seems to be plausible in the Japanese banking market, and we make this assumption in our model. Since 1986, the institutional framework and bank behavior have changed greatly. Banks have merged freely and the number of banks has decreased rapidly, restricting the extent of competition.

Our theoretical framework involves competitive depositors and borrowers, but a monopolistic bank. The monopolistic bank maximizes its profit, but the surplus level of the depositors and borrowers is below that of a competitive market. The

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[8] Under the two other approaches, the banks that engage in more sophisticated risk-taking and that have developed advanced risk measurement systems may, with the approval of their supervisors, select from one of two "internal ratings-based" (IRB) approaches to credit risk. Under an IRB approach, banks rely partly on their own measures of a borrower's credit risk to determine their capital requirements, subject to strict data, validation, and operational requirements.

government maximizes the profit of a monopolistic bank by changing the given parameters for the bank within its budget constraint. We assess the Program by examining whether the bank profit maximization process of the government simultaneously achieves a maximum surplus for depositors and borrowers. We compare the surplus at the point chosen by the government with surpluses at other points within the government budget constraint.

3. The Model

3.1 Bank behavior

[1] The loan and deposit markets and BIS regulation

There is one bank with monopolistic power in the deposit and loan markets. On the other hand, there are many competitive depositors and borrowers in each market.

The loan demand and the deposit supply functions are formulated respectively, as follows:

$$r_L = c'/L + d' \text{ and } r_D = -c''/D + d'' ,\ d' > d'' , \quad (1)$$

where L and D denote loans and deposits, respectively, r_L *and* r_D are loan and deposit rates, and c', c'', d', and d'' are positive constants. The balance sheet of the bank is:

$$L = D + K, \quad (2)$$

where K is bank capital. We suppose that bank capital is an exogenous and fixed parameter in the short run.

For the sake of simplicity, we ignore the required reserve ratio and consider only the bank capital ratio as set by BIS regulation. The 1988 Basel agreement imposes the restriction:

$$\frac{K}{(\lambda_b \beta + \lambda_{1-b}(1-\beta))L} \geq \bar{k}\,, \tag{3}$$

where the denominator is a risk-weighted asset and β is the expected bad loan ratio (β>0). The symbol λ_b denotes the risk weighting given to bad loans, whereas λ_{1-b} is the risk weighting for good loans. The weights are assumed to be $1 \geq \lambda_b > \lambda_{1-b} \geq 0$, which reflects the perception that the bad loans are the most serious threat to bank solvency. The regulatory required ratio ($\bar{k}$) is less than one. At present, $\bar{k}$ = 0.08.

As Milne (2002, p.2) pointed out, bank supervisors have limited resources and cannot continuously monitor the position of the banks. Moreover, even when they observe a breach of the regulations, they cannot control the operations of the bank concerned. Then, the bank in our model perceives the BIS regulation expressed by (3). The bank is assumed to behave under the regulatory required ratio of (5). However, Tsukuda and Miyakoshi (2004) provided an alternative formulation with a statistically more meaningful intuition. For the sake of simplicity, we suppose that the risk weighting is independent of the expected ratio of bad loans (β). Although the risk weighting may loosely depend on β in reality, at least in the short run it is independent.

[2] Maximization of expected profit

Considering the balance sheet of (2), the expected profit of the bank is:

$$\Pi = r_L(1-\beta)(D+K) - r_D D - g\beta(D+K)^2 - pK\,. \tag{4}$$

We suppose that a cost function for bad loans is quadratic in L (= D + K), i.e., the marginal cost of bad loans is increasing, whereas the holding cost of capital is linear in K. The symbols g and p, which is equal to d'' in (1) for the sake of simplicity, are positive unit costs. Substituting (1) and (2) into (4), we have the bank's expected profit maximization problem in the short run:

$$\max_D \Pi = -g\beta(D+K)^2 + (-d'\beta + d' - d'')(D+K) - c'\beta + c' + c''\,.$$

This is subject to the bank capital regulation (3), which can be rearranged as:

$$D \le ((\bar{k}\theta)^{-1} - 1)K \,, \qquad (5)$$

where $\theta = (\lambda_b - \lambda_{1-b})\beta + \lambda_{1-b}$. It is assumed that (1-β) d' – d'' > 0 in order to have a positive maximum profit in the absence of the capital ratio restriction. The solutions have different forms depending on whether the restriction is binding.

