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Self-interested bank regulation; theory and policy implications

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SELF-INTERESTED BANK REGULATION: THEORY AND POLICY IMPLICATIONS

by

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TREACHEROUS WATERS: Critics say Richard Pratt put the thrift industry on a course to disaster

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ABSTRACT

We examine the implications of banks being regulated by a self-serving agent who is entrusted with the tasks of enforcing socially optimal portfolio choices and implementing a socially optimal bank closure policy. In his attempt to develop a reputation as a capable monitor of bank portfolio choice, such a regulator exhibits laxity (relative to the social optimum) in closing banks. Moreover, confronted with such a regulator, the bank chooses excessive risk, relative to the social optimum. Thus, self-interested regulatory behavior exaggerates the liability of the deposit insurance fund. We use this framework to generate a variety of policy prescriptions for banking reform that address the organization of supervisory tasks, the process by which regulators are appointed and retained, and the need for discretion or rules in bank regulation.

SELF-INTERESTED BANK REGULATION

"He's His Own Man, But Works For You". *Election Slogan of Anonymous Politician.*

I. INTRODUCTION

The purpose of this paper is to formalize the notion that a bank regulator may pursue self interest rather than social welfare, and to examine the implications of this for deposit insurance and regulatory reform in banking. We model the pursuit of self interest by introducing uncertainty about the regulator's ability to monitor the bank's asset portfolio choice. This uncertainty creates an incentive for the regulator to acquire a reputation as a capable monitor, and this desire for reputation distorts his bank closure policy and inflates the liability of the deposit insurance fund. We use this perspective on bank regulation to generate numerous policy prescriptions about banking reform.

In the midst of an intense debate about the crisis in the depository institutions industry,[1] much has been written and said about the factors responsible for the crisis. While the recent surge in vitriol concerning regulators would seem to leave little doubt about the culpability of regulators, most acknowledge other factors as well. Thus, the precise role played by regulators in the dramatic developments of the last few years is unclear. More importantly, there seems to be disagreement on the reforms that should be adopted to improve bank regulation. The literature on bank regulation has provided a number of valuable suggestions for reform,[2] but those suggestions have mainly to do with the *rules* of regulation rather than with the *human* aspects of the regulatory process itself. That is, these proposals have suggested ways in which interinstitutional inequities can be diminished and problems of private information and moral hazard *between banks and their regulators* can be more effectively dealt with. Thus, for example, risk-sensitive deposit insurance pricing and risk-based capital requirements have been advocated.[3] Because of its focus on self-interested behavior by the *bank*, this literature has viewed the regulator as a faithful public servant maximizing some form of social welfare.[4] However, as Kane (1989a,1989b,1990) has forcefully argued, the delegation problem *between the taxpayer and her agent, the regulator*, may be the key to understanding what has happened to depository institutions[5] and how reform should proceed. It is this delegation problem that is the focus of our paper.

Our purpose is to study the *manner* in which the delegation problem manifests itself in regulatory behavior.[6] The following quote provides some insights.

> *Vested interests -- including elected officials with close ties to the industry -- pushed laws to ease regulation and blocked bills to tighten controls. The industry's practice of hiring regulators created a cozy relationship with institutions that the state was supposed to regulate. Woefully undermanned state bank examiners, able to audit some institutions only once every few years, failed to halt big, risky loans to developers or to detect them after they went sour. And a reluctance to publicize government reports warning of the system's shaky finances -- for fear of alarming depositors and causing bank runs -- allowed the problem to be largely ignored until it exploded.* "Road to Trouble: How Lax Regulation Threw Rhode Island into Banking Turmoil", Wall Street Journal, Wednesday, March 6, 1991.

