A Lender of Last Resort for Public Banks? Theory and an Application to Japan Post Bank*

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Abstract

This paper analyzes different regulatory arrangements for public banks in a liquidity crisis and applies the analysis to the current privatization process of the Japan Post Bank (JPB). We show that with suitably designed recapitalization rules, social welfare is higher than when complete discretion is allowed. For the latter case, we derive conditions under which the central bank or deposit insurer should act as lender of last resort (LLR). Moreover, we report details of the JPB privatization and show that in the case of a liquidity crisis at the JPB, the current allocation of the LLR function to the Bank of Japan is inefficient.

Keywords: Public banking; lender of last resort, central bank, deposit insurance, forbearance, Japan Post Bank.

JEL-Codes: G21, G28, L32

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1 Introduction

Although there has been a tendency towards the privatization of financial institutions until recently, public ownership of banks remains common. In 1995, the mean of government ownership of banks around the globe was about 41.6 percent (La Porta et al., 2002). Furthermore, several large banks have been partially or fully nationalized in the course of the recent financial crisis. There are two opposing views on the welfare effects of public banks. On the one hand, several papers argue that public banks enhance social welfare as they improve financial stability or provide funding for socially beneficial projects that, for instance due to externalities, could otherwise not be realized (Stiglitz, 1994; Allen and Gale, 2000; Hakenes and Schnabel, 2004; 2006). On the other hand, it is claimed that public banks lead to inefficiencies due to political pressures (Kornai, 1979; Shleifer and Vishny, 1994; Boycko, Shleifer and Vishny, 1996).[1]

Unlike these contributions, our paper focuses on the liability side of public banks. In particular, we analyze the optimal design of financial assistance for a public bank in a liquidity crisis. With this focus, our paper is closely related to Repullo (2000) and Kahn and Santos (2005, 2006), who consider whether the central bank or the deposit insurer should act as lender of last resort (LLR) or as a bank supervisor when information about the solvency of banks is non-verifiable. They show that the optimal allocation of the LLR function depends on the extent of a bank's liquidity shortage and that, in a multi-regulator arrangement, it is optimal to give supervisory power to the deposit insurer. A central assumption of these papers is that, in the event of a liquidity crisis, a bank will be forced into bankruptcy unless it obtains financial assistance from the LLR. Accordingly,

[1] The empirical literature provides more support for the hypothesis that public banks have negative welfare effects, see, e.g., Dinç (2005), Faccio (2006), Faccio, Masulis and McConnel (2006) and Micco, Panizza and Yanez (2007).

their results can be applied to private banks with dispersed ownership, which are unable to raise fresh capital at short notice.[2] In contrast, our model allows for a recapitalization by bank owners when a liquidity crisis occurs, which is a plausible assumption in the case of a public bank.

Our theoretical analysis focuses on two aspects. First, we investigate the incentives of a public bank's owner to provide fresh capital when a liquidity crisis has occurred. We find that under discretion, recapitalization decisions are not socially optimal (i) if the owner places a different weight on social bank failure costs than society, or (ii) if deposits are guaranteed by a deposit insurer, so that the owner does not bear all losses if the bank fails. In both cases, however, there is an optimal recapitalization rule that aligns the bank owner's preferences with social preferences, either by subsidizing (if the capital injections are too small) or taxing (in the case of excessively large capital injections) recapitalization. Second, we discuss the implications of adding a LLR - the central bank or deposit insurer - to the discretionary case. We find that the allocation of the LLR function will be relevant only if the deposit insurer guarantees deposits. Then, unlike the central bank, the deposit insurer provides funds as the LLR only if potential long-term losses from guaranteeing deposits are not excessively large. Moreover, we derive conditions under which the implementation of a LLR enhances social welfare. A LLR, however, does not generally ensure a socially optimal recapitalization policy.

While these theoretical results can be applied to any public bank, we use them specifically to assess the regulatory framework of the Japan Post Bank (JPB), which - as part of Japan Post Holdings Co. - is one of the largest banks in the world. At present, Japan

[2] Other papers that analyze the bail-out of private banks are Aghion, Bolton and Fries (1999), Diamond (2001a, 2001b) and Osano (2002, 2005). These papers focus on the incentive effects of public bail-outs on bank managers.

Post Holdings Co. is owned completely by the government (the Ministry of Finance). It is, however, undergoing a privatization process which commenced in October 2007. Over a ten year transition period, the government is obliged to reduce its stake in the Holding Company to 33 percent. Moreover, the JPB is expected to start going public in 2010. At the end of the transition period in September 2017, all of its shares must be traded on the stock market (Japan Post, 2008a).

JPB is an interesting case because during the privatization process, it has a hybrid liability structure as contracts for postal savings have been differentiated between those concluded before privatization ("old deposits") and those concluded since October 1, 2007 ("new deposits"). Old deposits together with corresponding asset accounts were assigned to a separate corporate body that is legally independent of the JPB. These deposits are guaranteed by the government but the administration and investment of assets and liabilities are commissioned to the JPB (CEFP, 2004: 7-9; Office of the United States Trade Representative, 2007). All new contracts, however, are insured through the Deposit Insurance Company of Japan (DICJ). These agencies and the Bank of Japan (BoJ), which serves as lender of last resort for Japanese banks, may pursue different goals. Accordingly, we assess how the current regulatory framework for the JPB affects the recapitalization of the JPB in the event of a liquidity crisis.

With the assessment of the regulatory framework for JPB, our paper contributes to the existing literature on JPB privatization. Porges and Leong (2006) describe the JPB privatization and consider whether privatization creates a level playing field for postal services. Amyx et al. (2005) and Maclachlan (2004, 2006) describe the political power struggle before the decision to privatize the Japanese postal service. Imai (2007) analyzes politician's attitudes towards post bank privatization. Imai (2008) examines whether

JPB helped raising untapped savings from savers who did not have access to private depository services. We add to this literature by analyzing the likely outcomes of liquidity assistance to JPB during the ten years transition period in which JPB is still owned by the government.