Case 1: A non-binding restriction

If restriction (5) is non-binding i.e., $K > (2g\beta)^{-1}((1-\beta)d'-d'')\bar{k}\theta$,[9] the optimal values of D, L and Π are given by:

$$D^* = (2g\beta)^{-1}((1-\beta)d' - d'') - K,\ L^* = (2g\beta)^{-1}((1-\beta)d' - d''), \qquad (6)$$

$$\Pi^* = (4g\beta)^{-1}((1-\beta)d' - d'')^2 - c'\beta + c' + c''. \qquad (7)$$

The partial derivatives at the optimal solutions are:

$$\frac{\partial D}{\partial K} = -1 \,, \quad \frac{\partial L}{\partial K} = \frac{\partial D}{\partial K} + 1 = 0 \,, \qquad (8)$$

$$\frac{\partial D}{\partial \beta} = \frac{\partial L}{\partial \beta} = -\frac{d' - d''}{2g\beta^2} < 0, \qquad (9)$$

$$\frac{\partial \Pi}{\partial K} = 0, \text{ and } \frac{\partial \Pi}{\partial \beta} = -(4g\beta^2)^{-1}((1+\beta)d' - d'')((1-\beta)d' - d'') - c' < 0. \qquad (10)$$

Case 2: A binding restriction

If restriction (5) is binding, i.e. $K < (2g\beta)^{-1}((1-\beta)d' - d'')\bar{k}\theta$, the optimal values of D, L and Π are given by:

$$D^* = ((\bar{k}\theta)^{-1} - 1)K,\ L^* = (\bar{k}\theta)^{-1}K, \qquad (11)$$

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9 The non-binding restriction means that when BIS regulation (3) is not imposed, the solution is $D^* = (2g\beta)^{-1}((1-\beta)d' - d'') - K$.

$$\Pi* = -\beta g L^2 + ((1-\beta)d' - d'')L - c'\beta + c' + c'' \qquad (12)$$

The partial derivatives at the optimal solutions are:

$$\frac{\partial D}{\partial K} = (\bar{k}\theta)^{-1} - 1 > 0, \ \frac{\partial L}{\partial K} = (\bar{k}\theta)^{-1} \quad , \qquad (13)$$

$$\frac{\partial D}{\partial \beta} = \frac{\partial L}{\partial \beta} = -(\lambda_b - \lambda_{1-b})\theta^{-1}L < 0, \qquad (14)$$

$$\frac{\partial \Pi}{\partial L} = -2g\beta L + (1-\beta)d' - d'' > 0, \ \frac{\partial \Pi}{\partial K} = \frac{\partial \Pi}{\partial L}(\bar{k}\theta)^{-1} > 0 \qquad (15)$$

$$\frac{\partial \Pi}{\partial \beta} = -(gL^2 + d'L + c') + \frac{\partial \Pi}{\partial L}\frac{\partial L}{\partial \beta} < 0 , \qquad (16)$$

where L= $(\bar{k}\,\theta)^{-1}$K. As restriction (5) is binding, the strict inequality in (15) holds. In addition, the inequality in (16) is true from (14) and (15). An increase of bank capital makes all the optimal deposits, loans, and profits increase. On the other hand, an increase of the expected bad loan ratio makes all the optimal deposits, loans, and profits decrease.

Whether the bank capital regulation (5) is binding depends on the values of K and β. When the restriction lies on the boundary, we have $K=(2g\beta)^{-1}((1-\beta)d'-d'')\bar{k}\,\theta$, where K is a decreasing convex function of β. The proof of convexity is given in the Appendix, and the locus is shown in Figure 1. The upper region of the locus is obviously the non-binding area, whereas the lower region is the binding area.

[3] The relation between K and β on the iso-profit curve

If the restriction is non-binding, the optimal profit given by (7) does not depend upon K. Setting the total differentiation of (7) equal to zero, we have:

$$\frac{dK}{d\beta} = -\frac{\partial \Pi}{\partial \beta}\Big/\frac{\partial \Pi}{\partial K} = \infty , \qquad (17)$$

because the denominator is zero from (10). On the other hand, if the restriction is binding, the optimal profit is given by (12). Then, we have:

$$\frac{dK}{d\beta} = -\frac{\partial\Pi}{\partial\beta}\bigg/\frac{\partial\Pi}{\partial K} = (gL^2 + d'L + c')\left(\frac{\partial\Pi}{\partial K}\right)^{-1} + (\lambda_b - \lambda_{1-b})\bar{k}L > 0. \tag{18}$$

The inequality holds from (15) and (16). In addition, we have $\lim_{\beta\to\beta_0}\frac{dK}{d\beta} = \infty$ because $\lim_{K\to K_0}\frac{\partial\Pi}{\partial K} = 0$ from (15), where K_0 and β_0 denote points on the boundary, and $\lim_{K\to K_0} L =$ $(2g\beta)^{-1}((1-\beta)d' - d'')$ in (15). Similarly, we can obtain:

$$\frac{d^2K}{d\beta^2} > 0. \tag{19}$$

The derivation is given in the Appendix, and the iso-profit curve is shown in Figure 1.

