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ABSTRACT

Strategic Creditor Passivity, Regulation and Bank Bailouts*

This paper analyses two aspects of banking crises: the choices that banks make to passively roll over loans in default versus actively pursuing their claims; and choices by regulators to 'punish' passive and insolvent banks versus rescuing them. Banks may choose to roll over loans in order to hide their poor financial conditions or to gamble for resurrection. Regulators can reduce creditor passivity through their *ex-ante* choice of monitoring capability and their *ex-post* choice of policy for distressed banks. Yet, if too many banks are discovered to be passive or insolvent, a situation labelled 'too-many-to-fail' (TMTF) may arise, whereby it is less costly to rescue than to close large numbers of banks. Banks may implicitly collude through their choice of actions in order to trigger TMTF. A principal result of the analysis is that when the regulator reacts to the threat of banks triggering TMTF, it is by 'softening'. One form of softening involves lowering the *ex-ante* monitoring capacity and 'punishing' a smaller number of banks *ex post*. More undetected passivity will thus exist in equilibrium than if TMTF could not be triggered.

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NON-TECHNICAL SUMMARY

This paper focuses on two interrelated aspects of banking crises: the choices banks make to passively roll over loans in default versus actively pursuing their claims; and choices by regulators to punish passive and insolvent banks versus rescuing them. Banks' attempts to hide loan losses by rolling over loans in default often create or exacerbate banking crises. Regulators' responses to banking crises have varied from bank closures to widespread bank rescues. The latter have occurred in economies such as Chile, Japan, Norway, Sweden and several economies in transition.

Whereas 'too-big-to-fail' explains why large individual banks may be rescued, it cannot explain the simultaneous rescue of several banks. This paper models a phenomenon labelled 'too-many-to-fail' (TMTF), which occurs when it is more costly to close down a large number of banks than to rescue and recapitalize them. The starting point of the analysis is that both the *ex-ante* design of regulatory institutions and the *ex-post* choice of policy applied to financially distressed banks are important for understanding interactions between bank and regulator behaviour. The choice of *ex-ante* institution is represented by a monitoring capability, chosen before any default occurs on banks' balance sheets. Because banks' financial states are not costlessly observable by the regulator, the monitoring capability will determine the probability that the regulator will detect when a bank with default is passive.

The choice of *ex-post* policy applied to banks that have been discovered passive or insolvent is a choice between two types of policies, labelled *intervention* and *rescue*. Intervention requires the regulator to undertake an additional examination of the bank to determine its solvency and to implement an action, such as replacement of bank management, temporary operation of the bank, merger with another bank, or bank closure. In contrast, with rescue there is no audit of the bank to determine its solvency; the bank is maintained in operation and recapitalized.

Each of the policies of intervention and rescue entails costs, which depend, among other things, on the number of banks discovered to be in distress. If, *ex post*, rescue is less costly than intervention, then TMTF will be triggered and rescue chosen. The choice of *ex-post* policy must be credible, given the number of discovered passive and insolvent banks. The regulator's objective in choosing monitoring capability and *ex-post* policy is to minimize the total social costs associated with financial distress of banks.

When banks are faced with default on their balance sheets, they choose between being 'passive' or 'active'. A choice of passivity is a decision to passively reschedule loans. Firms that should be reorganized or liquidated will continue operating according to the status quo; these firms thus have soft budget constraints. A choice to be active is a decision to actively recover the outstanding debt, either through an out-of-court workout or through a formal bankruptcy proceeding. Passivity is assumed to be a riskier action than being active. The decision to be active is also assumed costlessly observable by the regulator. The bank reveals its financial state when it is active.

Three potential motives for the choice of passivity are modelled. The first is an attempt to avoid signalling the bank's poor financial condition. The second is an attempt to 'gamble for resurrection', which results from the existence of deposit insurance and from the riskiness of passivity. The third motive is an attempt to trigger TMTF, which is linked to fact that TMTF creates a coordination problem. That is, financially distressed but solvent banks may implicitly collude to be passive if, *ex post,* the regulator will be forced into a situation of TMTF, given the number of discovered passive banks.

Bank behaviour will be a function of both the *ex-ante* monitoring capability and the expected *ex-post* choice of policy. If the regulator will impose intervention *ex post*, insolvent banks will always choose passivity in order to avoid revealing their financial state. Even when the regulator can precommit to rescuing active insolvent banks, these banks may still choose to be passive if the monitoring capability is too weak or recapitalization not sufficiently generous to eliminate the incentive to gamble for resurrection. When precommitments to rescue fail for these reasons, offers of recapitalization may need to be repeated in the future.

Banks that are distressed but still solvent will not choose passivity for the signalling motive; however, they may choose passivity in order to gamble for resurrection if the *ex-ante* monitoring capability of the regulator is low enough. Distressed but solvent banks may also choose passivity in order to trigger TMTF. Thus, the choice of passivity is not limited to insolvent banks.

The regulator's choice of *ex-ante* monitoring capability takes into account banks' responses to this choice and to the expected *ex-post* policy. Given the costs of intervention and rescue, the regulator would like to implement intervention *ex post*. An equilibrium exists in which intervention is the *ex-post* policy. This equilibrium may be susceptible to implicit collusion among banks, however, whereby, *ex post*, the regulator is trapped in a situation of TMTF. When the regulator believes that implicit collusion is likely, they will react *ex* *ante* to this possibility. Hence, a second equilibrium will exist. The second equilibrium is characterized by 'softening'. One form of softening is to weaken the *ex-ante* monitoring capability and apply intervention *ex post* to a smaller number of banks. The reduction in the number of detected passive banks avoids the triggering of TMTF; however, more undetected passivity will exist in equilibrium. When a high proportion of distressed banks is insolvent, the regulator's softening may take an alternative form of a precommitment to rescue active insolvent banks.

Thus, in economies where TMTF is a threat, it may be impossible to establish tough prudential regulations without risking a bailout of the entire banking system. The equilibrium choices of monitoring capability and *ex-post* policy will depend on the proportion of distressed banks expected to be insolvent, the costs of recapitalizing banks, and the likelihood that banks will implicitly collude to trigger TMTF. Differing regulatory responses to banking crises in Hungary, Norway and the United States are discussed in terms of the model.

1 Introduction

Many countries throughout the developing and industrialized world have suffered banking crises in recent years. Banks' attempts to hide loan losses by rolling over loans in default have often precipitated or contributed to these crises. In dealing with the crises, regulators have employed a variety of policies, ranging from bank closures to widespread bank rescues. This paper focuses on two interrelated aspects of banking crises: the choices banks make between actively pursuing satisfaction of their claims in default, versus remaining passive and rolling over the loans;[1] and choices by regulators to "punish" passive and insolvent banks, versus rescuing them.

Whereas the concept of "too-big-to-fail" can explain why regulators tend to rescue individual, large banks in financial distress, it cannot explain why governments in some countries have chosen to rescue all or most of the banks in the financial system. Widespread bank rescues have occurred in countries such as Norway, Sweden, Japan, Chile, and the economies in transition, including Hungary, the Czech Republic, Poland, and Bulgaria. In this paper I model a phenomenon labelled "too-many-to-fail" (TMTF) to explain the occurrence of widespread bank rescues. TMTF occurs when regulators react to the financial distress of several creditors by initiating rescues or otherwise allowing banks to remain in operation.

The starting point of the analysis of interactions between bank behavior and regulators' handling of banking crises is the modelling of both the *ex ante* design of regulatory institutions and the *ex post* choice of policy, once financially distressed banks have been discovered. Both *ex ante* institutions and regulators' *ex post* reactions to financial distress will influence bank behavior. Furthermore, institutions that are in place *ex ante* will determine the *ex post* feasibility of differing policies. To the best of my knowledge, this is the first analysis of bank regulation to take simultaneous account of the effects of *ex ante* and

[1] In a summary of the experiences with financial crises in five countries, Sundarajan and Balino (1991, p. 13) note: "It took some time for the [banking] problems to be discovered by supervisory authorities because of the normal tendency of banks in distress to reduce the transparency of their accounts."

Concern with the problems created by this type of creditor passivity is especially notable in discussions of financially distressed banks in the economies in transition. See, for example, Aghion, Bolton, and Fries, 1996, Begg and Portes, 1993a, 1993b, Coricelli and Thorne, 1993, Mitchell, 1993 and 1996, and Perotti, 1994.

ex post policies on bank and regulator behavior. The importance of *ex ante* institutions is illustrated by the following quote from World Bank (1989, p. 76), summarizing experience during the decade from 1978 to 1988, in which governments in twenty-five countries were forced to deal with distressed banks: "[I]n most [of these] countries ... inadequate regulation has permitted risky lending, and ineffective supervision has permitted banks to ignore their losses."

Two motivations for creditors in the model of this paper to passively roll over loans in default are their unwillingness to signal their own poor financial conditions and a desire to "gamble for resurrection," or to take advantage of what is often called a deposit insurance put option. Weak *ex ante* monitoring capability by the regulator will reinforce passivity resulting from either of these motivations. Yet another factor that may motivate distressed but solvent banks to engage in passive behavior is the prospect of TMTF, which creates a strategic complementarity in bank actions. Knowing that regulators are susceptible to TMTF may encourage banks to engage in a form of implicit collusion, by which they choose not to use bankruptcy against their defaulting debtors. Bad debts will accumulate on everyone's balance sheets, and the government will be pressured to bail out creditors in one form or another.

The regulator's policy choices in the model are endogenous. The *ex ante* design of institutions is a choice of monitoring capability, before any default has occurred on banks' balance sheets, and determines the regulator's ability to detect if banks are rolling over loans. Upon monitoring and discovering banks that have rolled over loans or are insolvent, the regulator chooses between two policy options: *intervention* and *rescue*. The table below describes the types of activities that are associated with each policy.

Intervention	auditing bank to determine solvency replacing bank management if bank solvent closing bank or merging it with another if insolvent forcing debtors with rolled over loans into bankruptcy possibility of operating bank for some period of time
Rescue	no audit of bank to determine solvency maintaining bank in operation recapitalizing bank

With intervention the regulator attempts to determine the bank's net worth and the appropriate remedy, whereas with rescue banks are simply recapitalized and allowed to remain in operation. Each of these policies entails costs. These costs depend, among other things, upon the number of banks discovered to be in distress. Moreover, even though initial monitoring may reveal that a bank has hidden some loan losses, the regulator is not fully informed of the individual bank's financial situation. The fact that when intervention is applied additional examination is necessary to determine the appropriate course of action for the bank (e.g., merger, liquidation, or change of management) implies that this policy is costly. If the regulator chooses not to undertake the examination, or if the regulator decides that it is too costly to close down a large number of banks in the economy, then the regulator will be obliged to recapitalize insolvent banks in order to keep them open. Since recapitalization is costly, rescue is also costly.

