Optimal Design of Bank Bailouts: The Case of Transition Economies

by

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The paper proposes a framework to analyze the effects of various bank bailout policies on bank managers' incentives first to lend prudently and second to disclose truthfully their non-performing loans. It is shown that tough bank closure rules have counterproductive effects on bank managers' incentives to invest and disclose prudently. Soft bailout policies create incentives to overstate loan losses to obtain larger recapitalizations. Such policies do not necessarily create *moral hazard* problems in lending. The paper characterizes the second-best recapitalization policy, which involves transfers conditional on the liquidation of non-performing loans. It is shown that the second-best recapitalization policy creates the same incentives for prudent lending as though bank closure rules. (JEL: D 50, D 80, G 20)

1. Introduction

In most recent banking crises bank regulators have been caught off their guard and have been forced to respond to the crisis in a hurry without the support of an institutional or legal framework designed to deal with bank failures. Unfortunately most bank regulations (and in particular the BIS regulations) are concerned with the ex ante problem of how to avoid bank failures, and few rules have been devised on how to deal with bank failures when they occur.

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This situation is in sharp contrast with the non-financial sector, where a detailed and elaborate bankruptcy law governs the process of liquidation or reorganization of financially distressed firms. In the case of banks it is generally up to the regulators to decide how to deal with an insolvent bank, and regulators have by and large too much discretion and little guidance on how best to restructure or liquidate an insolvent bank. When faced with a banking crisis regulators are often forced to improvise or imitate the hastily improvised solutions adopted by other regulators in some past crisis.

In this paper we address the question of how to design a bankruptcy institution for banks that would serve a similar purpose as the existing bankruptcy law for non-financial firms. Because of the specific nature of banking activities and because of deposit insurance it is not suitable to simply apply the existing bankruptcy law to banks. A special bankruptcy institution designed for banks is required. Such an institution would in all likelihood be as elaborate as current bankruptcy law and it is far beyond the scope of this paper, let alone the capabilities of the authors, to outline such an institution in all its details. The more modest aim here is to outline a framework which could serve as a basis for the design of such an institution.

Most policy dicussions of bank bailouts are concerned with regulatory forbearance and public confidence in the banking sector, with the supporters of bailouts emphasizing the dangers of a confidence crisis and the opponents emphasizing the moral hazard problems created by excessively soft bank bailouts. We shall take for granted that deposits must be insured and we shall sidestep the forbearance question by assuming that regulators can commit to an optimally designed bank bailout scheme.[1] Our focus will be on how to design the scheme optimally given that regulators can commit to the scheme.

The main questions we shall be dealing with are the following: When should a failing bank be bailed out? And if a bailout is desirable, how should the bank be bailed out? We shall be concerned with both the incentive effects of bailout policies on bank managers and the cost implications of the bailout for the government. In other words, the objective is to design a bailout scheme which preserves bank managers' investment and reporting incentives, while keeping the bailout bill as small as possible.

A common response of regulators in recent financial crises (e.g., in Norway, Mexico or Japan) has been to inject new funds (unconditionally) into distressed banks by purchasing preferred stock or subordinated bonds. The size of these injections has been massive (of the order of several percentage points of GDP).[2]

[1] The forbearance problem is somewhat tangential to the issues addressed in this paper. While we believe that this problem is of real concern we think that it is best to address this question separately.

[2] The latest rescue package set up by the Japanese authorities this year, of the order of $ 102bn, represents about 2.5% of GDP (see the *Financial Times* of February 28, 1998). The overall bailout cost of the Mexican banking sector as disclosed to parliament by President Zedillo was estimated to be 14.5% of GDP (see the *Financial Times* of April 20, 1998).

With the benefit of hindsight one may question both the rescue method and the size of the rescue. These capital injections have had the advantage of buying precious time and breathing space for regulators but they did not address the underlying non-performing loans problem.

To address this problem it is essential to give banks adequate incentives to liquidate bad loans. Following MITCHELL [1995], we argue in this paper that bank managers' incentives to misreport the extent of their banks' loan losses is a major source of inefficiency leading generally to inefficiently low liquidation of bad loans, and, thus, to a magnified banking crisis down the road. We show how the form of an efficient bank bailout scheme is to a large extent determined by how it mitigates or overcomes bank managers' incentives to hide loan losses.

Once it is recognized that bank managers can delay insolvency by hiding the extent of their banks' loan losses and that they may refrain from liquidating bad loans in an attempt to hide loan losses, it should be clear that strict bank closure rules requiring the closure of any insolvent bank may be counterproductive. Such rules may simply induce bank managers to hide the size of their banks' loan losses for as long as they can. Such behavior can result in huge misallocations of investments as well as massive bank failures.

Thus, this paper analyzes the effects of various bank bailout rules on both ex ante incentives to lend and ex post incentives to disclose the size of the non-performing loans problem. The basic set-up considered here includes three types of agents: firms, banks and a regulator. Firms and banks are controlled by their managers who derive private benefits from their continued operations and the main source of discipline on their behavior is the possibility of dismissal associated with insolvency. The regulator's objectives are to induce efficient ex ante investments, avoid the dead-weight cost associated with excessive bank recapitalizations, and promote the efficient restructuring or liquidation of firms which have defaulted on their blank loans.

Banks are assumed to have private information about the quality of their loan portfolios and the continuation values of firms in default. The regulator only knows the probability distribution over the fraction of non-performing loans across banks in the economy, therefore facing an *adverse selection* problem in the design of a bank recapitalization policy.