From the above results, it is obvious that the profit level is larger if β is smaller and K is larger in the binding area, and that the iso-profit curve is convex. However, only a decrease of β can increase the profit level in the non-binding area.

3.2 Government behavior

The monopolistic bank maximizes its expected profit in the short run in the loan and deposit markets, subject to the bank capital regulation. The bank cannot change its capital K or its expected bad loan ratio β in the short run. However, the government further contributes to maximizing the optimal expected profit, which has been maximized by the monopolistic bank in the first stage, by means of controlling the capital K and the expected bad loan ratio β, under the government budget constraint given by the Program. In other words, the government maximizes the profit of either equation (7) or equation (12) with respect to both K and β, subject to the budget constraint:

$$\overline{C} = \delta_1(K - K_a) + \delta_2(\beta_a - \beta),\ \beta \le \beta_a \text{ and } K \ge K_a,\ \overline{C} > 0. \tag{20}$$

The point A (K_a, β_a) in Figure 2 is an initial level, δ_1 is the unit price of increasing bank capital from the present value K_a, and δ_2 is the unit price of decreasing the expected bad loan ratio from the present value β_a.[10] The budget expense for this Program is $\overline{C}$. As the iso-profit curve in the non-binding area of restriction (5) has the characteristic that $\lim_{\beta\to\beta_0} \frac{dK}{d\beta} = \infty$, the government actually maximizes the profit of equation (12) in the binding area with respect to K and β, subject to equation (20).

One might assume that the government cannot control the bank capital or the expected bad loan ratio. However, in practice, the RCCJ injects capital and purchases the claims of entrepreneurs forcibly, regardless of the intentions of banks and entrepreneurs. Banks and entrepreneurs have criticized such compulsory policy execution. Taking this fact into account, we perceive these variables as controllable.

4. An Assessment of the Program

4.1 A theoretical assessment

First, the optimal solution for this Program is derived from the two conditions. Under condition (i), the tangent of the iso-profit curve (18) is equal to that of the budget constraint (20), $\frac{dK}{d\beta} = \delta_2 / \delta_1$, which in turn leads to:

$$(gL^2 + d'L + c')\left(\frac{\partial \Pi}{\partial K}\right)^{-1} = \frac{\delta_2}{\delta_1} - (\lambda_b - \lambda_{1-b})\bar{k}L > 0, \tag{21}$$

where L= $(\bar{k}\,\theta)^{-1}$K, and the inequality holds because the left-hand side is positive. Under condition (ii), the solution is on the budget constraint (20). The solution (β, K) satisfying (i) and (ii) is uniquely determined because the iso-profit curve is strictly

[10] The government budget constraint (20) is originally expressed by the inequality. However, because the optimal profit in the first stage is strictly increasing in K but decreasing in β, the optimal solution is on the line of (20) and the budget constraint can be expressed by the equality for the optimal solution.

convex, as shown in Figure 2. We assume that the optimal solution exists.

Based on these considerations, the profit curve Π ($K-K_a$, $\beta_a-\beta$) is strictly quasi-concave. We define $X_\beta=\beta_a-\beta$ and $X_K=K-K_a$ as variables of the policy instruments (i.e. reduction of the bad loan ratio and injections of capital). Similar propositions hold for the two policy instruments as for consumer theory because the profit curve is strictly quasi-concave. The following Slutsky equation can be derived:

$$\frac{\partial X_\beta}{\partial \delta_2} = \left.\frac{\partial X_\beta}{\partial \delta_2}\right|_{\Pi = const} - X_\beta \frac{\partial X_\beta}{\partial \overline{C}} < 0 . \tag{22}$$

The derivation is given in the Appendix. The first term on the right-hand side of the equation can be referred to as the substitution effect of instrument β with respect to its own price and it is always negative. Further, the second term is referred to as the income effect and it is always negative. In contrast to consumer theory, there is no inferior good as the profit curve in our framework involves other specifications beyond the fact that it is strictly quasi-concave. Then, the gross substitution effect of instrument β with respect to its own price is always negative. However, the substitution effect with respect to the price of another instrument is positive and hence the gross substitution effect is ambiguous.

We conclude that the government should not attempt to reduce the bad loan ratio (the increase of X_β) when the price of doing so increases. We do not support the proposition that reducing the bad loan ratio is essential regardless of high costs. In addition, whether the government should increase bank capital injections when the price of X_β increases depends on whether the policy instruments are gross substitutes or complements.