A principal result of the analysis is that when the regulator reacts to the potential of banks' triggering TMTF, (s)he reacts by "softening." This softening may occur either *ex ante* by the choice of a weaker monitoring capability than would otherwise have been chosen, or *ex post* by rescuing insolvent banks instead of applying intervention. A weakening of the *ex ante* monitoring capability will result in more undetected passivity among banks in equilibrium. Whereas the regulator lowers monitoring capability in order to avoid being trapped in a situation where rescues are necessary, this response creates a snowball effect: the prospect of high passivity among creditors leads the regulator to choose a low degree of monitoring, which results in high passivity in equilibrium. An implication of this result is that in economic conditions where the threat of TMTF is significant (such as early in transition or in economies with developing financial markets), it may be impossible for regulators to impose tough banking regulations.

Another of the results of the analysis is that in situations in which the degree of financial distress among banks is expected to be high and in which most of the financially distressed banks are insolvent, the regulator may want to precommit to a policy of rescue (and recapitalization) in order to encourage these banks to use bankruptcy against defaulters and thus reveal their insolvency. This policy, however, may fail–due to banks' desires to gamble for resurrection–if not accompanied by strong *ex ante* monitoring capability or by generous recapitalization. Because of the failure of the offer of rescue to save the banks that the regulator intended to save, it may be necessary to make additional rescue offers in the future. Thus, multiple episodes of recapitalization may occur as a result of the failure of previous recapitalizations. This explanation for repeated recapitalizations differs from the well acknowedged credibility problem, whereby an initial recapitalization creates expectations among banks of future recapitalizations, and banks act so as to make these expectations self-fulfilling.

An indirect implication of the analysis is that creditors' potential reluctance to seek satisfaction of claims in default and regulators' reactions to this passivity may significantly influence the implementation of bankruptcy laws in an economy. This effect can have drastic implications for countries with developing financial sectors. Effective default laws in any economy are needed to define property rights of a firm's claimants in the event of default, to improve the efficiency of resource allocation, and to discipline firm managers. When bankruptcy or other related procedures are not implemented, none of these beneficial functions may be served, and financial development will be hindered.

This paper relates to two bodies of literature: analyses of bank behavior in the presence of deposit insurance and analyses of regulators' bank closure decisions. Since much of the literature on bank behavior concentrates on banks' *ex ante* decisions to invest in risky assets as a result of deposit insurance, relatively few papers in this literature treat creditors' decisions to roll over loans in default. O'Hara (1993) identifies an equilibrium where banks roll over loans of insolvent debtors in response to the imposition of market-value accounting standards. Rajan (1994) analyzes a model where bank managers are passive (lenient, in his terminology) in order not to tarnish reputations in managerial or stock markets.

Most papers in the literature on bank closure also focus on the *ex ante* riskiness of banks' investments and on regulators' decisions to close banks on the basis of these investments.[2] These papers generally assume that the regulator knows or can observe the bank's riskiness of investment; therefore, the closure decision is made with full information. In addition, if a regulator does not close a bank, the bank is assumed to be able to stay in operation.

This paper differs from the existing literature on bank closure in a number of respects. It considers policies that require more than a simple decision to close a bank or not. Each policy option entails costs, and these costs explicitly include effects related to the

[2] See, for example, Acharya and Dreyfus (1989), Boot and Thakor (1993), Davies and McManus (1991), Kane (1990), and Mailath and Mester (1994).)

financial distress of multiple banks. In addition, the regulator does not have full information regarding banks' financial states at the point where he chooses a policy.

The bank closure models of Kane (1990) and Boot and Thakor (1993) yield regulatory forbearance as the result of an agency problem: regulators delay bank closure because they are acting in their own personal interest. The forbearance arising in this paper does not result from an agency problem between society and regulators: the regulator's objective is to minimize the total social costs related to bank financial distress.

Section 2 of the paper presents the general version of the model. In particular, it allows for varying degrees of financial distress among banks with defaulters. However, because of the complexity of the regulator's cost functions and of the interactions between *ex ante* institutions, bank behavior, and *ex post* policy choice, I first analyze two simpler versions of the model. In Section 3 all banks with defaulters are financially distressed but still solvent. In Section 4 all banks with defaulters are insolvent. The analysis in these sections provides the intuition for the results in the general model, which are discussed in Section 5. In the general model the optimal choice of *ex ante* and *ex post* policies will be a function of the proportions of insolvent and solvent distressed banks. This suggests the possibility of differing regulatory reactions to banking crises with differing causes. Regulatory responses to banking crises in the U.S., Norway, and Hungary are discussed in Section 5.

2 General Model

2.1 Description

There are N banks in the economy, each with liabilities of L. Each bank has outstanding risky debt in the amount of B. It also has other, nonrisky sources of income, I_0, such as income from provision of services or from the holding of government debt. A number m of the banks in the economy experiences default. The fraction of a bank's portfolio in default is given by α. Although m is known to the regulator, which banks experience default is not known in the absence of monitoring.

A bank's income in period 1, which is composed of nonrisky income and repayment of risky debt, will be denoted by I. A bank which is repaid by a proportion $(1-\alpha)$ of the total debt B owed by its debtors has a period-one income of $I = I_0 + (1-\alpha) \cdot B$.

A bank with default on its loans chooses between two actions: being "passive" or being "active." A choice of passivity represents a decision to passively roll over, or reschedule, loans, with no negotiations regarding reorganization of the firm. Thus, the passive bank rolls over debt and allows the defaulting firm to continue operating according to the status quo.

In contrast to the choice of passivity, a choice to be active represents a decision by the bank to actively recover at least a portion of the outstanding debt, either through an out-of-court workout or through a formal bankruptcy proceeding. Hence, if a firm's continuation value exceeds its liquidation value but if, at the same time, the firm should be reorganized, reorganization will occur. I use the terms "active banks" and "banks using bankruptcy" synonymously throughout the paper. I also assume that the use of bankruptcy (or out-of-court workout) is costlessly observable by the regulator. Thus, the regulator costlessly observes the level of default of an active bank's portfolio.

When banks are passive, default on debt remains hidden (unless the passivity is detected by the regulator). Because firms' loans are passively rescheduled, firms whose liquidation values are greater than their continuation values will be able continue in operation. These firms thus have soft budget constraints. Note that the motivation for soft budget constraints and the context in which they occur differ from those described in the model of soft budget constraints analyzed by Dewatripont and Maskin (1995). The latter consider a situation in which it is always *ex post* efficient to continue the firm in operation, although *ex ante* the investment has negative net present value. Banks cannot commit not to refinance a defaulter *ex post*, since a new loan will be recovered and the old loan is sunk. In the current paper, firms may be continued in operation even though it is not *ex post* efficient to do so.[3]

The time line below describes the sequence of events.

Timing:

Period 0

G establishes monitoring capability;

G may precommit to recapitalization and rescue of banks

Period 1

[3]Whereas there is an explicit assumption of the need for refinancing in Dewatripont-Maskin, there is no such assumption in this paper. The model here could easily by modified to incorporate the need for refinancing defaultors without changing any of the major results.

Banks observe income and default;

Banks choose action with respect to defaulters;

G monitors and discovers passive or insolvent banks;

G chooses policy for all detected banks (intervention or rescue, unless precommitment to rescue)

Period 2

Returns received from defaulters in period 1

Banks receive payoff, depending on whether detected passive or insolvent, and depending upon G's choice of policy

In period 0 the regulator chooses a monitoring capability that will determine a probability D with which the regulator will be able to detect passivity on the part of banks. At the beginning of period 1 banks earn income and observe default. Banks then choose an action to take with respect to defaulting debtors. The regulator then monitors banks and either detects insolvency and/or rolling over of loans or not in each bank. The regulator chooses the policy to apply to banks that have been discovered passive or insolvent. Banks' payoffs (or punishments) are realized in period 2.

I assume that deposit insurance exists. Because depositors will not monitor the bank in the presence of deposit insurance, the regulator's monitoring role is crucial. The assumptions regarding the monitoring function and the informational abilities of the regulator follow from two stylized facts. (1) Observation of a bank's financial standing is costly; hence, there is a costly verification problem. (2) It is in general much more difficult to identify a bank in financial difficulty than it is a bank that is healthy.[4] Monitoring requires each bank to submit to a periodic bank examination, during which the regulator reviews bank income statements and documents and attempts to determine if the bank has bad loans in its portfolio and if it has taken appropriate actions with respect to those loans. Given the choice of institutions, the probability is D that passive banks will be detected.

A key aspect of the model is that G's choice of policy *ex post* must be subgame perfect. That is, G is unable to commit himself *ex ante* to being tough *ex post* if being tough is

[4] An example consistent with this fact appears in U.S. banking history. New York was the first state in the United States to set up a bank supervisory authority. After its establishment in 1829, however, this authority was abolished in 1843 beacuse the legislature believed that the commissioners "[w]ere superfluous when bankers were honest, and of no avail when bankers were dishonest." (Klebaner, p. 44)

not credible. Hence, *ex post*, G will be forced into a situation of rescuing banks if it is less costly, given the number of discovered passive or insolvent banks, to rescue than to apply intervention. This situation will be labeled as one where too-many-to-fail (TMTF) takes effect.

On the other hand, G can commit himself to being more lenient *ex ante* than he might have wished *ex post*. G can precommit in period 0 to the rescue of banks by, for example, announcing that a policy of rescue and recapitalization will be administered in Period 2. A commitment in period 0 to rescue with a given amount of recapitalization may encourage insolvent banks to choose to be active and thus to reveal themselves. When rescue is implemented, the regulator provides recapitalization to banks and allows banks to continue in operation. The amount of recapitalization accompanying rescue is one of the regulator's choice variables; nevertheless, the regulator will be forced to offer insolvent banks at least the minimum level of recapitalization that will render them solvent.

2.2 Bank Strategies

As mentioned above, banks choose between being passive or active. When a bank rolls over loans in the amount of B, the return is assumed to be B with probability q and 0 with probability $(1-q)$. The return from use of bankruptcy for defaulting loans in the amount of B is given by $\tilde{B}$, where $B > \tilde{B} > qB$. Bankruptcy thus yields a higher expected return than does rollover, since bankruptcy allows the bank to take the action (reorganization or liquidation) with respect to the firm that yields the highest value of the firm's assets. In addition, rollover is implicitly assumed to be a riskier action than bankruptcy. The explanation for this assumption is that because no attempt is made by a passive bank to obtain information regarding the most valuable use of the firm's assets and to reallocate the assets to their most valuable uses, the uncertainty of repayment is greater with rollover than with bankruptcy.[5]

[5] What is important in the model is the existence of a risky action that can be associated with "gambling for resurrection." An alternative assumption that would yield similar results would be that first-period income I may be invested in a safe asset or in a risky asset with a lower expected return. However, since the focus of the paper is on banks' decisions to be active or passive, it seems reasonable to focus on rollover as a riskier action than bankruptcy.