Our analysis leads to a number of interesting results. First, a tough recapitalization policy in which bank managers are always dismissed results – as already suggested – in the bank managers rolling over bad loans in order to conceal the extent of their banks' loan losses and therefore in the *softening* of the firms' budget constraints (see MITCHELL [1995]). Vice-versa, a soft approach to recapitalization (in which the manager of a failing bank is not dismissed) encourages bank managers to take an overly tough approach to the liquidation of firms, while exaggerating their banks' recapitalization requirements.

However, and this is the second main conclusion of the paper, the socially efficient outcome can generally be achieved through a soft bailout policy combined with the carving out of bad loans at a suitable *non-linear transfer price*. In other words, our analysis suggests that the recapitalization of insolvent banks should be performed by buying out non-performing loans rather than through capital injections by buying subordinated bonds. Our key insight here is that a *non-linear* transfer price mechanism for bad loans can be used to combat effectively the adverse selection problem, and in particular to avoid over-reporting of non-performing loans by the healthier banks at the time of the bailout.

The existing theoretical literature on financial restructuring and bank recapitalization in transition economies comprises only a handful of papers. We have already referred to MITCHELL [1995] – the most closely related paper to ours and the first to model bank restructuring. It sets up a formal model of a bank restructuring where banks must incur a (convex) cost of effort to avoid asset dissipation by firms. That paper also emphasizes the problem that in case of bank managers suffering in some way when their banks get into trouble they will roll over loans in default in order to postpone facing the cost of financial distress. However, Mitchell develops a different formal set-up and considers different policy options.

Also taking a moral hazard approach to bank restructuring, BERGLOF AND ROLAND [1995] argue that ex ante recapitalizations of banks by governments can limit the extent to which banks will take on additional risky loans and then gamble for resurrection.

These studies do not provide a complete characterization of all possible bailout schemes and of the optimality of different bailout policies under different circumstances. While moral hazard considerations (and in particular the problem of excessive risk-taking in the choice of banks' portfolios) are reasonably well understood and arise in transition and developed market economies alike, informational asymmetries of the kind emphasized in the present paper are more likely to be relevant in the context of transition economies where the institutions for evaluating and disclosing the credit-worthiness of both firms and banks are inherently weak.

Two other related papers are SUAREZ [1995] and POVEL [1997]. The former studies bank closure rules and bank recapitalization in a dynamic complete information model. Given the informational asumptions stressed therein it is not entirely surprising that Suarez finds that the closure of insolvent banks has good ex ante incentive properties. The latter paper deals with bankruptcy of non-financial firms but emphasizes a similar tension between ex ante incentives to avoid bankruptcy and ex post incentives to file for bankruptcy in a timely fashion.

The remainder of the present paper is organized as follows. Section 2 sets out the basic model, specifying the objectives and constraints of firms, banks and the regulator. Section 3 compares a "tough" and a "soft" bank recapitalization policy taken in isolation. Section 4 derives necessary and sufficient conditions for the existence of an efficient "non-linear transfer scheme" used for the carving out of bad loans. Finally, section 5 provides a brief summary of the main lessons of our analysis.

2. *The Model*

The model builds on BOLTON AND SCHARFSTEIN [1990] by enlarging their framework to allow for three types of agents: firms, banks and a regulator. We consider each in turn.

2.1 Firms

For simplicity, we assume that all firms are run by self-interested managers. Be they state-owned or privatized firms, shareholders do not play a significant governance role; rather the focus is on bank debt as a disciplining device. A firm is represented by an asset, which yields a random return. In the first period, the return is either high, $\pi > 0$, or low (equal to zero). The probability of receiving a high return is $p \in (0, 1)$. This probability could be controlled by the firm manager's actions, but we shall take it to be exogenously given. In the second period, the firm also has a random continuation value, which is the discounted stream of future returns.

Each firm has an outstanding stock of bank debt and, for simplicity, no other liabilities. This stock of debt imposes a repayment obligation on the firm of $D \in [0, \pi]$. When a firm defaults, its bank can either liquidate the firm, making the firm manager redundant, or it can allow the firm to continue. The certain liquidation value is L. The continuation value, $\tilde{v}$, is either high, $v > 0$, or low (equal to zero), with $v > L > 0$. The probability of a high continuation value is $(1 - \beta)$, with $\beta \in (0, 1)$. In the event of default, the continuation value can be costlessly observed.

For simplicity, we shall assume that the *private* continuation value of firm managers is sufficiently large that they will always honor their debt repayment obligations if they can. This assumption rules out strategic defaults by firms.[3]

2.2 Banks

As with firms, we assume that self-interested managers run banks. On the asset side of their balance sheets, banks have a portfolio of loans to firms, each of which has a scheduled debt service payment of D. As specified above, each firm may default on its loan with probability $(1 - p)$. In the event of a default, and in the absence of strategic behavior by bank managers, the bank liquidates the

[3] It is possible to extend the model to allow for strategic defaults. The results obtained in this extension are qualitatively similar to those reported here.

firm with probability β and obtains L. The alternative to liquidation is firm continuation with a realized return v. If all firms have independently and identically distributed returns and each bank holds a large and well diversified portfolio of loans, then each bank has approximately a fraction $(1 - p)$ of non-performing loans.

On the liability side of their balance sheets, banks issue deposits in the amount d to fund each loan. Thus, the net worth of a bank (per loan) is

$$W = (1 - p)[\beta L + (1 - \beta)v] + pD - d. \tag{1}$$

For a bank to have a positive net worth, the weighted average payoff from non-performing and performing loans must thus exceed the value of deposits issued to fund the representative loans.