The paper is organized as follows: Section 2 presents the model and derives optimal liquidity assistance in a benchmark case with no informational asymmetries. Section 3 analyzes the government's incentives to recapitalize a public bank under discretion and proposes a rule which ensures optimal liquidity assistance. Section 4 assumes that such a rule does not exist and analyzes the behavior of the government and the LLR under discretion. Section 5 assesses the regulatory framework for JPB during privatization. Section 6 concludes.

2 Model set-up and benchmark case

We consider an economy at date t with three types of agents: a government (the Ministry of Finance) that owns a public bank and two regulatory authorities, the central bank (CB) and the deposit insurer (DI), which may act as LLR. The public bank consists of two divisions, $i = o, n$, where o stands for the "old" division and n for the "new" division. As is the case for JPB, all deposits in the old division are guaranteed by the government, whereas deposits with the new division are guaranteed by the deposit insurer.[3]

Inspired by Repullo (2000), we assume that at a previous date $t-1$, each division i of the bank has invested 1 USD in an indivisible, long-term project which matures at date $t+1$. If the division pursues the project until this date, it yields either a return R_i (with probability u_i) or nothing at all. At the investment date $t-1$, the probability

[3] To simplify the exposition, we normalize the insurance premium to zero.

of success u_i is a random variable with density function $f(u_i)$ satisfying $E[u_i] R_i > 1$. Thus, when making the investment, the project will have a positive expected net present value if held until maturity. At the current date t, the government as the division's owner privately observes the realization of u_i. Moreover, the project is illiquid. If it is terminated prematurely at the current date t, it will have only a small liquidation value $L_i \in (0, 1)$. The long-term project is the only asset that division i possesses. That is, it has no liquid funds.

Each bank-division i has financed its investment at date $t-1$ through demandable deposits $D_i = 1$. They can either be withdrawn early at date t or late at date $t+1$. A publicly observable fraction $v_i \in (0, 1)$ of deposits is withdrawn early at the current date t. As there are no liquid funds at this date, v_i can be interpreted as a liquidity shock suffered by division i. If it obtains funds of at least v_i from the government as its owner or the LLR in t, the division can pay out early depositors without terminating the long-term project. Project returns at date $t+1$ will then be either R_i or zero. Otherwise, the division will be forced to liquidate its project. The liquidation value L_i then materializes and there are no returns in $t+1$.

There is no legal relationship between the two divisions. Accordingly, the returns earned by one division cannot be used for paying out depositors from the other. Therefore, a bankruptcy of either division can occur at date t or at date $t+1$. It will occur at t if the division does not receive sufficient liquidity from the owner or from the LLR, because the liquidation proceeds L_i do not suffice to pay out all depositors. A Bankruptcy will occur at $t+1$ if the division has obtained financial assistance at t and the project fails at $t+1$, so that there are no funds available for paying out late depositors. If division i goes bankrupt, there is a social cost $D_i c_i = c_i$ due to, e.g., systemic risk and contagion to other banks. In addition, bankruptcy implies that the agent who has guaranteed deposits is obliged to pay out those depositors who receive nothing from the bankrupt division. In the event of bankruptcy of the old division, this obligation devolves on the government. If, in contrast, the new division is bankrupt, the DI will pay out the remaining depositors.

All agents in the economy are risk-neutral. The preferences of agents are represented by an additive-separable utility function defined over private profits and the social costs of bankruptcy. That is, as the owner of the bank, the government cares about expected net profits of the bank's divisions and the social bankruptcy costs c_i. It weights the latter with a factor $\alpha > 0$. The two regulatory authorities, the CB and the DI, both weight social bankruptcy costs with a factor $\beta > 0$. In addition, they care about expected losses (or profits) when acting as LLR and, in case of the DI, about the expected costs of guaranteeing deposits with the new division. In what follows, we restrict attention to the case $\alpha + \beta \geq 1$.[4] Finally, we assume that the regulatory authorities supervise the bank. Hence, they find out the realization of the success probabilities u_o and u_n at date t. This is, however, assumed to be non-verifiable by the public.

Before we analyze government and regulator behavior in a liquidity crisis, it is useful to examine a benchmark case in which the probabilities of success u_o and u_n are publicly observable and verifiable. In this first-best case, from the perspective of social welfare, it is optimal to provide financial assistance to division i at date t if the expected returns less the social bankruptcy costs of continuing the project are (weakly) higher than the

[4] This assumption simplifies the formal analysis without affecting our qualitative results.

liquidation proceeds, net of c_i. Division i should thus obtain sufficient liquidity at date t if $u_i R_i - (1 - u_i)\, c_i \geq L_i - c_i$. Accordingly, as in Repullo (2000), we obtain:

$$u_i \geq \frac{L_i}{R_i + c_i} =: u_i^*. \tag{1}$$

Hence, in order to maximize social welfare, each bank division should be closed if and only if the success probability of its long-term project is below a certain threshold u_i^*. The threshold is higher, the higher is the liquidation value L_i of the project and the lower are the potential long-term project returns R_i and the bankruptcy costs c_i. Moreover, u_i^* does not depend on the liquidity shock at t, as neither the potential liquidation proceeds nor the long-term project returns or the social bankruptcy costs depend on v_i.

3 Recapitalization by the government: Discretion vs. rules

When the success probabilities u_o and u_n of the divisions' projects are not publicly observable or verifiable, it is impossible to directly implement the first-best recapitalization rule (1). This raises the question of whether there is a suitable regulatory framework which induces a first-best recapitalization. This section concentrates on government incentives to recapitalize the bank's divisions after the liquidity shocks have materialized. We proceed in two steps. First, we analyze the government's behavior assuming that it can make discretionary recapitalization decisions. In this situation, the first-best will not be achieved unless some rather specific conditions are met. Second, we show that recapitalization rules can ensure that the government always chooses the first-best recapitalization policy.

3.1 Recapitalization under discretion

If no LLR provides liquidity assistance at date t, the government can choose between two options after a liquidity shock v_i has emerged. It can either inject its own liquid funds $K_i^{GOV} = v_i$ into division i so that bankruptcy is avoided, or it can refuse to provide funds implying that division i goes bankrupt at date t.[5] The government's incentives to recapitalize will differ between the divisions as it guarantees only the deposits of the old division but not the deposits of the new one.