Assumption 1: The banker's objective function is $\max[\Pi, 0] + \rho$, where Π represents bank profit and ρ represents a private benefit from operating the bank.[6]

Bank managers maximize expected bank profit (as long as it is positive) plus a private benefit of maintaining the bank in operation.

Assumption 2: $I_0 + (1-\alpha)B < L < B$.

Liabilities L to depositors are assumed to be high enough that for banks with default period-1 income I alone cannot satisfy the liabilities; however, full recovery of debts B is sufficient.

Define the two-period profit of a bank that is active (and that will be said to use bankruptcy) by[7]

$$\Pi^{bankr} = I_0 + (1-\alpha)B + \alpha\tilde{B} - L. \tag{1}$$

Assumption 3: $I_0 + (1-\alpha)B + \alpha qB < L$.

Assumption 3 implies that the expected earnings with rollover are less than the bank's liabilities.

What happens when a bank is passive? If it is not detected and if rollover succeeds, the banker earns a positive monetary return plus the private benefit ρ from keeping the bank in operation. If the bank is not detected and rollover fails, the banker earns no monetary return since revenues are less than liabilities. However, she still earns ρ since by not being detected the bank manages to stay in operation during period 1. If the passive bank is detected, then the banker's payoff will depend upon the *ex post* policy chosen by G.

Suppose that the regulator selects a detection probability D and "punishes" detected passive banks by firing the banker, who thus earns a payoff of zero.[8] The expected monetary payoff to the banker that rolls over a loan is

$$\Pi^{roll}(D) = (1-D) \cdot q[I_0 + B - L]. \tag{2}$$

[6] This objective function is also employed in Aghion, Bolton, and Fries (1996). As long as banks are not required to set aside provisions against expected loan losses, Π is equal to bank net worth. When loan loss provisions are required, bank profit Π differs from bank net worth by the deduction of the loss provisions.

[7] I assume that the bank's liabilities come due in period 2; therefore, the bank's solvency is determined by its two-period earnings minus liabilities.

[8] It is shown below that when G applies a policy of intervention, detected passive bankers will earn a payoff of zero.

With probability $(1-q)$ the debtor whose loan has been rolled over does not repay, and the banker's monetary payoff is zero.

2.3 The regulator's objective

The regulator's objective is to choose the *ex ante* monitoring capability and the *ex post* policy to minimize total costs associated with default on bank debt. These costs can be classified in two categories: *ex ante* or *ex post* costs. The *ex ante* component of costs is the cost of monitoring banks. *Ex post* costs include two components: losses in net worth of passive banks which are not detected; and costs of administering a policy—intervention or rescue—to banks discovered passive or insolvent. The costs of administering the policy of intervention include any costs resulting from disruptions of the financial system when banks are closed. Given the costs of auditing, operating, or closing down a large number of banks in an economy when intervention is applied, the policy of rescue will be chosen when it enables the regulator to avoid a large portion of these costs.

Ex ante costs of monitoring are assumed to be an increasing, convex function $g(D)$. The costs included in $g(\cdot)$ represent resources that are necessary to ensure that each bank faces a probability D of discovery if it chooses passivity. These resources include personnel, training, regulations, etc.

The component of *ex post* costs defined as the expected losses in bank net worth due to passivity arise from the fact that passive banks choose the "wrong" action with respect to defaulters. Their expected net worths are thus lower than they would be if the banks chose to be active. Define the expected loss in net worth per passive bank by

$$LNW = \alpha(\widetilde{B} - qB).$$

Define the expected total loss in net worth due to banks' undetected passivity by the function

$$h[D;P] = LNW \cdot (1-D) \cdot P,$$

where P represents the number of passive banks.

The total costs associated with each policy are specified more precisely in the subsections below.

Costs of intervention. Define $c_i(s)$ to be the administrative costs of a policy of intervention applied to s banks. The function $c_i(\cdot)$ is assumed increasing and convex. This function is assumed to include both direct and indirect costs associated with intervention. Direct costs include expenses for staff and resources required to undertake the activities associated with intervention. Indirect costs include social costs generated by disruptions in the financial system from the closing or the taking over of banks. Both direct and indirect costs could reasonably be expected to be convex in the number of banks subject to intervention. As the number of detected banks grows, however, the magnitude of the indirect, social costs of disruptions in the financial system would be expected to dominate the direct costs.[9]

It will be convenient for the analysis to define a function representing the total *ex post* costs associated with the policy choice of intervention. Define the *ex post* costs of intervention by

$$i(D; P, s) = h[D; P] + c_i(s), \tag{3}$$

where s is the number of banks to which intervention is applied. The precise value of s in the function c_i depends upon the number of passive banks, the number of insolvent, active banks, and whether G has precommited to rescue insolvent, active banks. The value taken by s will be thus be made explicit in Sections 3 and 4, which analyze differing versions of the model. For the purposes of illustration, assume that no insolvent banks are active and that intervention is applied only to detected passive banks. Then $s = D \cdot P$, where P is the number of passive banks.

Note that the function $h(\cdot)$ is linear and negatively sloped in D. The function $c_i(\cdot)$ is positively sloped in s; hence, if $s = D \cdot P$, this function is positively sloped in D. Because $i(D; P, D \cdot P)$ is the sum of these two functions, it may be increasing or decreasing in D. The functions $c_i(\cdot)$ and $h(\cdot)$ are depicted in Figure 1 for a given number P of passive creditors

[9] The specification and form of the function $c(\cdot)$ are exogenous to the model and may appear to be *ad hoc*. Formally deriving the social costs associated with bank closures would require specification of an aggregate model with financial and nonfinancial sectors. Such an exercise would constitute a separate project and is thus beyond the scope of this paper. For the purpose of this paper I assume that the regulator is able to calculate the social costs associated with bank closures and includes these calculations in the costs of intervention.

and for the case where $s = D \cdot P$.

Figure 1 *here.*

The total costs associated with an *ex ante* choice of D and an *ex post* policy of intervention for some given number P of passive creditors and s of creditors to whom the policy will be applied are defined to be

$$C_i(D; P, s) = g(D) + i(D; P, s). \tag{4}$$

Whereas $g(\cdot)$ is increasing in D, $i(\cdot)$ may be increasing or decreasing in D. The convexity of the *ex post* administrative-cost function $c_i(\cdot)$ implies that if the derivative of $i(\cdot)$ is positive at $D = 0$, it will be positive for all D. In this case the regulator intending to apply intervention will choose not to monitor banks, since total costs will be minimized at $D = 0$. In order to guarantee that the regulator has an incentive to choose a positive level of monitoring with intervention, I make the following assumptions.

Assumption 4: $\partial i(0; P, 0)/\partial D < 0$ for all P.

Assumption 5: $\partial C_i(0; m, 0)/\partial D < 0$.

Assumption 4 states that the function $i(\cdot)$ is negatively sloped at $D = 0$; i.e., that $c_i(\cdot)$ is flat enough at $D = 0$ so that the benefits of detecting a small number of banks outweigh the costs of administering a policy of intervention to those banks. The function $i(\cdot)$ may well become positively sloped at some value of $D > 0$. Assumption 5 states that at $D = 0$ the marginal cost of monitoring does not exceed the net marginal benefit of applying intervention to a small number of banks.

Costs of rescue. When the regulator uses a policy of rescue, banks are recapitalized and bank managers remain in control. Bankers thus earn at least their private benefit ρ. The regulator undertakes none of the activities associated with the policy of intervention; hence, none of the administrative costs or the social costs of closing banks are incurred. On the other hand, since the policy of rescue involves only recapitalization of the bank, it does not involve forcing the bank to take the "correct" action with respect to defaulters. Thus, if a bank has chosen passivity, its expected net worth, even if detected, is lower than if the bank had used bankruptcy for its defaulters.

The *ex post* costs of rescue include the loss in net worth resulting from passivity (detected or undetected) and the costs of recapitalizing banks. There are no costs of administering rescue other than the costs of recapitalization. Suppose that the policy of rescue is applied to s banks and the amount of recapitalization is R. Then administrative costs are

$$c_r(s) = R \cdot s. \tag{5}$$

Define the total *ex post* costs associated with a policy of rescue by

$$r(D; P, s) = LNW \cdot P + c_r(s). \tag{6}$$

Note that the costs due to loss in bank net worth from passivity are a function of the total number of passive banks and are thus constant with respect to D. As noted in the discussion of costs associated with intervention, the precise value of s relating to the administrative costs of rescue will depend upon a number of factors and will be made explicit in the analysis of Sections 3 and 4. For illustration, if no insolvent banks are active, $s = D \cdot P$, and $c_r(s)$, as well as $r(D; P, s)$, will be linear and increasing in D.

The total costs of an *ex ante* choice of D and an *ex post* choice of rescue applied to s banks are defined by

$$C_r(D; P, s) = g(D) + r(D; s). \tag{7}$$

Figure 2 compares the functions $i(D; \cdot)$ and $r(D; \cdot)$ for a given number P of passive banks and for the case where $s = D \cdot P$. The values of these functions at $D = 0$ are equal. The function $r(D; \cdot)$ is linear and increasing in D. The function $i(D; \cdot)$ is initially decreasing and may eventually become increasing in D.

Figure 2 here.

2.4 Discussion of general model

In the general model I allow for banks with defaulters to face differing degrees of financial distress. Namely, banks with defaulters may either be distressed but solvent or distressed and insolvent. Thus, there are effectively three types of banks in the model: banks with no default; banks with default but which are still solvent; and banks with default and which are insolvent. The motivation for allowing for varying degrees of financial distress is that banks with differing levels of financial distress choose passivity for different reasons. As mentioned in Section 1, there are three potential motives for a bank's choice of passivity: (1) avoiding signalling negative net worth; (2) gambling for resurrection; and (3) triggering TMTF. Insolvent banks will choose passivity–unless they have received a promise to be rescued–in order not to signal their insolvency. Even when promised rescue and recapitalization, insolvent banks may still choose passivity if the promised amount of recapitalization is not sufficiently high. The passivity in this case results from the motivation to gamble for resurrection. In contrast to insolvent banks, banks that can remain solvent if active will not choose passivity as a result of the signalling explanation. Yet, the existence of deposit insurance may give these banks an incentive to choose passivity and to gamble for resurrection, for low enough values of D. Thus, passivity is not a phenomenon that is limited to insolvent banks.