The fact that banks do fail in reality suggests that they cannot build completely diversified portfolios and that they are exposed to aggregate shocks. To introduce the possibility of bank failures we shall suppose that firms' returns are correlated to some extent so that the fraction of performing loans is a random variable which takes on a range of values, $p_1 > p_2 > p_3 > p_4 > 0$, with respective (positive) probabilities, $\mu_1, \mu_2, \mu_3, \mu_4$. We denote the expected fraction of performing loans to be $p = \sum_{i=1}^{4} \mu_i p_i$. A bank's realized net worth under each realization is then given by equation (2), but p_i $(i = 1, \ldots, 4)$ now substitutes for p. Thus, under the four possible outcomes p_i, a bank's realized net worth is equal to

$$W_i = (1 - p_i)[\beta L + (1 - \beta)v] + p_i D - d, \tag{2}$$

where we assume that

$$W_4 < W_3 < W_2 = 0 < W_1. \tag{3}$$

That is, only banks in states $i = 1, 2$ are solvent while banks in states $i = 3, 4$ are insolvent. As will become clear in section 3, we need at least four different states of nature in order to compare alternative bank bailout policies.

We shall also suppose that bank managers can exert effort ex ante to reduce the probability of a bank failure. That is, by being more diligent in evaluating the distribution of firms' first period cash flows and in structuring efficient loan portfolios they can reduce the likelihood that a large fraction of projects will fail. For simplicity, a bank manager's decision to exert effort is an all-or-nothing choice, $e \in \{0, 1\}$. The cost to the bank manager of exerting this effort is $c(e)$, where $c(0) = 0$ and $c(1) = c$. We assume that when $e = 1$ the probability distribution $\mu_i(1)$ (first-order) stochastically dominates the probability distribution

$\mu_i(0)$ when $e = 0$:

$$\sum_{i=1}^{j} \mu_i(1) > \sum_{i=1}^{j} \mu_i(0) \quad \text{for all } j = 1, 2, 3. \tag{4}$$

Finally, to simplify notation, we let $\phi_i = (1 - p_i)\beta$ denote the fraction of liquidated loans. We obviously have $\phi_1 < \phi_2 < \phi_3 < \phi_4$.

When a firm defaults, the manager of its bank must decide whether to allow the firm to continue or to seek its liquidation. We assume that the sale of the firm's assets can be observed costlessly so that the liquidation decision is observable and verifiable. However, loan continuation and write-down decisions are entirely at the discretion of the bank manager and cannot be verified. In other words, unless a non-performing loan is actually liquidated it is not possible to verify whether the loan is performing or not. This limited verification of the bank manangers' behavior in turn allows for strategic behavior on their part.

For example, bank managers may want to inefficiently refinance bad loans in order to hide (or understate) the overall extent of their non-performing loans problem. This seems to be a wide-spread banking practice, particularly in transition economies, but also in developing and industrialized market economies. Similarly, when a bank is to be bailed out, the bank manager may want to overstate the proportion of non-performing loans in order to elicit a larger recapitalization from the government. The core analysis of this paper centers around these two forms of strategic behavior by bank managers.

A bank manager's objective function involves a monetary and a private benefit component. The monetary component is the sum of a fixed salary (which we normalize to zero) and, in the case of a high-powered incentive scheme, a share of the bank's (reported) net worth, say equal to b. The private benefit component reflects the facts that bank managers like power, and that they, as firm managers, would rather retain their job than be fired. In addition, the objective function includes the cost of effort, if any, that is exerted in managing a bank's loan portfolio.

Formally, we can express a bank manager's objective function as

$$U_B = b \max(0, \hat{W}_i) + \tilde{B}[1 + \max(0, W_i + R)] - c(e); \tag{5}$$

where $\tilde{B} = B$ if the bank manager retains her position and $\tilde{B} = 0$ if the bank manager is fired, with $B > 0$ being the unit private benefit of running a bank of size one; $\hat{W}_i$ is the reported net worth of the bank (absent recapitalization) and W_i is the true net worth; any additional resources accruing to the bank in the first period, in particular as a result of recapitalization, is given by R.

To keep the analysis simple, we shall assume that a bank manager has only a low-powered incentive scheme (i.e., $b = 0$), and therefore, that

$$U_B = \tilde{B}[1 + \max(0, W_i + R)] - c(e). \tag{6}$$

The analysis can be extended straightforwardly to consider the effects of high-powered incentive schemes. The main effect of such schemes is to create even stronger incentives to hide bad loans, but to mitigate incentives to overstate losses.

2.3 The Regulator

The regulator's decision problem is to form a policy toward the recapitalization of banks with announced negative net worth. A constraint on this policy is that any bank which declares its net worth as negative must receive a recapitalization to bring its declared net worth back to zero. In other words, in our model all depositors are fully insured.[4] Our results and analysis do not critically hinge on this assumption. If only a fraction of deposits, $\hat{d} < d$, is insured our analysis would be unchanged when d is replaced by $\hat{d}$.[5]

The regulator's problem is then to design a bank bailout policy (i) to maximize the expected social return of the underlying assets of firms, (ii) to induce maximum effort of bank managers in the *ex ante* evaluation of firms' returns, and (iii) to minimize the cost associated with the excessive recapitalization of banks.

With full information about the true net worth of banks, the regulator would avoid excessive recapitalizations, and the corresponding dead-weigth loss, by simply transferring $-W_i$ to those banks in states $i = 3, 4$ in the first period. It would also maximize bank managers' incentives by committing to dismiss them whenever a bank is insolvent.