The second stage in assessing the Program is to examine the surplus that depositors and borrowers gain, as the surplus indicates their welfare level. The monopolistic bank maximizes its profits. Then, the surplus level of the depositors and borrowers is below the level of competitive markets. The government maximizes the profit of a monopolistic bank by using the instruments it possesses within the budget constraint. If the government procedure can maximize the depositors' and borrowers' surpluses as well as maximizing the profit of the monopolistic bank, the Program is the best one available for the depositors and borrowers. However, government behavior does not necessarily provide a maximum surplus for the depositors and borrowers. Hence, it is meaningful to examine whether the framework of this Program can attain the maximum surplus as well as the maximum profit.

We investigate the surplus along the loan demand curve and the deposit supply curve, as the Program does not cause either curve to shift. By using (13), (14), and (20), differentiations of L and D with respect to β along the government budget constraint in the binding region lead to:

$$\frac{dL}{d\beta} = \frac{\partial L}{\partial K}\frac{dK}{d\beta} + \frac{\partial L}{\partial \beta} = (\bar{k}\theta)^{-1}\{(\delta_2/\delta_1) - (\lambda_b - \lambda_{1-b})\bar{k}L\}$$

$$= (\bar{k}\theta^2)^{-1}\{(\delta_2/\delta_1)\lambda_{1-b} - (\lambda_b - \lambda_{1-b})(\bar{C} + \delta_1 K_a - \delta_2\beta_a)/\delta_1\} > 0, \quad (23)$$

where the relations $\theta = (\lambda_b - \lambda_{1-b})\beta + \lambda_{1-b}$, $L = (\bar{k}\theta)^{-1}K$, and (20) are used for deriving the last equality; and

$$\frac{dD}{d\beta} = \frac{dL}{d\beta} - \frac{dK}{d\beta} = (\bar{k}\theta)^{-1}\{(\delta_2/\delta_1)(1-\bar{k}\theta) - (\lambda_b - \lambda_{1-b})\bar{k}L\}. \quad (24)$$

The right-hand side of (23) is independent of both β and K, and is positive, from (21). That is, (23) is positive at all points of β and K on the government budget constraint in the binding region. The sign of (24) is indefinite. However, if we can assume that $\bar{k}\theta$ is sufficiently small, then the sign of (24) is positive at all points on the budget constraint. On the other hand, we know from inequality (9) that $\frac{dL}{d\beta} < 0$ and $\frac{dD}{d\beta} < 0$ on the budget constraint in the non-binding region. It is clear that the maximum surplus cannot be attained at the inside point of the budget constraint if we take account of (8) and (9) in the non-binding, and of (13) and (14) in the binding regions. Therefore, the maximum surplus for the borrowers and depositors on the budget constraint is attained only at the boundary point between the two regions.

We conclude that the government profit-maximization procedure cannot lead to a maximum surplus for either depositors or borrowers as long as the government remains within the budget constraint. However, we can say that if a higher level of surplus is required than that obtained by the government's maximization procedure, both K and β should be increased along the budget constraint.

In the third stage of the assessment, we investigate the effect of the Basel II Framework on the Program. Differentiating the optimal profit with respect to λ_b, we have the inequality:

$$\frac{d\Pi}{d\lambda_b} < 0 . \qquad (25)$$

The derivation is given in the Appendix. The Basel II Framework plans to ease the risk weight on the assets, which would have a favorable impact on this Program, as it would lead to greater profits for the monopolistic bank.

4.2 An empirical assessment

How do we empirically assess whether the instruments have achieved the goal of the Program? Here, we partially assess the instruments, determining whether the necessary conditions exist for the optimal instruments to achieve the Program's goal. That is, we check if the instruments exist in the binding area, which is a necessary condition to achieve the Program's goal.

We examine whether the instrument exists in the binding area in two ways. First, we determine the signs of inequalities (8), (9), (13), and (14), and examine whether those inequalities hold true in practice. The deposit demand function in (6) and (7) is linearized by the Taylor expansion:

$$D(K+\Delta K,\ \beta+\Delta\beta) \approx D(K,\ \beta) + \frac{\partial D}{\partial K}\Delta K + \frac{\partial D}{\partial \beta}\Delta\beta , \qquad (26)$$

around (K, β), which denotes the values of the previous year, whereas (K+ΔK, β+Δβ) denotes the values of the present year. Assuming that the partial derivatives are constant and independent of (K, β), we rewrite equation (26) as:

$$\Delta D = a + b\Delta K + c\Delta\beta \ , \tag{27}$$

where ΔD, ΔK, and Δβ are the changes in deposit, capital, and expected bad loan ratios from the previous to the present year, respectively, and a, b, and c are fixed constants.