For a given liquidity shock v_o, the government will provide a liquidity injection $K_o^{GOV} = v_o$ to prevent the old division going bankrupt at date t if:

$$-v_o - (1 - v_o) + u_o R_o - (1 - u_o)\,\alpha c_o \geq L_o - 1 - \alpha c_o. \tag{2}$$

The left-hand side of (2) represents the government's expected payoff if it recapitalizes the old division so that it continues to exist until $t + 1$. The government must then inject v_o into the division at date t. This amount is used to pay out early depositors. Moreover, at date $t + 1$, a total of $1 - v_o$ must be paid to late depositors, irrespective of the success of the long-term project. At this date, the project yields a return R_o with probability u_o, while it fails with probability $1 - u_o$, in which case the government has to bear bankruptcy costs c_o which are weighted by α. The right-hand side of (2) is the government's payoff when the division is closed at date t. Liquidation then yields L_o, the government must pay 1 to all depositors and bear the weighted bankruptcy costs.

[5] When recapitalizing a division, the government could, of course, also decide to provide more liquid funds than needed by choosing $K_i^{GOV} > v_i$. It will become apparent from the subsequent analysis, however, that the government never prefers a recapitalization with $K_i^{GOV} > v_i$ over a recapitalization with $K_i^{GOV} = v_i$. Therefore, restricting attention to the latter case does not sacrifice any generality.

It follows from (2) that the government will recapitalize the old division only if:

$$u_o \geq \frac{L_o}{R_o + \alpha c_o} =: \overline{u}_o. \tag{3}$$

Thus, if the probability of success u_o is not below the threshold $\overline{u}_o$, the government will recapitalize the old division after the liquidity shock has emerged. As was the case in the first-best scenario, the threshold does not depend on the magnitude of the liquidity shock. This is because the government guarantees all deposits, implying that the timing of deposit withdrawals is irrelevant for its recapitalization decision. However, the threshold $\overline{u}_o$ can differ from the first-best threshold u_o^*. On the one hand, if $\alpha < 1$ holds true, $\overline{u}_o$ will be higher than u_o^*. In this case, the government is too tough. That is, for any $u_o \in [u_o^*, \overline{u}_o)$, it refuses to provide liquid funds to the old division, although this would be optimal from a first-best perspective. This overly tough behavior stems from the too small weight that the government places on bankruptcy cost avoidance when recapitalizing the division. If, on the other hand, $\alpha > 1$ and thus $\overline{u}_o < u_o^*$ holds true, the government will be too soft so that it recapitalizes the division in some instances, although the division would be closed in a first-best world.

At the new division, deposits are guaranteed by the DI. Therefore, the government will inject liquidity $K_n^{GOV} = v_n$ into the new division if:

$$-v_n + u_n \left[R_n - (1 - v_n)\right] - (1 - u_n)\, \alpha c_n \geq -\alpha c_n. \tag{4}$$

The left-hand side of (4) is the government's expected payoff in the case of a recapitalization of the new division; the right hand side is the expected payoff of liquidation. In the former case, the liquidity injection v_n at date t goes to early depositors. If the project is successful at $t+1$, returns R_n materialize and late depositors receive $1-v_n$. If it fails, the division pays nothing to late depositors and the government bears the weighted bankruptcy costs. In the latter case, the liquidation proceeds $L_n < 1$ are used entirely to repay depositors so that the government receives nothing but suffers from bankruptcy costs.

Condition (4) results in:

$$u_n \geq \frac{v_n}{R_n - (1 - v_n) + \alpha c_n} =: \overline{u}_n (v_n), \tag{5}$$

so that the government will, as was the case with the old division, recapitalize the new division at date t only if the probability of success is sufficiently high. Now, however, the threshold $\overline{u}_n$ does depend on the magnitude of the liquidity shock with $\overline{u}_n$ being higher, the higher is the level of v_n. The intuition for this result is straightforward. The larger is the liquidity shock of the new division at t, the larger will be the amount that the government loses if it keeps the division in operation and the project ultimately fails. Relative to a first-best scenario, the government will thus be too soft in recapitalizing the new division if the shock is small, $v_n < \frac{R_n - 1 + \alpha c_n}{R_n - L_n + c_n} L_n =: v_n^*$, while, at least as long as α is not too large, it will be too tough if v_n is large with $v_n > v_n^*$.

3.2 Recapitalization under a rule

We have seen that discretion almost never leads to a first-best government recapitalization policy. A recapitalization rule might, therefore, be a useful instrument for improving governmental decisions. We will now determine whether this is indeed the case.

As a starting point, assume that, at date $t-1$, the following rule is stipulated: If the observable liquidity shock of division i turns out to be v_i at date t, the government may recapitalize the division only if it injects K_i^{GOV} into it. The remainder $K_i^{LLR} = v_i - K_i^{GOV}$ will then be provided by the LLR. Three remarks useful in clarifying this rule. First, we do not place any restriction on K_i^{GOV}. That is, a rule can, for example, stipulate $K_i^{GOV} > v_i$, implying that K_i^{LLR} is negative. This could be interpreted as a tax that the government must pay when recapitalizing a division. Second, we treat K_i^{LLR} as a one-off payment from the LLR to the division (in case of $K_i^{LLR} > 0$) or vice versa (in case of $K_i^{LLR} < 0$) that is not repaid.[6] Third, while the rule can be made contingent on the observable liquidity shock v_i, it cannot be made contingent on u_i as the success probabilities of the projects are not verifiable.

Given a rule $\langle K_o^{GOV}; K_o^{LLR} \rangle$, the government will prefer recapitalization of the old division over liquidation if:

$$-K_o^{GOV} - (1 - v_o) + u_o R_o - (1 - u_o) \alpha c_o \geq L_o - 1 - \alpha c_o. \tag{6}$$

Note that (6) differs from the discretionary case (2) in only one respect. Under the rule, the government must pay K_o^{GOV} for a recapitalization instead of v_o. From (6), it follows that the government will recapitalize the old division if:

$$u_o \geq \frac{L_o - \left(v_o - K_o^{GOV}\right)}{R_o + \alpha c_o} =: \overline{u}_o^{rule}.$$

A comparison of u_o^* and $\overline{u}_o^{rule}$ then leads directly to:

[6] Alternatively, we could assume that, for instance, in the case of $K_i^{LLR} > 0$, the LLR provides a credit which must be repaid with a positive probability. Then, we could reinterpret K_i^{LLR} as the difference between the credit amount provided at date t and the expected credit repayment at date $t + 1$. This, however, would complicate the analysis without yielding much additional insight.