The regulator's problem is made difficult, however, because it does not generally know the first period net worth of banks. So if the government wants to guarantee that all banks reach at least a minimum reported net worth of zero, it must be prepared to bailout banks up to an amount of $-W_4$, the worst possible net worth. Since the government does not know the net worth of banks, their managers may be able to get away with claiming to be in the worst possible state. Such misrepresentation by all bank managers would lead to excessive recapitalizations with an *ex ante* dead-weight loss of

$$\lambda[\mu_1(W_1 - W_4) + \mu_2(W_2 - W_4) + \mu_3(W_3 - W_4)] = \lambda E. \tag{7}$$

[4] Banks must have fully insured deposits for two basic reasons: First, the failure of a large institution may adversely impact other banks in the system through the payment system and the inter-bank market, which can precipitate a generalized loss of confidence. Second, depositors in a large bank may effectively exert political pressure for deposit guarantees. In addition, banks are *de facto* perceived by depositors as being fully backed by the government.

[5] However, under partial deposit insurance new issues must be addressed, such as the behavior of uninsured depositors. These issues are undoubtedly important but they are somewhat orthogonal to our analysis.

Of course, the government has the option to limit the size of recapitalizations to an amount less than $-W_4$, but then it exposes itself to the possibility of inadequate recapitalization of those banks in the worst state of nature.

The expected social return of the underlying assets of firms is given by their expected first period cash flows, $\bar{p}(e)\pi$ (where $\bar{p}(e) = \sum_{i=1}^{4} \mu_i(e)p_i$), plus their expected continuation values in each state,

$$\Omega_i = p_i(1-\beta)v + (1-p_i)\{\min[1-\beta), (1-\hat{\beta}_i)]v + \hat{\beta}_i L\}. \tag{8}$$

That is, for the proportion p_i of firms with high cash flows the expected continuation value is $(1-\beta)v$, since these firms will never be liquidated. For the proportion $(1-p_i)$ of firms with low cash flows the firm managers are forced to default and the average continuation values per loan are $\min[(1-\beta), (1-\hat{\beta}_i)]v + \hat{\beta}_i L$; here $\hat{\beta}_i$ denotes the fraction of defaulting loans the bank manager chooses to liquidate in each state $i = 1, \ldots, 4$.

Formally, the regulator's objective function can be summarized in the following expression:

$$U_G = \bar{p}(e)\pi + \sum_{i=1}^{4} \mu_i \Omega_i - \lambda E - c(e). \tag{9}$$

Thus, in our model social efficiency requires fulfillment of three conditions: First, a firm should be liquidated if, and only if, its liquidation value exceeds its continuation value $\tilde{v} \in \{0, v\}$; that is, $\hat{\beta}_i$ should be equal to β for states $i = 1, \ldots, 4$. Second, only those banks with truly negative net worth should be recapitalized; that is, E should be equal to zero. Third, bank managers should exert effort in managing their banks' loan portfolios provided that

$$\bar{p}(1)\pi - \bar{p}(0)\pi + \sum_{i=1}^{4} [\mu_i(1) - \mu_i(0)]\,\Omega_i > c. \tag{10}$$

We assume that this condition is satisfied, in other words that the *ex ante* evaluation of firms' returns by bank managers is socially efficient.

Throughout the remainder of the paper we make the (realistic) assumption that the liquidation value, L, is greater than a firm manager's private benefit from the firm's continued operation. In other words, it is socially efficient to liquidate a firm whenever the bank's continuation value of the project is zero, even though the firm manager always prefers not to liquidate. This assumption introduces an ex post inefficiency when firms which are able to service their current debt obligations but have a low continuation value remain in operation because of the private benefits derived by their managers. While first-best social efficiency would require that these firms be liquidated in the first period, this inefficiency is independent of the form of bank recapitalizations and is thus not a factor in evaluating the government's policy alternatives.

3. *Tough Versus Soft Recapitalization Policy*

The regulator's problem is to design a bank recapitalization policy that maximizes its objective (social efficiency) subject to the constraint of limited knowledge of banks' true net worth in the first period. Since the banks are managerially controlled, one possible condition to impose with a recapitalization relates to the dismissal of the bank manager. In particular, how tough or soft should the government be toward the manager of a bank in the event of its recapitalization.

Again, start with the benchmark case where the net worth of banks is known to the government in the first period. The optimal bailout policy is then straightforward: restore the net worth of banks in states $i = 3, 4$ to zero after allowing for the expected recovery of non-performing loans, and dismiss their managers if these recoveries deviate from expectations. This policy satisfies two of the three conditions for first-best efficiency. In particular, it guarantees both that only those banks with truly negative net worth are recapitalized and that firms in default are liquidated if, and only if, their liquidation value exceeds their continuation value. Satisfaction of the third condition for first-best efficiency, the *ex ante* evaluation of firms' returns and the structuring of efficient loans portfolios, depends on the incentives faced by bank managers.

Such a policy would clearly have perverse effects when the regulator must rely on bank managers' reports to learn about the first period net worth of banks. We illustrate these perverse effects in this section by considering two extreme bailout policies that are often discussed in practice: On the one hand, a *"tough" recapitalization policy* (subsection 3.1), which results in the liquidation of a bank that is found insolvent and the ensuing dismissal of its manager. On the other hand, a *"soft" recapitalization policy* (subsection 3.2), which maintains an insolvent bank's manager in control and fully bails out the bank. We also consider an *"in-between" policy* (subsection 3.3), which involves the liquidation of an insolvent bank and the dismissal of its manager only in the worst state of nature, $i = 4$; whereas any bank in state $i = 3$ is fully bailed out by the government, leaving the bank managers in control.