Then, we estimate the parameters using annual cross-section data from the Japanese banks. These variables are taken from the 2001, 2002, and 2003 issues of the Analysis of Financial Statements of All Banks, published by the Japanese Bankers' Association. The variables are deposit D and capital K (Reference Code for Financial Statement =aa, dk, respectively), and the bad loan ratio β includes all categories of bad loans (the actual bad loan ratio is used as a proxy for the expected bad loan ratio). We use data for all banks that follow the BIS regulation to maintain capital ratios at 8%. The numbers of banks was about 15, although it differed year to year because bank mergers occurred during these years. Most of the Japanese banks were subject to the 4% of domestic rules. The estimates from the ordinary least squares method are shown in Table 3. For 2001, the sign of b is negative, i.e., the instruments are in the non-binding area, but it is positive for 2002 and 2003, i.e., the instruments are in the binding area. This shows that the necessary conditions for achieving the Program's goal were in existence during 2002-2003. Moreover, the sign of c is negative, supporting the signs of (9) and (14), except that there is an ambiguity in 2003.

If the BIS regulation is actually binding, the bank capital ratio in (3) is 0.08. Therefore, the second way in which we examine whether the instrument exists in the binding area, is by determining whether the bank capital ratio was 0.08 during 2001-2003. Figure 3 indicates the bank capital ratios for the years 2001, 2002, and 2003 based on the Ginkobetsu-shyo-hiritsuhyo (in Japanese), published by the Japanese Bankers' Association. The bank capital ratios for all banks in all years exceeded 8%.

Our model postulates that the bank capital regulation is satisfied in terms of expectation and therefore the bank capital could be less than 0.08 in the probability sense. However, in practice, a bank capital ratio of less than 0.08 is not permitted in Japan, contrary to the assumptions of Milne (2002), and the bank in our model wants to keep its capital ratio sufficiently above 0.08 in the probability sense. Then, instead of (3), it is reasonable to assume that the bank behaves as follows:

$$\frac{K}{(\lambda_b \beta L + \lambda_{1-b}(1-\beta)L)} \geq \bar{k} + \alpha \ , \qquad (28)$$

where α is a premium to avoid violating the BIS regulation. If α is 0.02, the actual capital regulation is 0.1. The mean bank capital ratio for all banks in 2001 and 2002 was about 0.10, making the bank capital regulation binding, i.e., the instruments are in the binding area. However, the mean for 2003 was 0.1161 higher than 0.10, making the bank capital regulation non-binding, i.e., the instruments are in the non-binding area.

How should these differing yearly results be interpreted? If we rely on the estimated signs of derivatives on the deposit, we can interpret them to mean that the premium α increases in 2003. We will show the evidence for this increase. In fact, the capital injection at the beginning of 1998 was meant to apply to large banks obeying the BIS regulation of a 0.08 capital ratio. However, the capital injection was applied to many medium-sized banks following the BIS regulation of a 0.04 capital ratio (under a domestic rule) during 1999 to 2003. In addition, bank failures and mergers of large banks, including the UFJ, Risona, Mizufo, and Mitsui-Sumitomo banks, occurred during this period, as shown in Table 1. Such a serious situation induced the government to carefully inspect banks to discourage bad loans, and led banks to obey the capital ratio regulations strictly. Therefore, we assume that the premium increased during this period.

Therefore, one of the necessary conditions for the achievement of the Program's goal seems to be satisfied.

5. Conclusions

This paper provides a theoretical market equilibrium model to enhance policy analysis by assessing the Program for Financial Revival of the Japanese banks. The model incorporates the behavior of the banks, as well as the government, and the BIS bank capital regulation. Under the Program for Financial Revival, the government's policy instruments included capital injections to banks and the reduction of bad loans by purchasing claims of entrepreneurs. The government's goal was to achieve maximum profit for the banks, subject to its budget constraint. The analysis of the model revealed that: (i) the government can achieve the Program's goal only on the binding region of the BIS bank capital regulation under the budget constraint; (ii) the government should stop attempting to reduce bad loans when the cost of doing so increases; (iii) the government's profit-maximization procedure cannot result in a maximum surplus for either depositors or borrowers as long as the government remains within its budget constraint. However, if a higher level of surplus is required than that obtained by the government's maximization procedure, both K and β should be increased within the budget constraint; (iv) the Basel II Framework is favorable to the Program in the sense that it enhances the profits of the banks. The empirical evidence for Japanese banks, using data for the fiscal years 2001–2003, revealed that the necessary condition for achieving the Program's goal was satisfied.

The model in this paper simplified the actual revival Program and assessed it under a restricted theoretical framework. Needless to say, the relevance of our results crucially depends on whether our assumptions, including a monopolistic bank, are an accurate description of phenomena in the real world. This paper is a starting point for a theoretical examination of the Program for Financial Revival of the Japanese banks. An assessment of the Program under a more realistic framework is a subject for future research.