Proposition 1 *A recapitalization rule:*

$$\left\langle K_o^{GOV} = v_o - \frac{1-\alpha}{R_o + c_o} c_o L_o ; K_o^{LLR} = \frac{1-\alpha}{R_o + c_o} c_o L_o \right\rangle$$

ensures that the government will recapitalize the old division at date t if $u_o \geq u_o^*$.

The essence of the proposition is that a rule can induce the government to recapitalize the old division as in the first-best case. This is achieved by a money transfer K_o^{LLR}, which does not depend on the liquidity shock v_o. Recall from (3) that under discretion, the government will be too tough if $\alpha < 1$. The optimal rule then stipulates a payment from the LLR to the government, provided that the latter recapitalizes the division. This payment makes the government softer so that a first-best recapitalization policy is achieved. If, however, $\alpha > 1$ holds true, the government tends to be too soft so that the optimal rule induces first-best behaviour by forcing the government to pay a fixed amount to the LLR when recapitalizing the division. Thus, in case of the old division, the optimal recapitalization rule will involve a subsidy if discretion is associated with too tough behaviour while it will involve a tax if discretion is associated with too soft behaviour. Moreover, the subsidy or tax is independent of v_o as the behavior of the government under discretion does not depend on v_o either. This is due to the government's obligation to guarantee deposits fully.

The implications of a rule $\left\langle K_n^{GOV}; K_n^{LLR} \right\rangle$ for the new division are somewhat similar. Here, the government is willing to recapitalize the division at date t if:

$$-K_n^{GOV} + u_n \left[R_n - (1 - v_n) \right] - (1 - u_n) \alpha c_n \geq -\alpha c_n. \tag{7}$$

Again, the only difference between (7) and the discretionary case (4) is the different payment that the government must make if it wishes to avoid liquidation. Accordingly, the threshold for a recapitalization of the new division is given by:

$$u_n \geq \frac{K_n^{GOV}}{R_n - (1 - v_n) + \alpha c_n} =: \overline{u}_n^{rule},$$

and we thus obtain:

Proposition 2 *A recapitalization rule:*

$$\left\langle K_n^{GOV} = \frac{R_n - (1 - v_n) + \alpha c_n}{R_n + c_n} L_n ; K_n^{LLR} = v_n - \frac{R_n - (1 - v_n) + \alpha c_n}{R_n + c_n} L_n \right\rangle$$

ensures that the government will recapitalize the new division at date t if $u_n \geq u_n^*$.

The proposition shows that under an optimal rule, the government's decision on recapitalizing the new division will always be the first-best. Contrary to the case of the old division, the optimal rule for the new division depends on the realization of the liquidity shock v_n. If it is relatively small, $v_n < v_n^*$, the rule stipulates $K_n^{LLR} < 0$ with $\frac{\partial K_n^{LLR}}{\partial v_n} > 0$. It thus punishes recapitalization with a tax that decreases in the liquidity shock v_n of the new division. This leads to first-best recapitalization as the government would be too soft under discretion with the degree of overly soft behaviour being lower, the higher is the level of v_n. For large shocks $v_n > v_n^*$, the rule implies a subsidy $K_n^{LLR} > 0$, which increases in v_n since under discretion, the government tends to tougher, the higher is the liquidity shock.

To sum up this section, first-best recapitalization decisions can be achieved by suitably designed recapitalization rules, even though the realization of the success probabilities of the divisions' projects is not publicly observable. The optimal rule either subsidizes (when the government tends to be too tough) recapitalization or taxes it (when the government tends to be too soft). For the old division, the optimal subsidy or tax depends on the weight α that government places on bankruptcy costs while it is independent of the liquidity shock. For the new division, recapitalization is taxed for small shocks and it is subsidized for large shocks. Note that the optimal rule leaves no room for self interested discretionary behavior on the part of the LLR. Therefore, under a recapitalization rule, it is actually irrelevant which institution serves as LLR.

4 The interaction of the government and the LLR

One might argue that optimal recapitalization rules, as derived in the preceding section, are somewhat hard to implement. Because the government usually has at least some de facto or de jure legislative power, it could simply change the rules after a liquidity shock has emerged. Consequently, this section analyzes the implications of discretionary behavior of both the government, as the owner of the public bank, and the LLR for the recapitalization of the bank's divisions. For either division i, we proceed in three steps. First, we determine the maximum amount of liquidity that the government is willing to inject in order to prevent bankruptcy. We then determine the maximum amount that the LLR would be willing to provide in order to save the division. In the last step, we determine the conditions under which the division will survive until date $t+1$ and derive the optimal institutional arrangement under discretion.

4.1 Old division

Under what conditions will the old division of the public bank obtain sufficient funds at date t to prevent its bankruptcy when the government and the LLR jointly make discretionary recapitalization decisions? The government prefers a recapitalization of the division over liquidation at date t if (6) is met. This condition can be rearranged to:

$$K_o^{GOV} \leq v_o - L_o + u_o \left(R_o + \alpha c_o\right) =: \widehat{K}_o^{GOV},$$

with $\widehat{K}_o^{GOV}$ denoting the government's maximum willingness to pay for a recapitalization at date t. As one would expect, $\widehat{K}_o^{GOV}$ decreases in the potential liquidation proceeds L_o while it increases in the success probability u_o of the project, the potential return R_o, and social bankruptcy costs c_o. In the next step, we derive the behavior of the LLR under discretion. For the old division, it is not necessary to differentiate between the case of the CB acting as LLR and the DI as LLR. There are two reasons for this. First, neither institution is responsible for paying out remaining depositors when the division goes bankrupt. Second, both institutions attach the same weight β to social bankruptcy costs c_o. Therefore, the preferences of the CB as LLR and the DI as LLR are identical. In either case, the LLR cares only about the payoff of subsidizing or taxing recapitalization at date t and about the weighted expected bankruptcy costs. That is, the LLR prefers to pay K_o^{LLR} for a recapitalization of the old division rather than to liquidate it at date t if:

$$-K_o^{LLR} - \left(1 - u_o\right) \beta c_o \geq -\beta c_o$$

or if $K_o^{LLR} \leq u_o \beta c_o =: \widehat{K}_o^{LLR}$. The LLR is thus willing to provide more funds for recapitalization, the higher is the success probability of the project and the higher are social bankruptcy costs.