3.1 A "Tough" Recapitalization Policy

Consider first the case of a "tough" bailout policy in which the manager of a bank which reports a negative net worth is dismissed. The manager of a bank which realized p_1 or p_2 has no incentive to manipulate either the accounts of the bank or the decisions to liquidate firms, or to write down their loans. However, a bank would be insolvent if either p_3 or p_4 were realized. With such outcomes, its manager will act as if $p_k = p_2$ has occurred in order not to be fired. Since the liquidation of firms is verifiable, the bank manager will pretend that $p_k = p_2$ by liquidating a fraction ϕ_2 of firms in the bank's portfolio, where ϕ_2 is defined as the fraction of liquidated loans in the portfolio of a bank with realized p_2 (i.e., $\phi_2 = (1 - p_2)\beta$).

In other words, the bank manager will liquidate a fraction $\hat{\beta}_k$ of defaulting firms, such that

$$(11) \qquad (1 - p_k)\hat{\beta}_k = \phi_2 = (1 - p_2)\beta .$$

Therefore, the proportion of defaulted loans that are actually liquidated by the bank manager in states $k = 3, 4$ is less than the socially efficient proportion (i.e., $\hat{\beta}_k < \beta$). The incentive of bank managers to maintain the appearance of bank solvency under a tough bailout policy, thus leads to a softening of debt as a disciplining device on firms and thereby a softening of firms' budget constraints. More formally, a tough bailout policy leads to an ex ante payoff of

$$(12)\ U_G = \bar{p}(e)\pi + \sum_{i=1}^{2} \mu_i(e)\{p_i(1-\beta)v + (1-p_i)[(1-\beta)v + \beta L]\}$$
$$+ \sum_{i=3}^{4} \mu_i(e)\{p_i(1-\beta)v + (1-p_i)[(1-\beta)v + \hat{\beta}_i L]\} - c(e),$$

where, from equation (11), $\hat{\beta}_i < \beta$ for $i = 3, 4$. A tough bailout policy thus leads to an insufficient number of firm liquidations. The loss in social surplus due to the softness of banks on firms in default is the foregone liquidation value of those firms which are continued even though they have a zero continuation value.[6]

Introducing the possibility of strategic defaults by firms would amplify the loss in social surplus due to banks hiding the extent of their non-performing loans. More precisely, suppose that the private continuation value of firm managers is such that they would choose not to default strategically if the probability of liquidation in case of default is β, but might decide to default if they anticipate a lower probability of liquidation by banks. Then, not only will the number of firm liquidations be less than is socially optimal but there will also be a further build-up of non-performing loans in banks' portfolios.[7]

[6] The loss in social surplus also includes the misallocation of funds which could have been directed to better investments. An important limitation of our model is that it is not set up to account for that cost.

[7] For example, suppose that the private continuation value of firm managers is random, equal to V with probability $(1 - \varepsilon)$ and to zero with probability ε. Assuming that

$$\beta[1 - p_2(1-\varepsilon)]V < D < \beta V,$$

we then leave it to the reader to verify that in the case of a solvent bank (i.e., in states $i = 1, 2$), the pair of strategies ($\hat{\beta}_i = \beta$, strategic default with probability ε) is the unique Nash equilibrium. In the case of a bank in state $i = 4$, there exists a Nash equilibrium involving a higher probability of strategic default, namely with the pair of strategies ($\hat{\beta}_4 < \beta$, strategic default with probability one), where $\hat{\beta}_4$ satisfies

$$[1 - p_4(1-1)]\hat{\beta}_4 = \phi_2 = [1 - p_2(1-\varepsilon)]\beta .$$

There is, however, no dead-weight cost due to excessive recapitalizations under a tough bailout policy. Indeed, no bank recapitalizations take place under this rule because no bank managers will declare their institutions insolvent.

Whether bank managers are induced to exert effort in managing loan portfolios under this policy depends here only on the private benefits derived from this activity. In particular, a bank manager will exert such effort under a tough policy only if

$$E[U_B(1)] = \sum_{i=1}^{4} \mu_i(1) B[1 + \max(0, W_i)] - c$$
$$> E[U_B(0)] = \sum_{i=1}^{4} \mu_i(0) B[1 + \max(0, W_i)],$$

or, equivalently,

$$[\mu_1(1) - \mu_1(0)] B W_1 > c. \tag{13}$$

Note that no bank manager is ever dismissed in equilibrium under this policy because of the costless ability to misrepresent a bank's net worth, and that R equals zero. Note also that bank managers receive private benefits in all states of nature. The value of private benefits equals B in all states of nature except in state $i = 1$, when the value of private benefits equals $B(1 + W_1)$. The expected value of private benefits thus rises with managerial effort to the extent that this effort raises the probability that state $i = 1$ will occur.

3.2 A "Soft" Recapitalization Policy

Under a "soft" policy toward the recapitalization of banks, a bank manager is immune from dismissal, regardless of reported net worth of the bank. This approach creates an incentive for bank managers to overstate their banks' problem loans so as to increase the amount of recapitalization. Bank managers can easily overstate the extent of their anticipated loan losses by taking excessively high charges.[8] The change in bank managers' utility from reporting the worst possible net worth, W_4, instead of the true net worth, W_i, is always positive and equal to

$$\Delta U_b = B(W_i - W_4). \tag{14}$$

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[8] Note that by taking charges banks only bring forward in their books anticipated loan losses. They do not report actual loan losses. Unless reported anticipated loan losses turn into actual losses for banks, writing down loans is just "cheap talk" and bank managers have every incentive to exaggerate the size of anticipated loan losses if it results in larger recapitalizations.