Appendix

[A] Proof of convexity for the function $K=(2g\beta)^{-1}((1-\beta)d'-d'')\bar{k}\,\theta$

Rewriting the function, we have:

$$K = (2g)^{-1}\bar{k}\,\{-d'(\lambda_b-\lambda_{1-b})\beta + (d'-d'')(\lambda_b-\lambda_{1-b}) - d'\lambda_{1-b} + (d'-d'')\lambda_{1-b}\beta^{-1}\}. \quad \text{(A.1)}$$

Then, the first and second derivatives of K with respect to β are given as follows:

$$\frac{dK}{d\beta} = -(2g)^{-1}\bar{k}\,\{d'(\lambda_b-\lambda_{1-b}) + (d'-d'')\lambda_{1-b}\beta^{-2}\} < 0, \quad \text{(A.2)}$$

$$\frac{d^2K}{d\beta^2} = g^{-1}\bar{k}\ \ (d'-d'')\lambda_{1-b}\beta^{-3}\} > 0. \quad \text{(A.3)}$$

[B] Derivation of (19)

Noting $L = (\bar{k}\theta)^{-1}K$, we have:

$$\frac{dL}{d\beta} = (\bar{k}\theta^2)^{-1}\{\frac{dK}{d\beta}\theta - K\frac{d\theta}{d\beta}\} = (\bar{k}-\theta)^{-1}(gL^2+d'L+c')\{\frac{\partial\Pi}{\partial K}\}^{-1} > 0. \quad \text{(A.4)}$$

From (15), we obtain:

$$\frac{d}{d\beta}(\frac{\partial\Pi}{\partial K}) = (\bar{k}\theta^2)^{-1}\{\frac{d}{d\beta}(\frac{\partial\Pi}{\partial L})\theta - \frac{\partial\Pi}{\partial L}\frac{d\theta}{d\beta}\}$$

$$= (\bar{k}\theta)^{-1}\{(2gL+d') + 2g\beta\frac{dL}{d\beta} + (\lambda_b-\lambda_{1-b})\theta^{-1}\frac{\partial\Pi}{\partial L}\} < 0. \quad \text{(A.5)}$$

Finally, from (18) we have:

$$\frac{d^2K}{d\beta^2} = (\frac{\partial\Pi}{\partial K})^{-2}[\{\frac{d}{d\beta}(gL^2+d'L+c')\}(\frac{\partial\Pi}{\partial K}) - (gL^2+d'L+c')\frac{d}{d\beta}(\frac{\partial\Pi}{\partial K})] + \bar{k}(\lambda_b-\lambda_{1-b})\frac{dL}{d\beta}$$

$$= (\frac{\partial\Pi}{\partial K})^{-2}[(2gL+d')(\frac{dL}{d\beta})(\frac{\partial\Pi}{\partial K}) - (gL^2+d'L+c')\frac{d}{d\beta}(\frac{\partial\Pi}{\partial K})] + \bar{k}(\lambda_b-\lambda_{1-b})\frac{dL}{d\beta}$$

$$> 0. \quad \text{(A.6)}$$

From (A.4), (15), and (A.5), the term in parentheses in the first equation is positive. In addition, from (A.4), the last term in the first equation is positive. Therefore, the inequality in (A.6) holds.

[C] Derivation of (22)

The Lagrange equation for the profit maximization problem is written:

$$L = \Pi(X_\beta, X_K) + \lambda(\overline{C} - \delta_1 X_K - \delta_2 X_\beta): X_\beta>0,\ X_K>0, \tag{A.7}$$

The profit curve is strictly quasi-concave. Then, the derivation of the proposition is obvious. We show only the derivation for the income effect. The Kuhn-Tucker condition for (A.7) and the total derivatives are:

$$\Pi_K = \lambda\delta_1,\ \Pi_\beta = \lambda\delta_2,\ \overline{C} = \delta_1 X_K + \delta_2 X_\beta:\ \Pi_K \equiv \partial\Pi/\partial X_K, \Pi_\beta \equiv \partial\Pi/\partial X_\beta$$

$$\begin{bmatrix} \Pi_{\beta\beta}, \Pi_{\beta K}, -\delta_2 \\ \Pi_{K\beta}, \Pi_{KK}, -\delta_1 \\ -\delta_2, -\delta_1, \quad 0 \end{bmatrix} \begin{bmatrix} dX_\beta \\ dX_K \\ d\lambda \end{bmatrix} = \begin{bmatrix} \lambda d\delta_2 \\ \lambda d\delta_1 \\ -d\overline{C} + (X_K d\delta_1 + X_\beta d\delta_2) \end{bmatrix} \tag{A.8}$$