While, as this quote indicates, self interest can take a variety of forms, including unethical behavior, we wish to focus on the incentive a regulator has to undertake actions that protect his reputation. Our theory is based on the premise that even a small degree of uncertainty about the *quality* of the regulator can create significant departures from social optima.[7] The departure of principal interest to us is the timing of bank closures.[8]

Another paper which formally models the delegation problem between the bank regulator and the taxpayer is Campbell, Chan and Marino (1992) in which a regulator is modeled as an agent chosen to monitor the bank's investment choice, with effort expenditure which is privately costly to the regulator. Thus, Campbell, Chan and Marino view the delegation problem as a classical moral hazard situation, and proceed to examine the optimal incentive contract for the regulator. By contrast, our focus is on the regulatory reform implications of bank closure policy distortions caused by regulatory self interest.

The rest of this paper is organized as follows. The model is developed in Section II. It is a two-period model of dynamic asset portfolio choice by the bank. In each period, the bank chooses an asset portfolio, and there is a regulator who (imperfectly) monitors this asset choice. The regulator's "quality", as represented by his monitoring ability, is *a priori* unknown to all, but we allow perceptions of this quality to be revised through time. Thus the quality of the regulator is being (indirectly) inferred from the performance of the bank he monitors. However, the regulator and the constituency to which he reports (which we call the "market") are asymmetrically informed about the bank's performance at the start of each period; the regulator knows more. This means that regulatory actions -- such as bank closure -- convey information to the market about the bank's performance (or economic net worth), which in turn conveys information about the regulator's quality.

In Section III we analyze the actions of the regulator in a reputational equilibrium. Our main result is that, relative to the social optimum, the regulator will be too lax in his closure policy, permitting the second-period continuation of a bank that would be closed under the socially optimal policy. Interestingly, the socially optimal policy calls for possibly closing the bank at a *positive* level of capital. We also show that the poorer the *ex ante* reputation (perceived quality) of the regulator, the greater is the risk chosen by the bank in its asset portfolio.

In Section IV we explore the policy implications of our analysis. The issues we discuss are: consolidation versus separation of regulators, duration of a regulator's appointment, the process by which regulators are reappointed, regulatory latitude in bank closure decisions, the role of asset portfolio restrictions on banks, and the management of public perceptions. Section V concludes the paper. All proofs are in the Appendix.

II. THE MODEL AND SOCIAL OPTIMA:

A. The Model:

Time Line and Sequence of Events: There are two time periods. The first begins at $t = 0$ and ends at $t = 1$, and the second begins at $t = 1$ and ends at $t = 2$. The agents of interest to us are the bank and the regulator. At $t = 0$, the bank has assets in place which pay off a random amount $\tilde{y}$ at $t = 1$ and nothing thereafter. The random variable $\tilde{y}$ has a cumulative distribution function $F(\bullet)$ and a probability density function $f(\bullet)$ with support $[0,\bar{y}]$, where $\bar{y}$ is a positive and finite real-valued scalar. In addition to assets in place at $t = 0$, the bank also has a *discretionary* asset portfolio for which it can choose the payoff distribution. This portfolio requires a \$1 investment, has a single-period duration and yields a random payoff $\tilde{R}_1$ at $t = 1$. In the second period, the bank can make a similar portfolio choice. The random variable $\tilde{R}_1$ has a two-point support, taking a value of $R(\theta_1) > 0$ with probability (w.p.) $\theta_1 \in (0,1)$ and a value of zero w.p. $1 - \theta_1$. We assume $R(\bullet)$ is strictly decreasing and (possibly weakly) concave everywhere on the feasible set $\Theta \equiv [\underline{\theta},\bar{\theta}] \subset (0,1)$, and θ_1 can be chosen by the bank from the feasible set Θ.

The bank finances its first-period asset portfolio with $\$K_1$ of (book) equity capital and $\$1 - K_1$ of fully insured deposits. We assume that the current risk-insensitive deposit insurance pricing regime is in place, and thus set the deposit insurance premium at zero, without loss of generality.