The differing behavior of solvent and insolvent distressed banks introduces discontinuities at particular values of D in G's cost function for intervention. As a result, the optimal value of D given a policy of intervention may be set high enough to ensure that solvent banks are active although insolvent banks remain passive. On the other hand, such a value of D may give rise to a temptation on the part of the solvent banks to implicitly collude and become passive in order to trigger TMTF. In this case the third motive for passivity comes into play. G's ultimate *ex ante* choice of D and *ex post* choice of policy will depend upon the proportion of distressed banks that are insolvent and upon the likelihood that TMTF will be triggered by implicit collusion.

3 Model with banks that can remain solvent if active

I assume that nonrisky income I_0 and the proportion α of the portfolio in default are identical for all m banks with defaulters. Thus, there are only two "types" of banks in this special case of the model: those with no default and those with αB in default. This implies that once a passive bank is detected, its type is known. Given the assumption that bankruptcy is costlessly observable, the bank's type is also known if it chooses to be active. In this version of the model I assume that banks with bad debt have a level of default low enough that they can remain solvent if they are active. I assume, on the other hand, that if banks choose passivity, their expected net worth will be negative. Hence, banks with defaulters are financially distressed, though not insolvent.

Let α_G represent the proportion of banks' portfolios in default, where the subscript G represents "good" banks. (Banks in the next section will be labeled "bad" banks.) Because an active bank's expected net worth is positive, it will not choose passivity in order to avoid signalling negative net worth. Thus, the only potential motives for passivity in this version of the model can be gambling for resurrection or triggering TMTF.

If gambling for resurrection is valuable enough to banks, then banks with default will choose passivity, for low levels of D, as a result of this motive.[10] If, however, the level of monitoring is high enough, gambling for resurrection will not be profitable for banks, and they will choose to be active. Yet, for high enough levels of monitoring, banks may have the incentive to engage in implicit collusion (by becoming passive) if by doing so they can trigger TMTF. In a continuation equilibrium in which this type of implicit coordination occurs, bankers' expected payoffs from passivity will include the expected benefits from gambling for resurrection plus the certain private benefit from remaining in operation, since when TMTF is triggered detected passive banks will be rescued. Banks' expected payoffs in this situation will exceed the payoff from using bankruptcy. The prospect of TMTF can thus increase the level of passivity of banks in the economy.

The analysis of this section employs assumptions 1-5 of the previous section. The following assumption is added.

Assumption 6: $\Pi^{bankr} \equiv I_0 + (1-\alpha_G)B + \alpha_G \cdot \widetilde{B} - L > 0.$

Assumption 6 states that active banks are solvent.

Whether or not gambling for resurrection is attractive to banks with default is a question of parameter values of the model.

Definition 1: Gambling for resurrection is *valuable* if, given no monitoring ($D = 0$), the bank would prefer to be passive than to be active; i.e., $\Pi^{roll}(D=0) > \Pi^{bankr}$.

Using Eqn. (2) with a value of $D = 0$, it can be verified that gambling for resurrection

[10]That deposit insurance can lead banks to undertake excessively risky investment *ex ante* is well known. Nevertheless, the point that deposit insurance can influence a bank's *ex post* reactions to default has not been explored in models of deposit insurance.

will be valuable for the bank with default if the banker's expected monetary payoff with passivity is greater than that with bankruptcy, or if $q \cdot [I_0 + B - L] > \Pi^{bankr}$. Note that one of the benefits to gambling for resurrection derives from the fact that liabilities L are only paid by the bank with probability q; therefore, expected liabilities equal qL. The fact that the bank's expected payment of liabilities is less than the face value of these liabilities when the bank gambles for resurrection creates a bias in favor of passivity. The cost to passivity (in the absence of monitoring) is that expected loan recovery is lower than if the bank were active.

Assumption 7: Gambling for resurrection is valuable.

Assumption 7 implies that for some range of D banks with default will choose passivity. If gambling for resurrection were not valuable, then banks in this version of the model would never choose to be passive.

The timing of events in this version of the model is identical to that for the general model; however, it should be noted that in equilibrium the regulator will not precommit in period 0 to rescuing banks. Indeed, it will be shown in the next section that a precommitment in period 0 to rescuing banks is only used for insolvent banks in order to induce them to become active and to reveal themselves. Since banks in this section are solvent if they are active, there is no need for to rescue them when they are active.[11]

Thus, G selects *ex ante* a value of D and *ex post* a policy of intervention or rescue on the basis of the number of discovered passive banks and the costs of administering each policy. The fact that the *ex post* choice of policy must be subgame perfect implies that the *ex ante* choice of D will be made in anticipation of the *ex post* policy choice. The analysis of G's choice of D thus employs backward induction. Before analyzing G's choice of D and policy, I describe bank behavior, given an *ex post* policy choice.

3.1 Bank best responses to monitoring and choice of policy

3.1.1 Intervention.

The assumption that gambling for resurrection is valuable implies that for a certain range of D, banks' payoffs are higher with passivity than with bankruptcy. Define D_G as the

[11] I assume that it is politically infeasible to offer recapitalization to banks that are known to have positive net worth.

value of D at which the bank is just indifferent between being passive and active.

$$\Pi^{roll}(D_G) + (1 - D_G) \cdot \rho = \Pi^{bankr} + \rho, \tag{8}$$

where $\Pi^{roll}(D) \equiv (1 - D) \cdot q[I_0 + B - L]$. Given a policy of intervention, banks will choose passivity for all $D < D_G$ and will become active for all $D \geq D_G$.

3.1.2 *Ex post* choice of rescue.

When rescue is applied to passive banks, recapitalization must be given in period 2 to those banks whose loans were not eventually repaid. Because part of G's objective is to minimize the costs associated with administering a given policy, the amount of recapitalization accompanying the *ex post* choice of rescue will be the minimum necessary to render an insolvent bank just solvent.

Definition 2: $R_{\min}$ is the minimum amount of recapitalization necessary to render a *passive* bank whose rolled-over loan is not repaid just solvent.

In the model of this section $R_{\min} = [L - I_0 - (1 - \alpha_G)B]$.

Given a policy of rescue, the expected payoff to a passive bank is

$$(1 - D) \cdot q[I_0 + B - L] + D\{q[I_0 + B - L] + (1 - q) \cdot [I_0 + (1 - \alpha_G)B - L + R_{\min}]\} + \rho.$$

The first term of the above expression represents the passive bank's expected monetary payoff if it is not detected. The second term represents the monetary payoff if the bank is detected and if the rolled-over loan is repaid. The third term is the monetary payoff if the bank is detected and if the rolled-over loans are not repaid. Since the recapitalization brings the bank's net worth to zero, the third term equals zero. The fourth term is the banker's private benefit from keeping the bank in operation. The above expression reduces to

$$q[I_0 + B - L] + \rho,$$

which is equal to $\Pi^{roll}(D = 0) + \rho$. Assumption 7 guarantees that the above expression is greater than $\Pi^{bankr} + \rho$. Hence, given a policy of rescue, banks with default will choose passivity for all values of D. A policy of rescue will encourage passivity on the part of banks.

3.2 Equilibrium policy

As mentioned above, identification of the equilibrium choices of D and *ex post* policy is done through backward induction. This requires–for each of the policies intervention and rescue–computing the optimal value of D consistent with application of that policy, taking into account banks' best responses to the policy and the choice of D. However, since the *ex post* policy choice must be subgame perfect, the range of D over which G is allowed to optimize, given a particular policy, must be restricted to the range in which the *ex post* choice of that policy would be credible. These two steps yield two continuation equilibria: one for a choice of D and intervention and one for another choice of D and rescue. The total costs associated with each of the two continuation equilibria are then compared, and the continuation equilibrium which yields the lower costs will constitute the equilibrium.

Yet, the equilibrium identified by this method is not necessarily unique. The fact that banks may implicitly coordinate their actions–by choosing passivity in order to trigger TMTF when it is feasible to do so–can imply the existence of a second equilibrium. Suppose that the second equilibrium exists. Then, the first equilibrium will represent G's choice of D and policy when he believes that no implicit collusion to trigger TMTF will occur. The second equilibrium represents G's choice of D and policy when G believes that banks will implicitly collude whenever it is in their collective interest to do so.

I compute below the first equilibrium according to the method just described. Then I examine the equilibrium to see if it is vulnerable to implicit collusion by banks and thus check for the existence of a second equilibrium. I characterize the second equilibrium when it exists.

Define D^i to be the optimal value of D given a policy of intervention, and D^r the optimal value of D given a policy of rescue. Identification of D^r is straightforward.

Claim 1: *The optimal value D^r given a policy of rescue is* $D^r = 0$.

Proof: Given a policy of rescue, all banks with default will choose passivity. Given m passive banks and the fact that total costs of rescue $C_r(D; m, Dm)$ are increasing in D, the value of D that minimizes these costs is $D = 0$. ||

It remains to compute D^i. That all m banks with default will choose passivity for $D < D_G$, given a policy of intervention, and become active for $D \geq D_G$ implies that G's costs of intervention are discontinuous at D_G. Namely, at D_G the *ex post* cost function $i(\cdot)$

shifts from $i(D_G; m, D_G \cdot m) > 0$ to $i(D_G; 0, 0) = 0$. Since all banks become active at D_G, there is no longer any loss in net worth from undetected passivity, and intervention is not applied to any bank. Hence, there are no *ex post* costs. Increasing monitoring beyond D_G is costly and yields no additional benefit; therefore, G will never choose a level of D greater than D_G. The optimal value D^i given intervention will either be an interior solution, with $D^i \leq D_G$ and with m passive banks, or a corner solution D_G where no banks are passive. This is the result of Claim 2, which is stated without proof.