We denote the matrix on the left-hand side of (A.8) as D. The determinant of D is:

$$|D| = \frac{\Pi_K}{\lambda^2}(2\Pi_{K\beta}\Pi_\beta - \Pi_{\beta\beta}\ \Pi_K) - \frac{\Pi_{KK}\Pi_\beta\Pi_\beta}{\lambda^2} \tag{A.9}$$

From (15), (16), and the strict convexity of K in terms of β, as seen in (19), |D| is positive. We can derive the income effect by using (A.8), and considering (12) and (15):

$$\frac{\partial X_\beta}{\partial \overline{C}} = \frac{\Pi_{\beta K}\delta_1 - \Pi_{KK}\delta_2}{|D|} > 0 \tag{A.10}$$

Then, the income effect $-X_\beta \dfrac{\partial X_\beta}{\partial \overline{C}} < 0$ is always negative.

[D] Derivation of (30)

The government maximizes the profit of equation (12) with respect to both K and β, subject to the budget constraint (20). As the optimal solution is obviously on the budget constraint, we can consider that K is a function of β. Then, we can obtain a solution in a different manner to that of the main text, as follows. The first-order condition of a solution is:

$$\frac{d\Pi}{d\beta} = -(gL^2 + d'L + c') + \frac{\partial\Pi}{\partial L}\frac{dL}{d\beta} = 0, \tag{A.11}$$

where $L = (\bar{k}\theta)^{-1}K$, $\theta = (\lambda_b - \lambda_{1-b})\beta + \lambda_{1-b}$, and K is defined by (20). The solution for (A.11) is $\beta = \beta(\lambda_b)$. Noting $\Pi = \Pi[L(\beta(\lambda_b), \lambda_b), \beta(\lambda_b)]$ at the optimal β, we have:

$$\frac{d\Pi}{d\lambda_b} = \frac{\partial\Pi}{\partial\beta}\frac{d\beta}{d\lambda_b} + \frac{\partial\Pi}{\partial L}\frac{\partial L}{\partial\lambda_b} = -\{-2g\beta L + (1-\beta)d' - d''\}\theta^{-1}\beta L < 0. \tag{A.12}$$

We note that the term $\frac{\partial \Pi}{\partial \beta}$ in (A.12) is equal to $\frac{d\Pi}{d\beta}$ in (A.11), making it zero. The inequality in (A.12) holds from (15).

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Table 1. The number of failures of financial institutions

Fiscal years	1981-85	1986-90	1991-95	1996	1997	1998	1999	2000	2001	2002	2003
Total Failures	0	0	14	5	17	30	44	14	56	0	1
Bank	0 (157)	0	3 (154)	1	3	5	5	0 (136)	2	0	1 (131)
Shinkin-bank	0 (461)	0	2 (451)	0	0	0	10	2 (371)	13	0	0 (306)
Credit-cooperatives	0 (475)	0	9 (407)	4	14	25	29	12 (240)	41	0	0 (181)

Source: *Annual Report* (2004, p.1), Deposit Insurance Corporation of Japan. The entries in parentheses denote the number of financial institutions that existed in March of 1981, 1991, 2001, and 2004: *Economic Statistics Annual,* Bank of Japan.

Table 2. Credit crunch clams by hotlines

Period	2002:Q4 ~ 2003:Q1	2003:Q2	2003:Q3	2003:Q4	2004:Q1	2004:Q2
Numbers	428	257	222	157	116	107

Table 3. Estimation results for the parameters of the deposit function

$$\Delta D_i = a + b\Delta K_i + c\Delta\beta_i + \varepsilon$$

Year	a	b	c	$\overline{R}^2$	Sample size
2001	579809 (1.62)	-4.735 (-3.35)	-9.1E+07 (-3.94)	0.46	17
2002	457673.4 (1.82)	3.339 (3.84)	-4.4E+07 (-3.48)	0.59	12
2003	364216.7 (1.18)	2.940 (2.68)	6961596 (0.37)	0.44	14

Note: the numbers in parentheses are the t-values for the estimated parameters. $\overline{R}^2$ is the adjusted R^2.