At $t = 1$, the bank realizes $\tilde{y} + \tilde{R}_1$, and first-period depositors are paid off. The difference between $\tilde{y} + \tilde{R}_1$ and the payment to first-period depositors defines the bank's second-period capital; there is no new infusion of external equity capital. If the bank is allowed to continue, second-period deposits are raised at $t = 1$ to ensure that, when added to second-period capital, \$1 is available to the bank for investing in its second-period asset portfolio. If $\tilde{y} + \tilde{R}_1$ is less than the obligation to first-period depositors but the bank is allowed to continue, second-period deposits are also raised to repay first-period depositors. However, if the bank is closed at t = 1, the shortfall is covered by the federal deposit insurer. This asset portfolio yields a random payoff of $\tilde{R}_2$ at t = 2, at which time second-period depositors are paid off. If $\tilde{R}_2$ is insufficient, the deposit insurer covers the rest. The random variable $\tilde{R}_2$ also has a two-point support and takes a value of $R(\theta_2)$ w.p. θ_2 and a value of zero w.p. $1 - \theta_2$. The bank can choose θ_2 from Θ and $R(\theta_2)$ is strictly decreasing and (possibly weakly) concave everywhere on Θ. Since the assets in place at t = 0 expire at t = 1, there is no payoff from these assets at t = 2. Throughout this paper we will define asset risk by θ -- the higher the θ the lower the risk.

Role of the Regulator: The regulator is entrusted with two tasks. First, he must monitor the bank's asset portfolio choice at t = 0. There is some socially optimal choice, say θ_1^*, that the bank should make. However, the bank's actual asset choice is observable only to the bank. The quality of the regulator determines the probability with which the bank's asset choice can be detected. If the bank's asset choice is detected to be $\theta_1 \neq \theta_1^*$, the regulator can force the bank to switch to θ_1^*. If undetected, the bank's asset choice remains unchanged. The regulator can be one of two types: good (g) and bad (b). If the regulator is good, he will detect the bank's asset choice w.p. $\rho_g \in (0.5,1)$, and if the regulator is bad, he will detect the bank's asset choice w.p. $\rho_b \in (0.5,1)$, where $\rho_g > \rho_b$. Thus, w.p. ρ_i the bank will end up with θ_1^* and w.p. $1-\rho_i$ the bank will end up with θ_1 possibly different from θ_1^*. Moreover, for $i \in \{g,b\}$, we assume that $\rho_i \equiv \rho_i(\hat{\theta}_1)$ is a continuously differentiable function with $\partial\rho_i/\partial\hat{\theta}_1 < 0$, so that the higher is $\hat{\theta}_1$ the lower is the probability that the bank will be detected to have chosen something other than θ_1^*. The assumption $\rho_g > \rho_b$ is assumed to hold pointwise, i.e., $\rho_g(\theta) > \rho_b(\theta)\ \forall\ \theta \in \Theta$. We assume for simplicity that the regulator only monitors the bank's first-period asset choice and not its second-period asset choice.[9]

The second task of the regulator is to decide whether or not to close the bank at t = 1. We assume that the closure/continuation decision is publicly observable.[10]

Information Structure: The bank is the most informed player in this game. It observes its own capital at each point in time as well as its own asset portfolio choice. The regulator observes the bank's actual asset portfolio choice only if he detects it and forces a change, and at the start of each period he observes the bank's book capital for that period. Thus, at t = 1 the regulator observes the sum $\tilde{y} + \tilde{R}_1$, but *not* the individual components $\tilde{y}$ or $\tilde{R}_1$. At t = 2 the regulator observes $\tilde{R}_2$. The market is the least informed player in the game. It observes the bank's book capital, but with a one-period lag. That is, at t = 1 the market observes the bank's capital at t = 0, and at t = 2 the market observes the bank's capital at t = 1. We assume that the market's ability to observe the bank's second-period capital is predicated on the bank continuing for a second period. If the bank is closed at t = 1, the market's information is the same as it was at t = 1, i.e., it observes the closure decision but not the bank's second-period capital. The regulator's type is unknown to everybody at t = 0, at which time all agents have the prior belief that there is a probability $\gamma \in (0,1)$ that the regulator is good; γ is common knowledge.