Claim 2: *Denote by D^* the value of $D \in [0, D_G]$ such that the first-order condition for minimization of $C_i(D; m, Dm)$ is satisfied. When the F.O.C. is satisfied,*

$$g'(D^*) - LNW \cdot m + \frac{\partial c_i(D^* m)}{\partial D} = 0.$$

The optimal value D^i given a policy of intervention will either be D^* or D_G, where D_G represents a corner solution. In the latter case,

$$g'(D_G) > LNW \cdot m - \frac{\partial c_i(D_G \cdot m)}{\partial D}$$

and

$$g(D_G) < C_i(D^*; m, D^* m). \tag{9}$$

The left-hand side of inequality (9) represents the total (*ex ante* and *ex post*) costs of intervention, given D_G. The right-hand side represents the total costs of intervention with D^*. The optimal value will be D_G when the downward shift in the *ex post* costs at D_G more than compensates for increasing D beyond the point where the first-order condition for minimization of $C_i(D; m, Dm)$ is satisfied. Claim 2 implies that if the D^i is an interior solution, then it will correspond to a value of D on a decreasing portion of the *ex post* cost function $i(\cdot)$. Because monitoring is costly, the *ex post* benefits from intervention will not be exhausted at the optimal level of monitoring. The policy of intervention will be applied to $D^i m$ banks, while $(1 - D^i)m$ banks will remain undetected. Thus, there will exist undetected passivity in the economy when intervention is the equilibrium policy and when $D^i \neq D_G$.

In order to identify an equilibrium, it suffices to compare the continuation equilibria with D^i and intervention and with $D = 0$ and rescue. The following proposition states the result of this comparison.

Proposition 1 *An equilibrium exists with D^i and intervention.*

Proof: See Appendix.

Proposition 1 implies that if G believes that no implicit collusion of banks will occur, then D^i and intervention will be the equilibrium. G prefers to apply intervention than rescue.

In order to check for the existence of a second equilibrium, it suffices to ask whether the equilibrium of Proposition 1 is vulnerable to implicitly collusive behavior on the part of banks. In other words, given D^i, could a group of banks trigger an *ex post* choice of rescue by simultaneously choosing to be passive? A necessary condition for an affirmative answer to this question is that the *ex post* costs of intervening in $D^i m$ banks exceed the costs of rescuing $D^i m$ banks.

Proposition 1 and the definition of D^i imply that the only situation in which it could be feasible for banks to trigger TMTF is the case where $D^i = D_G$ and where D_G is a corner solution. This case represents the situation where G has chosen a high level of monitoring in order to benefit from the drop in the level of passivity at D_G. If, given D_G, the costs of intervention with $D_G m$ banks exceed the costs of rescue with $D_G m$ banks, then the equilibrium of Proposition 1 is susceptible to implicitly collusive behavior by banks, and a second equilibrium exists. If all m banks were to choose passivity given D_G, the only credible choice of policy *ex post* would be rescue.

Define a *collusive continuation equilibrium* as one in which banks (implicitly collude to) choose passivity in order to trigger a choice of rescue, whereas if the government could have commited to implementing intervention, banks would have chosen to be active. The claim below provides necessary and sufficient conditions for the existence of a collusive continuation equilibrium.

Claim 3: *Suppose that in the continuation equilibrium with intervention, $D^i = D_G$ and D_G is a corner solution. Then, if $c_i(D_G \cdot m) > R_{\min} \cdot D_G m + LNW \cdot D_G m$, a collusive continuation equilibrium exists for $D = D_G$.*

Proof: See appendix.

When the hypotheses of Claim 3 hold, G will not be able to avoid rescuing banks when they engage in implicit collusion. It is thus necessary to characterize the equilibrium choices of D and policy when G believes that banks will undertake implicit collusion. In order to choose optimally D and *ex post* policy, G compares costs with D_G and rescue with the costs associated with a choice of $D < D_G$ and intervention.

The following proposition characterizes the choices of D and policy in the second equilibrium.

Proposition 2 *Suppose that: (1) the optimal value of D in a continuation equilibrium with intervention is a corner solution D_G; (2) a collusive continuation equilibrium exists; and (3) G believes that implicit collusion will occur. Then, an equilibrium with D^* and intervention exists, where D^* is defined in Claim 2.*

Proof: See appendix.

The value D^* of the proposition is the value of D at which the first-order condition is satisfied in G's cost minimization problem with $C_i(D; m, Dm)$. Proposition 2 has two implications. First, rescue will not occur in equilibrium even though it can occur in a continuation equilibrium given a choice of D_G. Second, G reacts to the possibility of implicit collusion and the triggering of TMTF by becoming "softer," through lowering the level of monitoring. Although G would choose a higher value of D in the absence of implicit collusion, the threat of implicit collusion will prevent G from implementing intervention with this level of monitoring. The only way to credibly remain tough *ex post* is to weaken regulatory institutions *ex ante* (lower D from D_G to D^*).

When D is lowered and intervention applied, more undetected passivity occurs in equilibrium than would have if it were impossible for banks to trigger TMTF. In practice, definitions of bad debt, requirements for loan loss provisions, and the capacity of the regulatory body to undertake bank examinations may all be weaker than in the absence of TMTF. Thus, when regulators are faced with financially distressed banks and when TMTF is a potential outcome, it may be impossible to implement strong regulatory institutions without running the risk of a bailout of the entire banking system.

The result that the regulator may weaken regulatory institutions in response to the threat of TMTF contrasts with the more typical result in a principal-agent setting, where the principal monitors more rather than less when incentive problems worsen. The result here arises from the fact that there are multiple agents who can coordinate their strategies.

4 Model with insolvent banks

In this version of the model I assume that the level of default is sufficiently high that all banks with default are insolvent. Two features appear in the analysis of this section that were not present in the previous section: the signalling motive for passivity and the incentive for G to precommit in Period 0 to a policy of rescue. Because distressed banks are insolvent, even if these banks use bankruptcy for their defaulters, their expected earnings do not cover their liabilities. These banks are nevertheless assumed not to be illiquid: if their insolvency is not discovered, they are able to stay in operation during period 1 even if they roll over their loans.[12] Call the level of default α_B, where the subscript B represents "bad banks." The following assumption is substituted for Assumption 6 of the previous section.

Assumption 6′: $\Pi^{bankr} = I_0 + (1 - \alpha_B)B + \alpha_B \tilde{B} - L < 0.$

This section also makes use of the following definitions.

Definition 3: $R_{\min} \equiv L - I_0 - (1 - \alpha_B)B.$

$R_{\min}$ has the same interpretation as in Definition 2 in the previous seçtion. It is the minimum level of capitalization necessary to render a passive bank whose rolled-over loan is not recovered just solvent.

Definition 4: $\widetilde{R}_{\min}$ is the minimum amount of recapitalization necessary to render an *active* insolvent bank just solvent.

$\widetilde{R}_{\min} = L - I_0 - (1 - \alpha_B)B - \alpha_B \cdot \widetilde{B}.$

Obviously, $\widetilde{R}_{\min} < R_{\min}.$

Definition 5: Define *"extra" recapitalization* to be any amount of recapitalization greater than $\widetilde{R}_{\min}$.

4.1 Bank best responses to monitoring and choice of policy

4.1.1 Intervention.

Since active banks are insolvent, a policy of intervention will apply both to active banks with default and to passive banks that are detected. Application of intervention to a bank

[12] It is in fact quite common for insolvent banks to remain liquid for a period following the insolvency. For example, most of the insolvent S&Ls during the U.S. S&L crisis were liquid up to the point of closure.

will result in a payoff of zero. On the other hand, the expected payoff to a passive banker is $(1-D)\cdot\{q[I_0+B-L]+\rho\}$. Since this expression is positive, all banks with default will choose passivity for all levels of D, given a policy of intervention. The fact that the passive banker earns at least ρ if the passivity is not detected implies that the motivation for the choice of passivity in this case is to avoid signalling that the bank is insolvent.

4.1.2 *Ex post* choice of rescue.

Because it is possible that G may want to precommit to rescue of insolvent banks, I distinguish bank behavior in the case where rescue is chosen *ex post* and that in which G precommits in period 0 to rescue. Consider an *ex post* choice of rescue. The amount of recapitalization that is credible *ex post* is the amount that minimizes G's *ex post* costs, subject to the constraint that the bank becomes solvent. This amount is $\widetilde{R}_{\min}$ for active insolvent banks and $R_{\min}$ for detected passive banks. The claim below states that banks never have an incentive to become active given an *ex post* choice of rescue.

Claim 4: *Given an ex post choice of rescue, insolvent banks will choose passivity for all values of D.*

Proof: The expected payoff to a passive bank, given an *ex post* choice of rescue is given by

$$(1-D)\cdot\{q[I_0+B-L]+\rho\}+D\cdot\rho, \tag{10}$$

or

$$(1-D)\cdot\{q[I_0+B-L]\}+\rho.$$

This payoff is greater than the payoff ρ that the active bank receives, given rescue.||

Whereas the motivation for passivity given a policy of intervention is to avoid signalling negative net worth, the motivation to remain passive given an *ex post* choice of rescue is to gamble for resurrection. That $q[I_0+B-L]>0$ implies that gambling for resurrection is valuable to the insolvent bank. If gambling for resurrection were not possible–or equivalently, if rollover were not a riskier action than bankruptcy–the bank in this version of the model would be indifferent between being active and being passive given an *ex post* choice of rescue.

4.1.3 Precommitment to rescue.

There are two key differences between a precommitment to rescue and an *ex post* choice of rescue. First, with a precommitment to rescue, G is able to offer an amount of recapitalization that is larger than the amount that would be credible *ex post.*[13] Second, G can precommit to rescuing only banks that are active, thereby inducing insolvent banks to become active in order to benefit from rescue. Nevertheless, the proposition below demonstrates that because of the possibility of gambling for resurrection, a precommitment to rescue with an offer of minimum recapitalization will not necessarily induce insolvent banks to become active.

Proposition 3 *A precommitment to rescue of active banks, accompanied by recapitalization* $\widetilde{R}_{\min}$, *will not induce insolvent banks to become active unless the level D is sufficiently high.*

Proof: See appendix.

The message of Proposition 3 is that even when G can limit the policy of rescue to banks which are active, simply removing the negative effect of signalling insolvency is not enough to induce insolvent banks to become active, unless D is high enough. The intuition for the result is similar to that of Claim 4 of Section 3 and is due to the possibility of gambling for resurrection. Thus, if G is interested in inducing insolvent banks to become active, he will have to do so either by choosing a sufficiently high level of monitoring (which reduces the expected gains from gambling for resurrection) or by offering sufficient extra recapitalization (which raises the payoff to becoming active). Both of these alternatives are costly.

In fact, there exists a continuum of pairs $(D, R(D))$ where $R(D)$ represents the minimum level of recapitalization, given D, that will induce banks to become active given a precommitment to rescue. $R(D)$ is defined by

$$\Pi^{bankr} + R(D) + \rho = (1-D) \cdot q[I_0 + B - L] + (1-D)\rho,$$

or

$$R(D) = \widetilde{R}_{\min} + (1-D) \cdot q[I_0 + B - L] - D\rho. \qquad (11)$$

[13] I assume that whereas it is not feasible to commit *ex ante* to being tougher than would be optimal *ex post*, it is feasible to commit *ex ante* to being more lenient than might be optimal *ex post*.