One benefit of soft bailouts, however, is that they restore bank managers' incentives to impose financial discipline on the firms they lend to. Indeed, without a hard budget constraint, their incentive is to liquidate every defaulted loan if, and only if, the continuation value is less than the liquidation value. Thus, with a soft recapitalization policy, bank managers harden the budget constraint on firm managers.

The social payoff achieved through a soft bailout policy is

$$(15)\quad U_G = \bar{p}(e)\pi + \sum_{i=1}^{4} \mu_i(e)\{p_i(1-\beta)v + (1-p_i)[(1-\beta)v + \beta L]\} - \lambda[\mu_1(e)(W_1 - W_4) + \mu_2(e)(W_2 - W_4) + \mu_3(e)(W_3 - W_4)] - c(e).$$

There are thus at least two social costs of a soft bailout policy: One is the dead-weight cost from excessive recapitalizations.[9] The second is an inadequate incentive for bank managers to exert effort in evaluating investment returns of firms and in structuring efficient loan portfolios. As with the tough recapitalization rule, the only incentive for bank managers to exert such effort under a soft rule arises from the associated private benefits.

More specifically, under this soft recapitalization policy, note that the government recapitalization of a bank equals the net worth of that bank in the worst state of nature. A bank manager would thus exert effort only if

$$(16)\qquad \sum_{i=1}^{3} [\mu_i(1) - \mu_i(0)]\, B[\max(0, W_i) - W_4] > c.$$

Now, since

$$-\sum_{i=1}^{3} [\mu_i(1) - \mu_i(0)] = \mu_4(1) - \mu_4(0),$$

this incentive constraint is equaivalent to

$$(17)\qquad [\mu_1(1) - \mu_1(0)]BW_1 + [\mu_4(1) - \mu_4(0)]BW_4 > c.$$

Comparing equations (13) and (17) reveals that whenever $\mu_4(1) - \mu_4(0) < 0$, the incentive-compatibility constraint on managerial effort is less tight under a tough than under a soft recapitalization policy provided that $|W_4|$ is not too large.

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[9] In practice, this cost is reduced somewhat since by purchasing preferred stock or taking a stake in a bank, the regulatory authorities obtain a cut in all future profits of that bank. It is not clear, however, that regulators are able to fully recover excessively generous recapitalizations.

The reason that a tough policy is not necessarily more effort-inducing than a soft policy is that under a soft bailout policy the benefit of overstating loan losses is an increasing function of the extent of the overstatement. It may thus not always be a good idea for the government to minimize the scope for ex post overstatement of the bad loans problem (i.e., by implementing a tough bailout policy) because this may sometimes have adverse ex ante incentive effects.

We summarize our discussion so far in the proposition below.

Proposition 1: (a) Ex post efficiency: When μ_4 is close to one, that is, when the banking system as a whole is known by the government to be in crisis, a soft bailout policy dominates though bailout. However, when $(\mu_1 + \mu_2)$ is sufficiently close to one, that is, when the banking system is basically sound, tough bailout dominates soft bailout.

(b) Ex ante incentives: A tough bailout policy will generally provide stronger ex ante incentives than a soft bailout policy, except when $|W_4|$ is large.

While tough (soft) bailout policies dominate ex post when the banking system is known by the government to be basically sound (in deep crisis), the comparison between these two extremes becomes less clear cut in intermediate situations. For example, when μ_3 is close to one, then the excessive recapitalization of banks in state $i = 3$ and the excessive liquidation of firms by those banks under soft bailout policy must be weighted against the insufficient liquidations by banks in states $i = 3, 4$ under tough policy. The balance depends upon the dead-weight loss parameter λ, and upon the cost of excessive liquidation $(v - L)$.

3.3 An "In-Between" Policy

Now consider a less extreme approach toward the recapitalization of banks, under which dismissal of a bank manager depends on the amount of required recapitalization. Specifically, if a bank reported that p_3 has occurred, the bank would be recapitalized without its manager being dismissed. But if a bank manager reports p_4, the bank would be liquidated and its manager dismissed. In other words, a bank manager would be held accountable only for an extremely poor outcome.

Under this policy, banks in states $i = 1, 2$ will seek to increase their size by attracting excessive recapitalizations while banks in state $i = 4$ hide the true extent of their insolvency problem. Banks in state $i = 3$, however, accurately reveal their net worth and take efficient liquidation decisions. Thus, although such an "in-between" bailout policy combines inefficiencies present in the two extreme policies, it involves a smaller dead-weight cost from excessive recapitalizations than under soft bailout and less under-liquidations of defaulted firms than under a tough policy.

In terms of ex ante incentives, this policy may provide worse incentives for bank managers. Under this in-between recapitalization policy a bank manager would exert effort only if

$$\sum_{i=1}^{2} [\mu_i(1) - \mu_i(0)] B(W_i - W_3) > c. \tag{18}$$

A comparison of equations (18) and (16) readily reveals that the incentive-compatibility constraint on managerial effort is less tight under an in-between than under a soft recapitalization policy. Whether the incentive-compatibility constraint is less tight than under a tough policy depends again on the amount of the recapitalization a bank receives. As before, the reason that a tough policy is not necessarily less tight is because recapitalizations yield private benefits which increase with the size of the overstatement of loans losses.

Our discussion in this section can be summarized by the following.