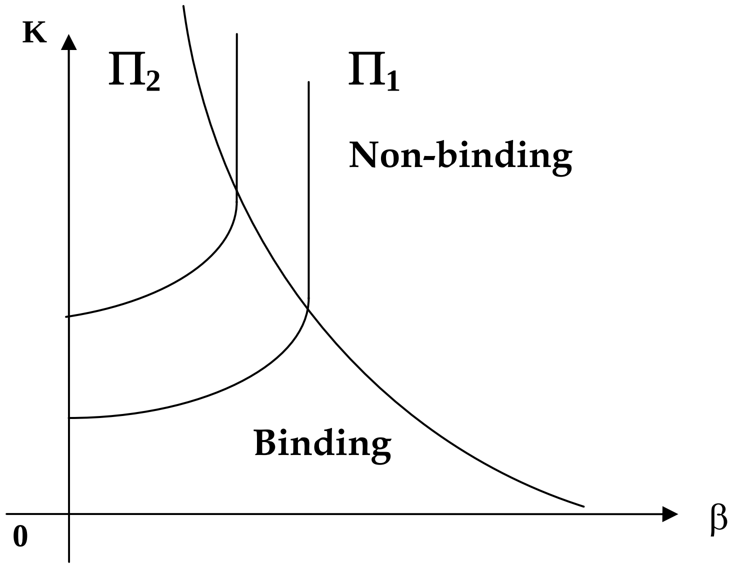


Figure 1

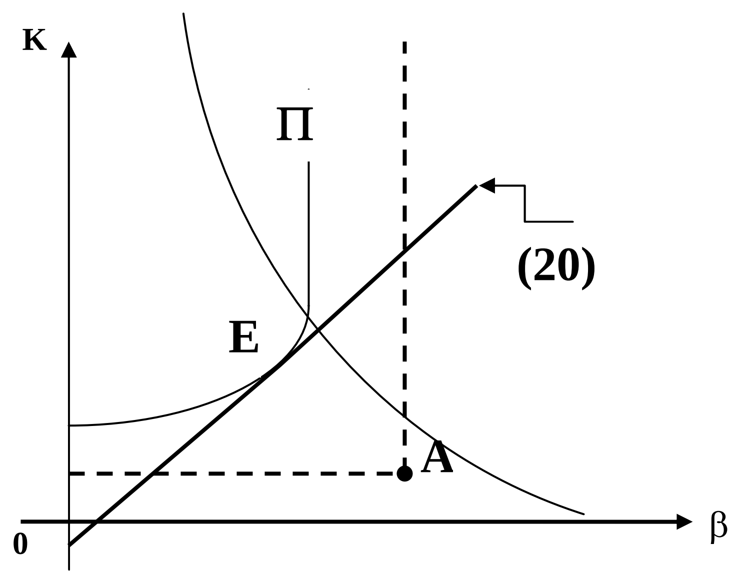
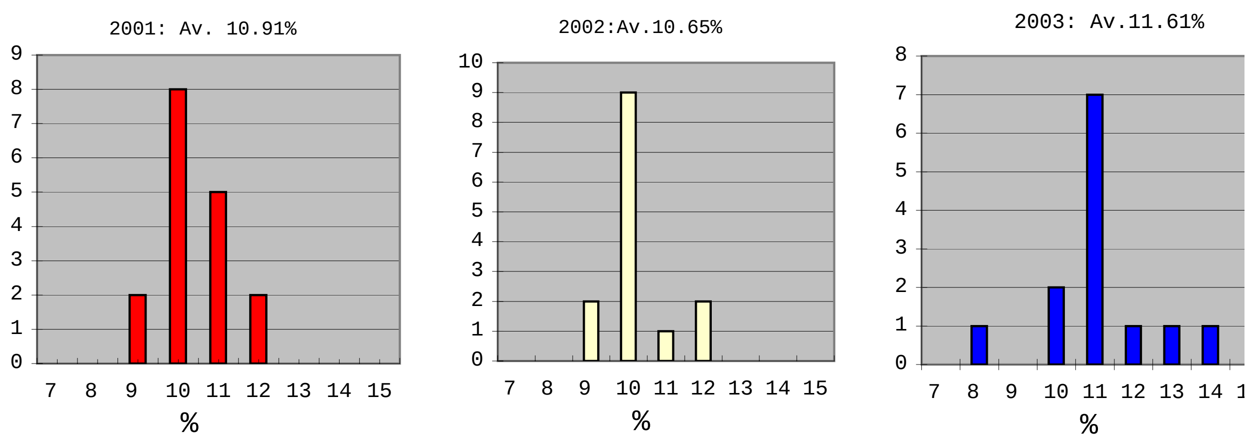
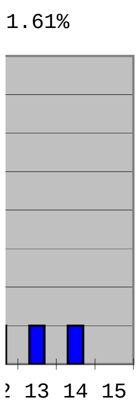


Figure 2

Figure 3. Bank Capital Ratio



Notes: The number on the vertical axisis is the number of the banks.
The Av. denotes the average of the bank capital ratio for all banks.


1.61%
13
14
15