The result of Proposition 3 follows directly from expression (11). A precommitment to rescue with an amount of recapitalization equal to $\widetilde{R}_{\min}$ will induce insolvent banks to become active only if $D \geqslant \widetilde{D}$, where $\widetilde{D}$ is defined such that $(1-\widetilde{D}) \cdot q[I_0+B-L] - \widetilde{D}\rho = 0$.

It is now possible to restate the result of Proposition 3 more generally.

Corollary 1 *Given a precommitment to rescue active banks with an offer of recapitalization $\widehat{R} = R(\widehat{D})$, banks will choose passivity for all $D < \widehat{D}$ and will be active for all $D \geqslant \widehat{D}$.*

The proposition and corollary demonstrate that when G wishes to precommit to rescue in order to induce insolvent banks to become active, there is a tradeoff between the level of *ex ante* monitoring and the amount of recapitalization necessary. For example, if G offers $R = \widetilde{R}_{\min} + q[I_0 + B - L]$, then he will be able to induce banks to become active even in the absence of monitoring. In this case one would observe the policy of rescue associated with weak regulatory institutions and a high level of recapitalization. On the other hand, if the level of monitoring is $\widetilde{D}$, G need not offer more than $\widetilde{R}_{\min}$. In this case one would observe the combination of strong regulatory institutions and relatively low levels of recapitalization. Which combination of D and recapitalization will be chosen by G, given a precommitment to rescue, will depend upon the costs of establishing strong regulatory institutions (i.e., of *ex ante* monitoring) relative to the costs associated with employing funds for recapitalization. When the political costs of recapitalizing banks are high, the only means of inducing insolvent banks to become active through a precommitment to rescue will be to establish strong regulatory institutions.

Proposition 3 and the corollary thus have powerful implications, despite their simplicity. They demonstrate that an announcement that banks will be rescued and recapitalized will not necessarily eliminate creditor passivity in the economy. If regulatory institutions are weak and recapitalization not sufficiently generous, insolvent banks may choose not to reveal themselves, which may lead to the need for a second offer of recapitalization in the future. Hence, multiple episodes of recapitalization may result from the failure of prior recapitalizations to induce insolvent banks to reveal their insolvency. It is well understood that a recapitalization of banks can create a moral hazard problem, creating expectations of future recapitalization which cause banks to act so as to make these expectations self-fulfilling. It is not, however, well understood that when regulatory institutions are weak, rescue policies may fail to save the very banks intended to be saved and may, therefore, need to be repeated.

4.2 Equilibrium policy

In the absence of a precommitment to rescue, G's optimal choices of D and policy are calculated in the same way as in Section 3. For the purpose of comparing the results of this section with those of Section 3, I first assume that there is no precommitment to rescue, and I identify the optimal choice of D in the continuation equilibrium with intervention and the choice of D in the continuation equilibrium with an *ex post* choice of rescue. I compare these two continuation equilibria to see which G prefers. In order to identify an equilibrium, I compare this "preferred" continuation equilibrium in the absence of a precommitment to rescue to the continuation equilibrium with a precommitment to rescue. Finally, I then check if this equilibrium is susceptible to implicit collusion among banks to trigger TMTF. If so, I characterize the second equilibrium.

4.2.1 Continuation equilibria given no precommitment to rescue.

As in the case of Section 3, the optimal value of D given an ex post choice of rescue will be $D = 0$. The explanation for this result is identical to that for Claim 1. The claim below describes the optimal value of D given a policy of intervention.

Claim 4: *Let D^i represent the optimal choice of D given a policy of intervention. Then D^i satisfies,*

$$g'(D^i) - LNW \cdot m + \frac{\partial c_i(D^i; m, D^i \cdot m)}{\partial D} = 0. \qquad (12)$$

D^i is the value of D which satisfies the F.O.C. of G's cost minimization problem with $C_i(D; m, Dm)$. The result of Claim 4 is similar to that of Claim 2 without the possibility of a corner solution.

Comparison of the two continuation equilibria yields a result that is analogous to that of Section 3.

Proposition 4 *The continuation equilibrium in the absence of a precommitment to rescue is D^i and intervention.*

As in the case where distressed banks are solvent, G prefers the continuation equilibrium with intervention to that with an *ex post* choice of rescue. The proof of the proposition is identical to that of Proposition 2 in Section 3.

4.2.2 Continuation equilibrium given a precommitment to rescue

In this section I characterize a continuation equilibrium with a precommitment to rescue. A first question to address is whether the precommitment to rescue will apply only to active insolvent banks or also to discovered passive banks. The claim below demonstrates that it is less costly to limit the precommitment to rescue to active insolvent banks.

Claim 5: *It is less costly to implement a precommitment to rescue of active insolvent banks if intervention is applied to detected passive banks than if rescue is applied to detected passive banks.*

Proof: See appendix.

Claim 5 implies that if R precommits to rescue, the policy will be applied only to active banks, with intervention being applied *ex post* to detected passive banks. Note that although the threat of intervention for passive banks exists, if in equilibrium G precommits to rescue, the amount of recapitalization offered will be sufficient to induce all insolvent banks to become active. Thus, no banks will choose passivity in equilibrium, and intervention will not be applied.

The claim below describes the optimal choice of D, given a continuation equilibrium with a precommitment to rescue.

Claim 6: *The optimal value D^{pr} associated with a precommitment to rescue satisfies*

$$g'(D^{pr}) = \{q[I_0 + B - L] + \rho\} \cdot m,$$

unless $g'(0) > \{q[I_0 + B - L] + \rho\} \cdot m$, in which case $D^{pr} = 0$.

Proof: D^{pr} minimizes total costs of a precommitment to rescue, which equal $g(D) + R(D) \cdot m$.

4.3 Equilibrium

To identify the equilibrium it suffices to compare the costs associated with the continuation equilibria with intervention and with precommitment to rescue . In general, either of the continuation equilibria may be the equilibrium. Total costs associated with the continuation equilibrium with intervention are given by

$$C^i(D^i; m, D^i m) = g(D^i) + LNW \cdot (1 - D^i)m + c_i(D^i; m, D^i m).$$

Total costs in the continuation equilibrium with a precommitment to rescue are given by

$$g(D^{pr}) + R(D^{pr}).$$

The equilibrium will be the continuation equilibrium with the lower costs. The following proposition identifies a necessary condition for a precommitment to rescue to be an equilibrium.

Proposition 5 *(1) If $\widetilde{R}_{\min} \geq LNW$, then D^i and intervention is an equilibrium; (2) If $\widetilde{R}_{\min} < LNW$, then the equilibrium may either involve intervention or a precommitment to rescue.*

Proof: See appendix.

Proposition 5 states that a necessary condition for a precommitment to rescue to be an equilibrium policy is that $\widetilde{R}_{\min} < LNW$. In other words, the minimum recapitalization for an active insolvent bank must be lower than the loss in net worth associated with a passive bank. If this is not the case, then intervention will always entail lower costs than a precommitment to rescue.

It remains to check whether an equilibrium with intervention, when it exists, is susceptible to implicit collusion among banks to trigger TMTF. In order for insolvent banks to trigger TMTF, they must switch from being passive to being active. If this occurs, then when G tries to implement intervention, the policy must be applied to all m banks. If $\widetilde{R}_{\min} \cdot m < c_i(m)$, then G will be forced to rescue banks, and TMTF will have been triggered.

Define a *collusive continuation equilibrium* as an equilibrium where insolvent banks become active in order to trigger TMTF. The claim below provides necessary and sufficient conditions for existence of a collusive continuation equilibrium.[14] Define $\widetilde{D}$ to be the value

[14] In Rajan (1994) bank managers switch from being passive to active (and thus reveal their bad loans) in states of the world in which their reputations are the least adversely affected; i.e., in states of the world in which many banks have been affected by negative shocks. In the current paper the switch by banks from being passive to active creates a situation in which banks jointly benefit from more lenient treatment.

of D such that $(1-\widetilde{D})\cdot q[I_0+B-L]-\widetilde{D}\rho=0$. $\widetilde{D}$ is the value of D such that banks become indifferent between being active and passive given a precommitment to rescue with recapitalization $\widetilde{R}_{\min}$.

Claim 7: *Let D^i be the optimal value of D in an equilibrium with intervention. If (i) $D^i > \widetilde{D}$ and (ii) $\widetilde{R}_{\min}\cdot m < c_i(m)$, then a collusive continuation equilibrium exists.*

Proof: See appendix.

The proposition below characterizes the second equilibrium.

Proposition 6 *Suppose that an equilibrium with intervention exists and a collusive continuation equilibrium exists. Then, there exists a second equilibrium. This equilibrium will involve either $D=\widetilde{D}$ and intervention or $D=D^{pr}$ and a precommitment to rescue.*

Proof: See appendix.

Proposition 6 states that G reacts to the possibility of implicit collusion and the triggering of TMTF by becoming softer, either through lowering the level of monitoring or by precommiting to rescue. In order for the equilibrium described by Proposition 6 to exist, intervention must be the preferred policy in the absence of implicit collusion. Whereas in the case with distressed but solvent banks G lowers D and applies intervention in response to the prospect of implicit collusion, with distressed and involvent banks G may find it less costly to precommit to rescue. Whether intervention is less costly than a precommitment to rescue will depend upon a number of factors: the administrative costs of intervention; the costs of recapitalization; and the *ex ante* costs of monitoring.

5 General results and applications to banking crises

5.1 Results with the general model

Sections 3 and 4 treat separately the cases where banks with default are insolvent and where they are solvent. A question of interest is to what extent the results would change in a model with both types of banks with bad debt. Namely, suppose that a proportion γ of banks with default are "good" and that $(1-\gamma)$ of banks in default are "bad." G knows the value of γ but does not know without monitoring which banks with default are good and which are bad.

In this model bank best responses to choices of D and policy are the same as the best responses analyzed in the separate models; however, G's costs change slightly. For example, given a policy of intervention, bad banks will choose passivity for all D, while good banks will be passive for all $D < D_G$ and active for $D \geq D_G$, as before. Whereas the *ex post* costs of intervention will still shift downward at D_G, they will not shift to zero since bad banks remain passive for $D \geq D_G$. Consequently, the optimal value of D given a policy of intervention may be greater than D_G, since the benefit of raising D above D_G is the detection of more passive bad banks. That the optimal value of D, given a policy of intervention, may exceed D_G implies that good banks will have an incentive to engage in implicit collusion for a wider range of D than in the model of Section 3.