Preferences: All agents are risk neutral. The bank maximizes its expected net profit. The regulator maximizes the following objective function

$$\lambda_1\{\gamma_1^m + \delta\gamma_2^m\} + \lambda_2[\theta_2 R(\theta_2) - 1] \tag{1}$$

where γ_t^m is the regulator's reputation for quality at time $t \in \{1,2\}$, δ_1, λ_1 and λ_2 are real-valued, positive scalars, and $\theta_2 R(\theta_2) - 1$ is the social surplus from the bank's second-period asset portfolio. The term in the braces in (1) represents the personal gain to the regulator from reputation building, so that the regulator is maximizing a weighted average (with λ_1 and λ_2 representing the weights) of his personal reputation and social welfare. The regulator's reputation γ_t^m is simply the market's posterior belief at time t, i.e., γ_t^m is the probability with which the market perceives the regulator to be good. Since λ_1 and λ_2 are exogenous, this specification gives us the flexibility to consider the range of regulators from the "completely selfish" ($\lambda_2 = 0$) to the "completely selfless" ($\lambda_1 = 0$). Note that we have not included in this objective function social surplus related to the first-period project because the regulator cannot take any actions to affect it, other than through his bank closure policy; the effect of "social-welfare pressure" on closure policy is already captured by the second-period social surplus.

B. The Social Optima:

Consider first the second-period asset portfolio choice. The socially optimal choice is simply the ***first best*** which is ***equivalent*** to the asset choice the bank would make if it were all-equity financed in the second period.[11] That is, we solve

$$\max_{\theta_2} \theta_2 R(\theta_2) - 1 \times r_f \tag{2}$$

where r_f is one plus the riskless interest rate. Here $\theta_2 R(\theta_2)$ is the expected (gross) payoff from the bank's second-period asset portfolio and r_f is the required end-of-period payoff to the risk neutral bank shareholders on their \$1 investment. It is easy to verify that the unique maximizer of (2) is

$$\theta_2^* = - \frac{R(\theta_2^*)}{R'(\theta_2^*)} \tag{3}$$

Next, we solve for the socially optimal bank closure policy at $t = 1$. To analyze this, we must solve for the actual second-period asset portfolio choice that a bank with capital $\widetilde{K}_2$ would make at $t = 1$. Note that the bank's second-period capital is

$$\widetilde{K}_2 = \widetilde{y} + \widetilde{R}_1 - [1 - K_1]\, r_f \tag{4}$$

where $[1 - K_1]r_f$ is the payment made on the fully insured first-period deposits. Note that $\widetilde{K}_2$ can be negative, in which case the bank raises more than \$1 in second-period deposits; we will later assume that exogenous parameters are such that $\tilde{K}_2 < 1$ with probability one, so that a positive amount of deposits are raised in the second period. Thus, the bank solves

$$\max_{\theta_2} \theta_2[R(\theta_2) - \{1 - \tilde{K}_2\} r_f] - \tilde{K}_2 r_f \tag{5}$$

The unique maximizer of (5) is

$$\hat{\theta}_2(\tilde{K}_2) = \frac{\{-R(\hat{\theta}_2) + [1 - \tilde{K}_2]r_f\}}{R'(\hat{\theta}_2)}. \tag{6}$$

The following result is now immediate.

Lemma 1: In the second period, the bank chooses more risk than is socially optimal.

We can now define the *socially optimal closure rule* as follows: close down the bank if its privately optimal second-period choice is a negative net present value (NPV) asset portfolio.

We can now establish the determining property of the socially optimal bank closure rule.

Proposition 1: There exists a critical value of the second-period capital, say $\bar{K}_2$, such that the socially optimal closure policy dictates that the bank should be closed if its actual capital $\tilde{K}_2 < \bar{K}_2$ and continued if $\tilde{K}_2 \geq \bar{K}_2$. Moreover, $\partial\bar{K}_2/\partial r_f > 0$ and there exists a critical value of the deposit funding cost (riskless interest rate), say $\bar{r}_f - 1$, such that $\bar{K}_2 > 0$ if $r_f > \bar{r}_f$.