Proposition 2: (a) Ex post efficiency: When μ_3 is close to one, an in-between bailout policy dominates both tough and soft bailout policies from an ex post efficiency viewpoint.

(b) Ex ante incentives: An in-between bailout policy will provide less effort incentives than a tough bailout policy, except when $|W_3|$ is sufficiently large.

While an in-between policy may under certain circumstances reduce the ex post dead-weigth cost of the recapitalization of banks and the cost of excessive continuation of defaulted firms, other policies may perform as well or better both from an ex post and an ex ante point of view. Such an alternative is explored in the next section.

4. Bank Recapitalizations Conditional on Firm Liquidations

Since one observable and verifiable action of bank managers is the liquidation of defaulted firms, this parameter can provide a possible condition for the regulator's policy toward the recapitalization of banks. The purpose of this section is to examine whether the regulator can use this parameter to achieve its overall objective of first-best social efficiency and, if so, under what circumstances.

We shall show that it is possible to use this action of bank managers as a conditioning parameter for recapitalizations in order to achieve two of the three criteria for first-best social efficiency. These criteria are the efficient liquidation of firms in default (i.e., $\hat{\beta}_i = \beta$ for $i = 1, \ldots, 4$), and the absence of excessive bank recapitalizations. A complementary policy, however, may be required to provide a sufficiently strong incentive for bank managers to exert effort in the *ex ante* evaluation of firms' returns.

A key issue in the design of a bank recapitalization policy which is conditional on the liquidation of defaulted firms is the relationship between the liquidation of firms by a bank and the amount, if any, of its recapitalization. Consider first a simple linear transfer scheme under which the government pays a fixed amount t for any loan to a firm which is liquidated by the bank manager (with proceeds L). To achieve a zero net worth for banks in the worst state of nature, $i = 4$, the transfer amount t must raise the true net worth of such a bank to break-even:

$$\phi_4(L+t) + (1-p_4)(1-\beta)v + p_4 D = d. \tag{19}$$

However, this recapitalization policy would be too generous for those insolvent banks in state $i = 3$, increasing their net worth beyond zero. Banks with positive net worth, moreover, would be encouraged to participate in the scheme even though they are not in need of recapitalizations.

Excessive recapitalizations can be eliminated, however, if the government introduces a non-linear transfer scheme. Suppose that the government sets a low transfer amount, t_L, for loans to firms in default which are liquidated, up to a threshold $\bar{m} \geq \phi_2$ of a bank's portfolio. And that beyond that threshold transfers per liquidated loan are increased to $t_H > t_L$. We can then establish the following.

Proposition 3: There exists an $\bar{m} \geq \phi_2$ such that the above two-part transfer scheme $(t_H, t_L, \bar{m})$ implements a policy that leads to the efficient liquidation of firms in default (i.e., $\hat{\beta}_i = \beta$ for $i = 1, \ldots, 4$), and that recapitalizes only those banks which are truly insolvent if, and only if,

$$p_4 D + (1-p_4)(1-\beta)v + (\phi_4 - \phi_2)v + \phi_2 L \geq d. \tag{20}$$

Proof: Without loss of generality we can assume $D > v$.

First, in order to avoid excessive liquidation of non-performing loans by bank managers, the high transfer price, t_H, cannot be larger than the minimum possible recovery on a defaulted loan, v. With $t_H > (v - L)$, managers of all banks would have an incentive to engage in excessive liquidation since doing so would increase their recoveries on non-performing loans, including the per-loan transfer from the government. So we must have $t_H \leq (v - L)$. Without loss of generality, we restrict the analysis to two-part transfer schemes such that $t_H = (v - L)$.

Now, it is sufficient to show that the low transfer, t_L, and the cut-off level, $\bar{m}$, can be chosen so as to deter solvent banks in state $i = 2$ (and *a fortiori* those in state $i = 1$) from participating in the scheme. This requires that the pair $(t_L, \bar{m})$ satisfies the condition

$$(\phi_2 - \bar{m})v + \bar{m}(L + t_L) \leq \phi_2 L. \tag{21}$$

The LHS of equation (21) is the payoff that a bank in state $i = 2$ would receive by participating in the government's recapitalization scheme; the RHS is the bank's revenue from remaining outside the scheme and from liquidating those non-performing loans which have a zero continuation value. One set of parameter values for which this condition is satisfied is $t_L = 0$ and $\bar{m} = \phi_2$.

It is also sufficient to show that the two-part transfer scheme $(t_H = v - L, t_L = 0, \bar{m} = \phi_2)$ succeeds in fully recapitalizing insolvent banks in states $i = 3, 4$. Consider in particular a bank in state $i = 4$, the worst possible state. The realized net worth of such a bank under this recapitalization scheme which links government transfers to a bank's liquidation of firms in default, is

$$p_4 D + (1 - p_4)(1 - \beta) v + (\phi_4 - \phi_2) v + \phi_2 L - d. \tag{22}$$

From equation (22), it is clear that condition (20) must hold in order for a bank in state $i = 4$ to be fully recapitalized. This condition is therefore sufficient to ensure full recapitalization of insolvent banks, and to avoid both excessive liquidation of non-performing loans and excessive recapitalization of solvent banks.

To complete the proof, we must show that condition (20) is also necessary. This requires showing that the conditions cannot be relaxed by allowing a more generous two-part transfer scheme with $t_L > 0$.