In the model with good and bad banks a collusive continuation equilibrium may be triggered by good banks, by bad banks, or by both. Good banks will be passive when they trigger a collusive equilibrium, and bad banks will be active when they trigger such an equilibrium. G's reactions to the threat of a collusive continuation equilibrium are similar to those described in Section 4: he may lower D and apply intervention to all detected passive banks in equilibrium or he may precommit to rescue active bad banks.

A final observation concerning the model is that it does not incorporate a requirement that banks set aside provisions for expected loan losses. A requirement to set aside loan loss provisions (and thereby lower bank profit by the amount of these provisions) will increase the incentive for good banks to be passive, since passivity will not only allow gambling for resurrection but will also raise reported bank profit and the banker's monetary payoff. As a consequence, good banks will choose passivity for a greater range of D when loan loss provisions are required than when they are not, and their incentives to engage in implicit collusion will also be strengthened.

5.2 Regulatory reactions to banking crises with differing origins

As noted in the introduction, the fact that the equilibrium choices of D and policy depend upon the proportions of distressed banks that are solvent and insolvent suggests that one might expect to observe differing regulatory responses to banking crises with differing causes or with differing costs associated with the possible policies. For example, if a banking crisis is caused by a shock that simultaneously renders multiple banks insolvent, then an immediate offer to rescue and recapitalize banks might not be surprising. On the other hand, if a banking crisis has been brewing over time and if levels of financial distress vary across banks, one could predict that regulators will not undertake widespread rescues. One might, however, observe a weakening of monitoring, so that fewer banks are characterized as problem banks. Finally, given that TMTF leads to the existence of multiple equilibria, it is possible that G might anticipate an equilibrium in the absence of implicit collusion; however, given the choice of D, the regulator finds himself *ex post* in a situation of TMTF.

In the U.S. S&L crisis, no widespread bank rescues occurred; however, in response to the potential insolvency of many S&Ls, regulators lowered D and applied intervention to a smaller number of banks. According to Dewatripont and Tirole (1994, Ch.4), U.S. regulators lowered solvency standards by first lowering the floor on the minimum capital-asset ratio from 5% to 3%, then by adopting laxer accounting procedures. More S&Ls could thus be deemed solvent according to the new rules. As Dewatripont and Tirole observe, "FSLIC intervention could [thus] focus on a 'respectable' proportion [of the banks that were actually insolvent]." The explanation for the lowering of D, according to Dewatripont-Tirole, is that the FSLIC did not have the funds that would have been necessary to reimburse depositors had all of the insolvent S&Ls been closed. Therefore, the regulators weakened *ex ante* requirements for solvency.

In terms of the model of this paper, the description of the S&L crisis suggests the presence of an additional constraint in the regulator's problem: a ceiling on costs incurred with any policy for distressed banks. In the case of the S&Ls, a situation of TMTF was triggered because the costs of applying intervention to all of the troubled S&Ls exceeded the cost ceiling. Note that the assumption that the insolvent S&Ls would have to be closed and their depositors reimbursed suggests that the costs of resecue were as high as the costs of intervention. Thus, the costs of rescue would have also exceeded the cost ceiling. Hence, the only feasible reaction by regulators was to effectively lower D and to apply intervention to a smaller number of banks.

Dewatripont-Tirole remark that the U.S. regulators' response to the S&L crisis differed dramatically from the regulatory response to financial distress faced in 1982 by a number of major U.S. commercial banks when Mexico was unable to pay interest on its debt. In part because of the fear of a contagion effect on other countries if Mexico defaulted, the

U.S. government indirectly recapitalized the commercial banks by undertaking a number of measures to keep Mexico afloat. According to Dewatripont-Tirole, "Although perhaps still insufficiently capitalized, [these banks] did not develop into troublemakers the way thrifts and a number of other commercial banks did."

One interpretation of these events is that the U.S. government implemented a type of precommitment to rescue, where the recapitalization affected only the banks with loans outstanding to Mexico. Why did the government choose recapitalization as opposed to its choice of intervention in the S&L case? There are at least two potential explanations. First, this *ex ante* recapitalization produced a benefit that is not present in the model: by eliminating the contagion effect, it lowered the proportion of the banks' portfolios that would ultimately have been in default (α in the model). Second, the costs to the financial system of the simultaneous closure of a number of major commercial banks were probably much greater than the costs associated with closures of S&Ls, due to the more limited nature of the S&Ls' lending. In other words, the costs of intervention were probably much higher for the commercial banks than for the S&Ls. For both of these reasons, rescue may have been the cheaper policy.

The Norwegian government undertook a rescue of several banks in 1991, when the banks were reporting significant loan losses and when their guarantee funds had been exhausted. Although the necessary funds were not currently in existence, the government generated funds to rescue the banks. The fact that a significant number of the commercial banks in the banking system became simultaneously troubled probably contributed to the decision to rescue. The banking crisis had apparently resulted in large part from excessively risky lending– exacerbated by monetary expansion–that virtually all of the banks had undertaken following deregulation in 1984-1985.[15]

There have been a number of attempts on the part of regulators in the economies in transition to effectively lower D by postponing the application, or lengthening the phase-in period, of financial regulations that would more easily expose the financial health of creditors. Bank regulators in Hungary postponed the phase-in of capital adequacy requirements for banks dictated by the Law on Financial Institutions passed in December, 1991. Authorities in the Czech Republic postponed until April, 1993 implementation of a bankruptcy

[15]For descriptions of the Norwegian banking crisis, see Hope (1992) and Steigum (1993).

law passed in October, 1991. Actions in both cases were motivated by fears of dealing with multiple insovent banks or firms.

Hungarian regulators undertook several recapitalizations of the troubled banking system between 1992 and 1996. In 1993 a loan consolidation program was put into effect by which the major commercial banks were able to swap bad debt for a special government security. The debt swap was motivated by the belief that the newly created commercial banks had been overburdened with bad loans inherited from the previous regime. Although the government declared that the loan consolidation program would not be repeated, it subsequently felt compelled to implement another loan consolidation program in 1994. According to Bonin and Schaffer (1995), bad loans of some of the large, troubled firms had not been included by the banks in the first consolidation program because they had been rolling over these loans; thus, the loans had not been declared "bad."

In the months following the first loan consolidation program, the portfolios of the six largest banks deteriorated substantially, leading to the second program. Part of the deterioration came from the open recognition of loans that banks had been previously rolling over. Thus, prior to loan consolidation, banks had been passive. The loan consolidation program was an offer to rescue that was linked to loans that had previously been declared in default. This "precommitment" failed to include all of the bad debt because of the passivity. Once banks realized that rescue was a possibility, insolvent banks became "active," revealing their bad debt, with the hope of triggering TMTF.

In conclusion, although the potential for triggering a policy of too-many-to-fail might appear to be greater in economies with developing financial markets than in economies with developed markets, even developed market economies are not immune to the risk. One concern expressed by Wall (1993) in a review of the Federal Deposit Insurance Corporation Improvement Act of 1991 is that the act does not provide adequate protection against "sudden massive losses at one or more banks." In the event of sudden losses "[r]egulators, [who] have limited operational resources (such as people) and [who] may also face financial constraints that restrict the number of bank closings they can handle at one time...may want to provide 100 percent coverage as a means to avoid closing too many banks in a short period." Moreover, these massive losses do not actually have to occur suddenly in order to appear sudden. "Rather than truly being sudden, large losses may only appear to be so because banks and bank regulators have failed to provide for the timely recognition of reduction in asset values."

When implicit collusion among banks is deemed highly likely, the regulator may opt for a slow buildup of bank supervisory power over time. The cost of such a policy is that the level of creditor passivity in the economy may remain at a high level over a long period of time, thereby weakening the disciplinary functions of financial markets.

6 Appendix

Proof of Proposition 1: That $D^i > 0$ implies that total costs with D^i and intervention are lower than with $D = 0$ and intervention. Yet, total costs with $D = 0$ and intervention are equal to total costs with $D = 0$ and rescue. (See Figure 2.) These costs just equal $LNW \cdot m$, the loss in net worth from m passive banks. Hence, since $D^r = 0$ with rescue, total costs with $D^i > 0$ and intervention must be lower than total costs with D^r and rescue. ||

Proof of Claim 3: If banks are passive at D_G, the *ex post* costs of intervention will be $i(D_G; m, D_G m) = LNW \cdot (1 - D_G)m + c_i(D_G m)$, and the *ex post* costs of rescue will be $r(D_G; m, D_G m) = LNW \cdot m + R_{\min} \cdot D_G m$. TMTF will be triggered if $i(D_G; m, D_G m) > r(D_G; m, D_G m)$, or if the inequality in the statement of the claim holds.||

Proof of Proposition 2: In order for the proposition to be true, it must be true that $g(D^*) + c_i(D^*; m, D^* m) < g(D_G) + c_r(D_G; m, D_G m)$. But, $g(D^*) + c_i(D^*; m, D^* m) < g(0) + c_r(0; m, 0) < g(D_G) + c_r(D_G; m, D_G m)$, where the first inequality follows from Proposition 1 and the second inequality follows from the assumptions that $g(\cdot)$ and $c_r(\cdot)$ are increasing in D.||

Proof of Proposition 3: Suppose that the precommitment to rescue is applied only to active banks and that detected passive banks have intervention applied and earn a payoff of zero. If an active bank is rescued with an amount of recapitalization equal to $\widetilde{R}_{\min}$, the banker's total payoff will be ρ. On the other hand, if the bank is passive and is not detected, its expected payoff is $q[I_0 + B - L] + \rho$. Consequently, if the level of monitoring is low enough, the expected payoff for passivity will be higher. More precisely, define $\widetilde{D}$ such that $(1 - \widetilde{D})\{q[I_0 + B - L] + \rho\} = \rho$. ($\widetilde{D}$ is the value of D at which banks become indifferent between being passive and being active, given a precommitment to rescue and $\widetilde{R}_{\min}$.) For all $D < \widetilde{D}$, banks will choose passivity. Only if $D > \widetilde{D}$ will banks choose to be active.||

Proof of Claim 5: It suffices to consider a precommitment to rescue that succeeds in inducing insolvent banks to become active. Otherwise, the precommitment to rescue is equivalent to an *ex post* choice of rescue. For a given value of D, the amount of recapitalization that must accompany a precommitment to rescue when intervention is applied to detected passive banks is given by:

$$R(D) = \widetilde{R}_{\min} + (1 - D) \cdot q[I_0 + B - L] - D\rho.$$

The amount of recapitalization that must accompany a precommitment to rescue when rescue is applied to detected passive banks is given by:

$$\Pi^{bankr} + R^+(D) + \rho = q[I_0 + B - L] + \rho,$$

or

$$R^+(D) = \widetilde{R}_{\min} + q[I_0 + B - L].$$

It is clear that for any D, the amount of necessary recapitalization is lower in the former case. ||