Based on the maximum willingness to pay $\widehat{K}_o^{GOV}$ of the government and the maximum willingness to pay $\widehat{K}_o^{LLR}$ of the LLR, we can now assess whether or not the old division will be recapitalized at date t. If the sum of $\widehat{K}_o^{GOV}$ and $\widehat{K}_o^{LLR}$ covers the liquidity shock v_o, the government and the LLR will agree to recapitalize the old division which then survives until $t+1$. If, however, $\widehat{K}_o^{GOV} + \widehat{K}_o^{LLR}$ falls short of v_o, no arrangement exists which is acceptable for both parties and prevents liquidation. Accordingly, the government and the LLR will recapitalize the division under discretion only if:

$$u_o \geq \frac{L_o}{R_o + (\alpha + \beta)\, c_o} =: \widetilde{u}_o. \tag{8}$$

It is evident from (8) that the interaction of the government and the LLR leads to a recapitalization policy for the old division that is independent of the liquidity shock v_o. This is because in any circumstances the responsibility for paying out depositors devolves on one of the two parties, namely the government. In addition, due to $\widetilde{u}_o < \overline{u}_o$, adding a LLR to the discretionary case unambiguously leads to a softer recapitalization policy. As the LLR, be it the CB or the DI, derives utility from a recapitalization of the old division in form of a possible avoidance of bankruptcy costs, it is always willing to provide some liquid funds for recapitalization so that the threshold for the success probability decreases. Put differently, the implementation of a LLR leads to an internalization of the utility of recapitalization that would otherwise not be accounted for.

Unless $\alpha + \beta = 1$, the threshold $\widetilde{u}_o$ differs from the first-best threshold u_o^* so that the coexistence of the government and the LLR does not lead to a first-best recapitalization policy under discretion. Instead, if $\alpha + \beta > 1$, their recapitalization decisions will be too soft. However, given that there is no recapitalization rule, should there be a LLR for the old division from the perspective of social welfare? In order to answer this question, we need to compare the social loss under discretion with and without an LLR. This leads to:

Proposition 3 *From a social welfare perspective, the existence of a LLR for the old division under discretion:*

- *is never beneficial if* $\alpha \geq 1$*;*
- *is beneficial if* $\alpha < 1$ *and* $\beta < \beta^{crit}$*, where* β^{crit} *is defined implicitly by:*

$$\int_{\widetilde{u}_o}^{\overline{u}_o} \left(u_o \left(R_o + c_o\right) - L_o\right) f\left(u_o\right) du_o = 0.$$

Proof. See Appendix. ■

The proposition suggests to distinguish between two cases under discretion. First, the introduction of a LLR that can act in its own self interest will never lead to a recapitalization policy that is closer to first-best if the government places a high weight $\alpha \geq 1$ on social bankruptcy costs. In this case the government will already be too soft if there is no LLR. If a LLR then is implemented, the policy will become even softer so that there are more instances in which the old division is not liquidated, although this would raise social welfare. Second, if the government places a relatively small weight $\alpha < 1$ on bankruptcy costs, the existence of a LLR may lead to higher social welfare. In this case, the government would be too tough if there were no LLR. The introduction of a LLR then again leads to a softer recapitalization policy which will be more in line with first-best recapitalization as long as β does not exceed a threshold β^{crit}. Otherwise, the LLR would induce the government to recapitalize the old division, even for very small success probabilities, so that social welfare will be higher if there is no LLR.

4.2 New division

In case of bankruptcy of the new division, depositor claims are not guaranteed by the government. Therefore, a recapitalization of the new division that costs K_n^{GOV} will make the government (weakly) better off than liquidation at date t if condition (7) is met. The government is thus willing to pay, at most, $\widehat{K}_n^{GOV} := u_n (R_n - (1 - v_n) + \alpha c_n)$ for a recapitalization at date t.

Let us now determine the LLR's willingness to pay for a recapitalization of the new division at date t. Here, in contrast to the old division, we need to differentiate between the CB and the DI acting as LLR. While the former institution suffers only from the weighted social costs if the division goes bankrupt, the latter must make an additional payment to the remaining depositors, because it has guaranteed the deposits.

Assume for the moment that the CB acts as LLR. If it provides liquidity K_n^{CB} to the new division in order to prevent liquidation, the CB will lose this amount and suffer from the bankruptcy costs with a probability of $1 - u_n$. As liquidation leads to bankruptcy costs with certainty, the CB prefers the former alternative over the latter if:

$$-K_n^{CB} - (1 - u_n) \beta c_n \geq -\beta c_n.$$

Consequently, its maximum willingness to pay for recapitalization satisfies $\widehat{K}_n^{CB} := u_n \beta c_n$.