Suppose we take $t_L > 0$, and still have $t_H = (v - L)$. The necessary condition on t_L and $\bar{m}$ for banks in state $i = 4$ to be fully recapitalized becomes

$$p_4 D + (1 - p_4)(1 - \beta) v + (\phi_4 - \bar{m}) v + \bar{m}(L + t_L) \geq d. \tag{23}$$

In choosing the optimal t_L and $\bar{m}$, the government seeks to ease the above constraint, while discouraging solvent banks from participating in the scheme. In other words, the government is to choose $(t_L, \bar{m})$ so as to

$$\begin{aligned} &\max\, [(\phi_4 - m) v + m(L + t_L)] \\ &\text{s.t. } (\phi_2 - m) v + m(L + t_L) \leq \phi_2 L. \end{aligned} \tag{24}$$

At the optimum the incentive constraint for a bank in state $i = 2$ is binding, so that the above problem simplifies to

$$\max_m\, [(\phi_4 - \phi_2) v + mL + (\phi_2 - m) L], \tag{25}$$

for which there is no unique maximum. Setting $t_L = 0$ and $\bar{m} = \phi_2$ thus involves no loss of generality, provided that condition (23) is satisfied. With $t_L = 0$ and $\bar{m} = \phi_2$, this is nothing but condition (20).

This establishes that condition (20) is both necessary and sufficient, and therefore completes the proof. *Q.E.D.*

Whenever condition (20) is satisfied, a bank bailout policy which is conditional on the liquidation of firms in default can meet two of the requirements for first-best social efficiency. Efficient liquidation decisions by bank managers and no excessive recapitalization of banks by the government. Moreover, this result obtains regardless of the government's knowledge (or beliefs), $\mu_i(e)$, about the state of the overall banking system. In particular, it dominates the tough, soft and in-between policies considered in the previous section, none of which would achieve these requirements for first-best efficiency, except perhaps on a negligible (measure-zero) subset of parameter values for $\mu_i(e)$. If condition (20) is not satisifed, this conditional recapitalization policy would lead to excessive recapitalization of solvent banks in state $i = 2$ (and/or of insolvent banks in state $i = 3$), with the associated dead-weigth cost. In which case, a tough bailout policy may sometimes dominate, in particular if $(\mu_1 + \mu_2)$ is close to one.[10]

The analysis of this section thus shows that conditioning the recapitalization of banks on an observable and verifiable action of bank managers can increase the ex post efficiency of bank bailouts and, under certain circumstances, meet the two requirements for ex post efficiency.

As for ex ante effort incentives, it turns out that the tough recapitalization policy analyzed in section 3 and the more complicated conditional recapitalization developed in this section provide bank managers with precisely the same incentives to exert effort. It is straightforward to show that the incentive-compatibility constraint for a bank manager to exert effort under the conditional bank recapitalization policy simplifies to

$$[\mu_1(1) - \mu_1(0)]\, BW_1 > c, \tag{26}$$

which is the same as under the tough recapitalization policy (see equation (13)). This equivalence arises because, the expected value of private benefits rises with managerial effort only to the extent that this effort raises the probability that state $i = 1$ will occur, since bank managers receive exactly B in all other states of nature.

That our conditional recapitalization scheme provides the same ex ante effort incentives as a tough bailout policy, should come as no surprise. Both policies give bank managers the option of distorting their ex post reports about loan losses (i.e., about β_i), although our conditional scheme is designed in such a way that bank managers are *indifferent* between distorting (and announcing state $i = 2$) and not distorting. This in turn explains why ex ante effort incentives are the same under the two policies, even though our scheme avoids the ex post

[10] Another potential problem with this non-linear transfer scheme is that it may create incentives for solvent banks to sell their bad loans to insolvent banks. To prevent such profitable arbitrage from taking place the regulator would need to monitor the secondary market for loans and scrutinize more closely net purchasing banks.

inefficiencies induced by a tough bailout policy. Our scheme should thus be seen as a strict improvement over a tough recapitalization policy.

To conclude this section, we point to a limitation of our findings and to a possible further extension. The analysis shows that by reducing the incentive of bank managers to exaggerate the extent of their banks' bad loans, a suitably designed conditional recapitalization scheme in which government transfers to insolvent banks are linked to their liquidation of firms in default can achieve some of the first-best social efficiency conditions. However, in somewhat more complex circumstances, these efficiency gains could be lost. For example, if we allow for heterogeneity in the quality of non-performing loans (such as differences in the liquidation values of each loan) and if the exact quality of bad loans were the private information of bank managers, then the two-part transfer scheme considered above would fail to deliver first-best efficiency because there would no longer be a simple relationship between the proportion of liquidated loans in a bank's portfolio and its true net worth. Characterizing a more sophisticated non-linear transfer scheme that would "solve" this problem, and more generally deriving the conditions under which such a scheme can dominate some simpler schemes (such as those analyzed in section 3) is left for further research.

5. *Conclusion*

The main lessons emerging from our analysis are first that recapitalizations should be made explicitly conditional on the liquidation of non-performing loans. Ideally, recapitalizations should not take the form of purchases of preferred stock or subordinated bonds. Of course, it may not be practical or feasible to set up such a conditional scheme at short notice following the outbreak of a banking crisis. This is why we advocate the institution of a bankruptcy procedure for banks in anticipation of future banking crises. We believe that, just as with non-financial firms, the establishment of such an institution can go a long way in resolving in an orderly and efficient way most banking crises.

The model in this paper is, of course, highly stylized and can only serve as a framework to organize our analysis of bank bailouts. While it does cover most important incentive aspects raised by bank failures and bailouts it does so only in a highly simplified way. Much additional work is required to design a proper bankruptcy institution for banks, but we hope that this paper can serve as a first step in this direction.

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