Proof of Proposition 5: That $D^i > 0$ in a continuation equilibrium with intervention implies that $g(D^i) + LNW \cdot (1 - D^i)m + c_i(D^i; m, D^i m) < LNW \cdot m$, where the right-hand side of the inequality represents the total costs of intervention with $D = 0$. If $\widetilde{R}_{\min} \geq LNW$, then $g(D^i) + LNW \cdot (1 - D^i)m + c_i(D^i; m, D^i m) < \widetilde{R}_{\min} \cdot m < g(D^{pr}) + R(D^{pr})$, where the last inequality follows from the definition of $R(D^{pr})$. ||

Proof of Claim 7: Because $D^i > \widetilde{D}$, banks' expected payoffs are higher with D^i and rescue (with $\widetilde{R}_{\min}$) than with D^i and intervention. Condition (ii) implies that, given the discovery of m active insolvent banks, it is less costly for G to implement rescue than intervention.||

Proof of Proposition 6: TMTF can be triggered only when $D > \widetilde{D}$. G can thus avoid TMTF and apply intervention by setting $D = \widetilde{D}$. He will compare the costs of this solution with the costs associated with a precommitment to rescue. The equilibrium will thus involve intervention (precommitment to rescue) as $C_i(\widetilde{D}; m, \widetilde{D}m) < (>)\ g(D^{pr}) + R(D^{pr})$. The optimality of D^{pr} given a precommitment to rescue implies that $g(D^{pr}) + R(D^{pr}) \leq g(\widetilde{D}) + \widetilde{R}_{\min} \cdot m$. ||

References

[1] Aghion, Philippe, Bolton, Patrick, and Fries, Stephen. "Financial Restructuring in Transition Economies," mimeo, 1996.

[2] Begg, David and Portes, Richard. "Enterprise Debt and Economic Transformation: Financial Restructuring in Central and Eastern Europe," in Colin Mayer and Xavier Vives, Eds. *Capital Markets and Financial Intermediation*, Cambridge University Press, 1993a.

[3] Begg, David and Portes, Richard. "Enterprise Debt and Economic Transformation," *Economics of Transition*, Vol. 1, No. 1, 1993b:116-117.

[4] Bonin, John and Schaffer, Mark. "Banks, Firms, Bad Debts, and Bankruptcy," *CEPR Discussion Paper*, No. 234, 1995.

[5] Boot, Arnoud W. and Thakor, Anjan. "Self-Interested Bank Regulation," *Amer. Econ. Rev.*, Vol. 83, No. 2(May, 1993):206-212.

[6] Coricelli, Fabrizio and Thorne, Alfredo. "Dealing with Enterprises' Bad Loans," *Economics of Transition*, Vol. 1, No. 1, 1993:112-115.

[7] Dewatripont, Mathias and Tirole, Jean. *The Prudential Regulation of Banks*, MIT Press, 1994.

[8] Dittus, Peter. "Bank Reform and Behavior in Central Europe," *Journ. Compar. Econ.*, Vol. 19, No. 3 (Dec., 1994):335-361.

[9] Hope, E. "The Banking Crisis in Norway: Problems and Prospects," Mimeo 1993, Foundation for Research in Economics and Business Administration, Bergen.

[10] Kane, Edward J. "Principal-Agent Problems in S&L Salvage," *Journ. Fin.*, Vol. 45, No. 3 (July, 1990):755-764.

[11] Mailath, George and Mester, Loretta. "When Do Regulators Close Banks: When Should They?" *Journ. Fin. Intermed.*, 1993.

[12] Mitchell, Janet. "Cancelling, Transferring, or Repaying Bad Debt: Cleaning Banks' Balance Sheets in Economies in Transition," Cornell University Working Paper #443, May, 1996.

[13] Mitchell, Janet. "Creditor Passivity and Bankruptcy: Implications for Economic Reform," in Colin Mayer and Xavier Vives, Eds. *Capital Markets and Financial Intermediation*, Cambridge University Press, 1993.

[14] O'Hara, Maureen. "Real Bills Revisited: Market Value Accounting and Loan Maturity," *Journ. Finan. Intermed.*, 1993.

[15] Perotti, Enrico. "Collusive Arrears in Economies in Transition," Financial Markets Group Discussion Paper #198, London School of Economics, 1994.

[16] Rajan, Raghuram. "Why Bank Credit Policies Fluctuate: A Theory and Some Evidence," *Quart. Journ. Econ.*, Vol. 109, No. 2 (May, 1994):399-442.

[17] Sandarajan, V. and Balino, Tomas J.T. *Banking Crises: Cases and Issues*, International Monetary Fund, Washington: 1991.

[18] Steigum, E. "Financial Deregulation, Credit Boom, and the Banking Crisis: The Case of Norway," Discussion Paper 15/1992. Norwegian School of Economics and Business Administration.

[19] Wall, Larry. "Too-Big-to-Fail After FDICIA," *Federal Reserve Bank of Atlanta Economic Review*, Jan.-Feb., 1993.

[20] World Bank, *1989 World Development Report*, New York: Oxford University Press.

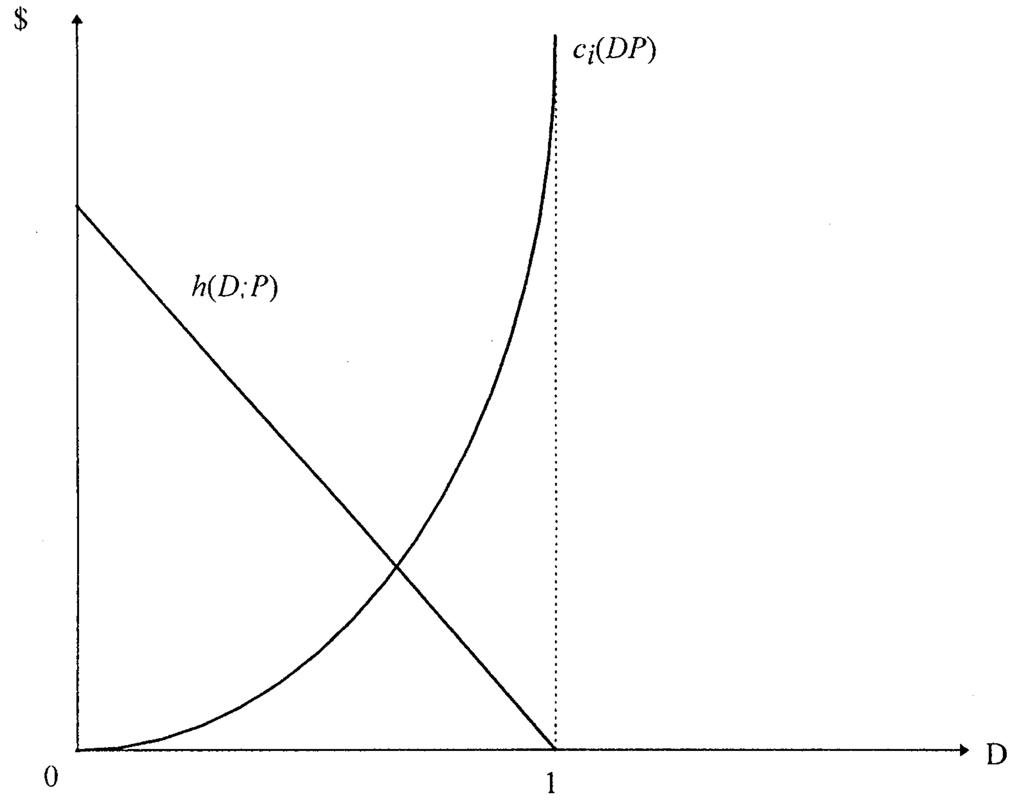

Figure 1

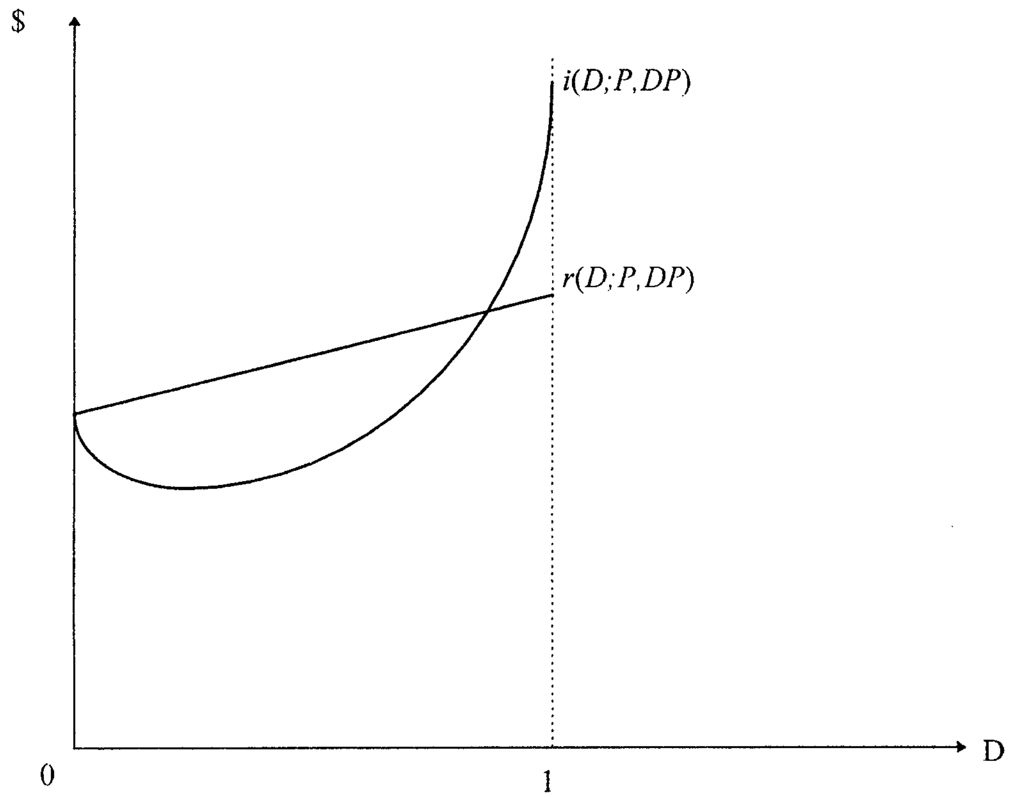

Figure 2