The government and the CB as LLR will agree on a recapitalization of the new division only if $\widehat{K}_n^{GOV} + \widehat{K}_n^{CB}$ covers the division's liquidity needs v_n. Under discretion, they will thus recapitalize the new division at date t only if:

$$u_n \geq \frac{v_n}{R_n - (1 - v_n) + (\alpha + \beta) c_n} =: \widetilde{u}_n^{CB}(v_n). \tag{9}$$

The threshold $\widetilde{u}_n^{CB}$ increases in v_n since, from the perspective of the government and the CB, higher liquidity shocks are associated with a lower value of the DI's deposit guarantee. Moreover, a comparison of $\widetilde{u}_n^{CB}$ and $\overline{u}_n$ reveals that adding the CB as LLR to the scenario leads to a softer recapitalization policy, $\widetilde{u}_n^{CB} < \overline{u}_n$. As was the case for the old division, this is due to the possible internalization of the utility gained by the CB from not liquidating the new division. With respect to social welfare, $\widetilde{u}_n^{CB}$ and $\overline{u}_n$ imply:

Proposition 4 *From a social welfare perspective, the existence of the CB as LLR for the new division under discretion:*

- *is never beneficial if* $\alpha \geq 1 + \frac{(1-L_n)(R_n+c_n)}{c_n L_n}$
- *is beneficial if* $\alpha < 1 + \frac{(1-L_n)(R_n+c_n)}{c_n L_n}$ *and* $v_n > \widetilde{v}_n^{CB}$*, where* $\widetilde{v}_n^{CB}$ *is implicitly defined by:*

$$\int_{\widetilde{u}_n^{CB}}^{\overline{u}_n} (u_n (R_n + c_n) - L_n) f(u_n) \, du_n = 0.$$

Proof. See Appendix. ■

If the choice is between no LLR or the CB as LLR, it is necessary two differentiate between two cases. First, if α is sufficiently large, it will never pay to appoint the CB as LLR. In this case the government is already too soft in the event of a liquidity shock if there is no LLR. Accordingly, it makes no sense from a social perspective to implement an

LLR that makes the recapitalization policy even softer. In the case of a relatively small α, however, appointing the CB as LLR will improve welfare if the liquidity shock is large so that without a LLR, the government would recapitalize the new division in too few instances.

When appointed as LLR, the DI will behave differently than the CB, because the DI is obliged to pay out the remaining depositors when the new division goes bankrupt. Therefore, if it acts as LLR and must pay K_n^{DI} for rescuing the division, it is ready to do so only if:

$$-K_n^{DI} - (1 - u_n)(1 - v_n + \beta c_n) \geq -(1 - L_n) - \beta c_n. \tag{10}$$

The left hand side of (10) reflects the expected payoff of the DI if the division survives at date t. Then, the insurer pays K_n^{DI} at date t. If the project fails at date $t+1$ and yields no return, the DI must pay $1 - v_n$ to late depositors and incurs the bankruptcy costs. According to the right hand side of (10), liquidating the division at date t leads to a payment obligation $1 - L_n$ of the DI and to inevitable bankruptcy costs. As the maximum willingness to pay for a recapitalization, we therefore obtain: $\widehat{K}_n^{DI} := (1 - u_n) v_n - L_n + u_n (1 + \beta c_n)$. In contrast to all previous cases, the maximum willingness to pay of the LLR may be negative. This will occur if the liquidity shock v_n and the success probability u_n of the project are sufficiently small. In the case of a recapitalization, the DI then regards the potential avoidance of bankruptcy costs as less important than the higher long-term costs due to the deposit guarantee.

The willingness to pay $\widehat{K}_n^{GOV}$ of the government does not depend on the allocation of the LLR function. Consequently, the government and the DI would agree to recapitalize the new division in negotiations if $\widehat{K}_n^{GOV} + \widehat{K}_n^{DI} \geq v_n$. This leads to:

$$u_n \geq \frac{L_n}{R_n + (\alpha + \beta)\, c_n} =: \widetilde{u}_n^{DI}. \tag{11}$$

The threshold $\widetilde{u}_n^{DI}$ does not depend on the liquidity shock. This is because in any circumstances, one of the two negotiating parties, the government or the DI, is responsible for paying out depositors so that the share of early withdrawals. Furthermore, for sufficiently small liquidity shocks, $\widetilde{u}_n^{DI} > \overline{u}_n$ holds true. When the shock v_n is small, the DI incurs an expected loss due to the deposits guarantee if the division survives. Accordingly, as the LLR, it agrees to a recapitalization only if it obtains a payment from the government so that the latter tends to be tougher than in the case without a LLR. However, such a payment can only be enforced if the LLR has the right to close the division at date t even if the government wishes to continue operations. Otherwise, if the LLR had no unilateral right to close the division, the relevant threshold would be $\min\{\overline{u}_n, \widetilde{u}_n^{DI}\}$. Then, in the case of $\widetilde{u}_n^{DI} > \overline{u}_n$, the government could simply recapitalize the new division and ignore the losses of the deposit insurer as if there were no LLR.

Assuming that the LLR does indeed have the unilateral right to close the new division, a comparison of the expected social loss with and without the DI as LLR leads to:

Proposition 5 *From a social welfare perspective, the existence of the DI as LLR for the new division under discretion is beneficial if either* $v_n < \tilde{\tilde{v}}_n^{DI}$ *or* $v_n > \widetilde{v}_n^{DI}$*, with* $\tilde{\tilde{v}}_n^{DI} := \frac{R_n - 1 + \alpha c_n}{R_n - L_n + (\alpha+\beta) c_n} L_n$*, and where* $\widetilde{v}_n^{DI} > \tilde{\tilde{v}}_n^{DI}$ *is defined implicitly by:*

$$\int_{\widetilde{u}_n^{DI}}^{\overline{u}_n} \left(u_n \left(R_n + c_n\right) - L_n\right) f\left(u_n\right) du_n = 0.$$

Proof. See Appendix. ■

The proposition states that the social value of the DI as LLR for the new division depends on the extent of the liquidity shock v_n. If the shock is small, $v_n < \tilde{\tilde{v}}_n^{DI}$, the government would pursue a very soft recapitalization policy. The DI should then be appointed as LLR in order to toughen the behaviour of the government. This will indeed be achieved, because for small liquidity shocks, the DI is unwilling to provide funds for recapitalization. Instead, the DI will impose a tax on recapitalization. If the shock is rather large, $v_n > \widetilde{v}_n^{DI}$, the existence of the DI as LLR will be beneficial as well. The government would then be too tough without a LLR and the DI has a positive willingness to pay for recapitalization, so that recapitalization will be softer and closer to the first-best if the DI serves as LLR. In the case of intermediate liquidity shocks $v_n \in \left[\tilde{\tilde{v}}_n^{DI}, \widetilde{v}_n^{DI}\right]$, adding the DI as LLR to the scenario does not enhance social welfare. That is, the recapitalization decisions of the government will then be more in line with the first-best if the DI does not serve as LLR.

Form propositions 4 and 5, we can infer two essential properties of the optimal institutional arrangement for the new division in a liquidity crisis. First, if the liquidity shock is sufficiently moderate, from a social point of view, it will never pay to appoint a LLR which is willing to provide funds for recapitalization. Then, there should either be no LLR at all, or the DI as LLR should tax recapitalization. Second, if the liquidity shock is sufficiently large, there should be a LLR which is willing to provide funds for recapitalization. Whether this role should be allocated to the CB or to the LLR depends on the extent of the shock and on the respective preferences of the involved agents.

5 Assessment of JPB privatization

The scenario introduced in section 2 of a bank divided into two separate divisions with a risky project and subject to substantial deposit withdrawals is appropriate for JPB for the following reasons. As of March 31, 2008, JPB held 73.9% of its total assets in the form of Japan Government Bonds (JGB) that are subject to substantial interest rate risk. Since interest rates were abnormally low during the last decade, they are more likely to increase than to fall in the near future; even a small increase of the interest rate for 10 years JGBs of 50 basis points for five years is likely to result in a substantial decrease in JPB's cash flow and profit in fiscal year 2011. Moreover, JPB is rapidly losing market share to other Japanese banks. While the balance of postal savings amounted to 204 trillion YEN at the end of March 2006, they decreased to 183 trillion YEN at the end of February 2008 (a loss of 10.3%; Japan Post, 2008b).

In Japan at present, there are no recapitalization rules for public banks. This is also true for JPB during the privatization process. That is, there is no formal agreement between the Ministry of Finance and either DICJ or BoJ on how to recapitalize an illiquid division of JPB after a liquidity shock has occured. In the light of our theoretical model, the involved parties thus forego the opportunity to ensure a first-best recapitalization policy by stipulating rules like those suggested in propositions 1 and 2. Instead, they have complete discretion with respect to a recapitalization of a JPB division with urgent liquidity needs.

Taking the non-existence of recapitalization rules as given, the question arises of whether the current regulatory framework is at least the socially optimal arrangement under discretion. As mentioned in the introduction to this paper, the LLR function in Japan is allocated to the BoJ. It can decide freely whether or not to serve as LLR when a bank is in trouble. In particular, there is no formal regulation that prevents liquidity provision by the BoJ in the case of relatively small liquidity shocks. Moreover, there are no formal restrictions on the extent to which the BoJ can provide liquidity assistance.

According to our results in section 4, there should be a LLR for the old division in the discretionary case only if two prerequisites are met. First, the government places a sufficiently small weight α on social bankruptcy costs c_o and, second, the LLR's weight β of c_o is not too large. Only then, having no LLR would result in too tough recapitalization decisions and the implementation of a LLR, by leading to a softer recapitalization policy, would improve social welfare. It is reasonable to suspect that neither of the two prerequisites is fulfilled in the Japanese case because the decision makers had painful experiences during the financial crisis in the 1990s.[7] Accordingly, the current regulatory framework for the old division of JPB is likely to be suboptimal even if only the discretionary case is considered. However, since the importance of the old division will decline in the future as old savings expire, this problem may resolve itself in due course.

With regard to the new division of JPB, the analysis in section 4 shows that the impact of a LLR on social welfare depends on the size of the liquidity shock and the

[7] According to Nakaso (2001: 28) there "...may well be cases in which the central bank will still decide to extend emergency support for the sake of financial stability, even knowing that it may result in a loss with a certain probability."

weight attached by the government and the respective LLR to the social bankruptcy costs. Here, assigning the LLR function to BoJ is socially beneficial under discretion if the government's weight α is smaller than the benchmark value given in proposition 4 and if the liquidity shock is not too small. As argued in the preceding paragraph, the former condition may be violated while the latter condition will definitely be violated whenever the liquidity crisis is not too severe. In such a situation, it would be better to prohibit liquidity assistance by the BoJ and either to have no LLR at all or to appoint the DIJC as LLR.

To conclude this section, we have demonstrated that the current regulatory framework for the divisions of JPB in a liquidity crisis is likely to be suboptimal from a social welfare perspective. The Japanese government would be well advised to introduce recapitalization rules like those defined in propositions 1 and 2. Alternatively, if explicit rules are unenforceable, social welfare could at least be improved by limiting the BoJ's rights to provide liquidity assistance. A reform of the regulatory framework is of particular importance for the new division of JPB as this division will gain in size relative to the old division over the next years.

6 Summary

The purpose of this paper was twofold. First, we considered the consequences of different regulatory arrangements for public banks in a liquidity crisis. Second, we applied our results to the case of the Japan Post Bank (JPB) and showed that the current allocation of regulatory powers over JPB, which is still owned by the Japanese government, is suboptimal. We have shown that discretionary recapitalization decisions by the government result in either excessively small or excessively large capital injections in a wide variety of circumstances while a suitably designed recapitalization rule could ensure a first-best recapitalization policy. We have also shown that there should be a LLR that is willing to provide funds for recapitalization only if the liquidity shock is sufficiently large. Whether this role should be allocated to the CB or to the DI depends on the size of the liquidity shock and on the respective preferences of the involved agents.

Appendix

Proof of proposition 3

In a first-best world, (1) implies that the expected social payoff of division o at date t is:

$$\pi_o^{fb} = \left\{ \begin{array}{ccc} u_o R_o - (1-u_o)\, c_o & \text{if} & u_o \geq u_o^* \\ L_o - c_o & \text{if} & u_o < u_o^* \end{array} \right\}.$$

Accordingly, as u_o is unobservable, it follows from (3) that at date t the expected social loss under discretion without a LLR for the old division is $E\left[\bar{l}_o\right] = \int_{u_o^*}^{\overline{u}_o} \phi_o(u_o)\, f(u_o)\, du_o$ with $\phi_o(u_o) := u_o(R_o + c_o) - L_o$ while it follows from (8) that the expected social loss under discretion with a LLR for the old division is $E\left[\widetilde{l}_o\right] = \int_{u_o^*}^{\widetilde{u}_o} \phi_o(u_o)\, f(u_o)\, du_o$. Under discretion, the existence of a LLR for the old division thus reduces the expected social loss only if:

$$\int_{\widetilde{u}_o}^{\overline{u}_o} \phi_o(u_o)\, f(u_o)\, du_o > 0. \qquad (12)$$

Note that $\phi_o(u_o)$ is increasing in u_o and equal to zero for $u_o = u_o^*$. Now, we can distinguish two cases. First, suppose that $\alpha \geq 1$ (and thus $\widetilde{u}_o < \overline{u}_o \leq u_o^*$). Then, $\phi_o(u_o) \leq 0$ for all $u_o \in [\widetilde{u}_o, \overline{u}_o]$, so that (12) is violated. Second, suppose that $\alpha < 1$ (and thus $\widetilde{u}_o \leq u_o^* < \overline{u}_o$).

Then, the left-hand side (LHS) of (12) is positive for $\beta = 1 - \alpha$ (in which case $\widetilde{u}_o = u_o^*$ holds true) and decreasing in β (as $\widetilde{u}_o$ is decreasing in β). Therefore, (12) is met only if $\beta < \beta^{crit}$, where β^{crit} is implicitly defined by $\int_{\widetilde{u}_o}^{\overline{u}_o} \phi_o(u_o)\, du_o = 0$.

Proof of proposition 4

By parallel arguments as in the proof of proposition 3, it can be shown that under discretion, having the CB as LLR for the new division reduces the expected social loss only if:

$$\int_{\widetilde{u}_n^{CB}}^{\overline{u}_n} \phi_n(u_n) f(u_n)\, du_n > 0. \tag{13}$$

Note that $\phi_n(u_n) := u_n(R_n + c_n) - L_n$ is increasing in u_n and equal to zero for $u_n = u_n^*$. Now, we can distinguish two cases. First, suppose that $\alpha \geq 1 + \frac{(1-L_n)(R_n+c_n)}{c_n L_n}$ (and thus $\widetilde{u}_n^{CB} < \overline{u}_n \leq u_n^*$ for all v_n). Then, $\phi_n(u_n) \leq 0$ for all $u_n \in \left[\widetilde{u}_n^{CB}, \overline{u}_n\right]$ so that (13) is violated. Second, suppose that $\alpha < 1 + \frac{(1-L_n)(R_n+c_n)}{c_n L_n}$ and define $v_n^{**} := \frac{R_n - 1 + (\alpha+\beta)c_n}{R_n - L_n + c_n} L_n$. Then, there are three subcases. First, if $v_n < v_n^*$, it follows that $\widetilde{u}_n^{CB} < \overline{u}_n < u_n^*$ so that $\phi_n(u_n) \leq 0$ for all $u_n \in \left[\widetilde{u}_n^{CB}, \overline{u}_n\right]$ implying that (13) is violated. Second, if $v_n \in [v_n^*, v_n^{**}]$, it follows that $\widetilde{u}_n^{CB} \leq u_n^* \leq \overline{u}_n$ so that the LHS of (13) is (i) not positive if $v_n = v_n^*$ (and thus $\widetilde{u}_n^{CB} < u_n^* = \overline{u}_n$), positive if $v_n = v_n^{**}$ (and thus $\widetilde{u}_n^{CB} = u_n^* < \overline{u}_n$), and (iii) increasing in v_n. Therefore, (13) is met if $v_n > \widetilde{v}_n^{CB}$, where $\widetilde{v}_n^{CB}$ is defined implicitly by $\int_{\widetilde{u}_n^{CB}}^{\overline{u}_n} \phi_n(u_n) f(u_n)\, du_n = 0$. Third, if $v_n > v_n^{**}$, it follows that $u_n^* < \widetilde{u}_n^{CB} \leq \overline{u}_n$ so that $\phi_n(u_n) > 0$ for all $u_n \in \left[\widetilde{u}_n^{CB}, \overline{u}_n\right]$ implying that (13) is met.

Proof of proposition 5

By parallel arguments as in the proof of proposition 3, it can be shown that under discretion, having the DI as LLR for the new division reduces the expected social loss only if:

$$\int_{\widetilde{u}_n^{DI}}^{\overline{u}_n} \phi_n(u_n) f(u_n) du_n > 0. \tag{14}$$

Define $\tilde{\tilde{v}}_n^{DI} := \frac{R_n - 1 + \alpha c_n}{R_n - L_n + (\alpha+\beta) c_n} L_n$. Now, we can distinguish three cases. First, suppose that $v_n < \tilde{\tilde{v}}_n^{DI}$ (and thus $\overline{u}_n < \widetilde{u}_n^{DI} \leq u_n^*$). Then, $\phi_n(u_n) \leq 0$ for all $u_n \in [\overline{u}_n, \widetilde{u}_n^{DI}]$ (with strict inequality for some u_n) implying that (14) is met. Second, suppose that $v_n \in [\tilde{\tilde{v}}_n^{DI}, v_n^*)$ (and thus $\widetilde{u}_n^{DI} \leq \overline{u}_n < u_n^*$). Then, $\phi_n(u_n) \leq 0$ for all $u_n \in [\widetilde{u}_n^{DI}, \overline{u}_n]$ implying that (14) is violated. Third, suppose that $v_n \geq v_n^*$ (and thus $\widetilde{u}_n^{DI} \leq u_n^* < \overline{u}_n$). Then, the LHS of (14) is (i) non-positive if $v_n = v_n^*$ (and thus $\widetilde{u}_n^{DI} \leq u_n^* = \overline{u}_n$) and (ii) increasing in v_n. Therefore, (14) is met if $v_n > \widetilde{v}_n^{DI}$, where $\widetilde{v}_n^{DI} > \tilde{\tilde{v}}_n^{DI}$ is defined implicitly by $\int_{\widetilde{u}_n^{DI}}^{\overline{u}_n} \phi_n(u_n) f(u_n) du_n = 0$.

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