It is intuitive that the socially optimal closure rule involves examining the bank's capital at the start of the second period. From (6) we see that the bank's second-period asset portfolio choice is a function of its second-period capital. Since the regulator cannot directly control the bank's portfolio choice in this period, it indirectly prevents exploitation of the deposit insurance fund by shutting down the bank when its book capital falls below a threshold.[12]

It is interesting that the socially optimal policy may require that a bank be closed even when the book value of its capital is positive. The reason for this prescription is that it is possible for the bank to find it optimal to pursue negative NPV investments even when it has positive capital, given deposit insurance in its present form.[13] Of course, in computing the social optimum we have not dealt with the constitutional issues about the seizure of private property that such a recommendation has caused some bankers to raise.[14]

III. PROPERTIES OF THE REPUTATIONAL EQUILIBRIUM

A. Parametric Restrictions:

First we assume that

$$\bar{y} + R_1(\underline{\theta}) < 1 + [1 - K_1]r_f \qquad \text{(R-1)}$$

The term on the left hand side (LHS) of (R-1) is the maximum possible first-period cash flow. Thus, (R-1) implies that, regardless of the first-period outcome, some deposits must be raised in the second period to finance the $1 investment in that period. Further, we assume that

$$R_1(\bar{\theta}) > \bar{K}_2 + [1 - K_1]r_f \qquad \text{(R-2)}$$

Restriction (R-2) implies that if the first-period asset portfolio succeeds, then $\tilde{K}_2 > \bar{K}_2$ regardless of $\tilde{y}$. Hence, the social optimum demands that the bank should not be closed down at $t = 1$ if the first-period asset portfolio has a successful outcome. Finally, we assume that

$$R(\bar{\theta}_2) > [1 - K_1][r_f]^2 + r_f \qquad \text{(R-3)}$$

The restriction (R-3) guarantees that the bank's shareholders always strictly prefer to continue at $t = 1$. That is, if the second-period project succeeds, the shareholders can expect to receive a positive payoff even if the total first-period payoff was very low.

B. First Period Asset Portfolio Choice of Bank:

Given a socially optimal first-period asset portfolio choice of θ_1^*, we let $\hat{\theta}_1 \in [\underline{\theta},\theta_1^*)$ represent the bank's privately optimal first-period asset portfolio choice.[15] Since we are interested in the regulatory monitoring of bank activities that could *increase* the liability of the deposit insurance fund, we wish to focus on $\hat{\theta}_1 < \theta_1^*$. If, for some reason, the bank were to wish to choose $\hat{\theta}_1 > \theta_1^*$, then it is undertaking an action that *decreases* the deposit insurer's liability, relative to that imposed by the socially optimal portfolio choice. It would represent a situation in which the bank seeks "excessive safety" and would not be of interest to us here.[16]

Suppose that in the reputational equilibrium, the regulator closes the bank at t = 1 if $\tilde{y} + \tilde{R}_1 < z^*$, where z^* is some critical value; if $\tilde{y} + \tilde{R}_1 \geq z^*$, the bank is allowed to continue in the second period.[17] Now define $\tilde{K}_2^s$ as the bank's capital level at the beginning of the second period if there is success on the first-period asset portfolio and $\tilde{K}_2^f$ as the bank's capital level at the beginning of the second period if there is first-period asset portfolio failure. Also let y_c be the critical value of $\tilde{y}$ such that $\tilde{K}_2^f > 0$ if $\tilde{y} > y_c$ and $\tilde{K}_2^f \leq 0$ if $\tilde{y} \leq y_c$. Thus,

$$\tilde{K}_2^s \equiv \tilde{y} + R(\theta_1) - [1 - K_1]r_f \tag{7}$$

$$\tilde{K}_2^f \equiv \tilde{y} - [1 - K_1]r_f \tag{8}$$

$$y_c \equiv [1 - K_1]r_f \tag{9}$$

Now let $L(\theta_1,K_1)$ be the second-period rents of the bank, conditional on a particular first-period asset portfolio choice θ_1 and first-period book capital K_1. These are the rents to the bank from continuing *relative* to being closed down. Thus, where the last integral in (10) is zero if $z^* \geq y_c$.

$$
\begin{aligned}
L(\theta_1, K_1) = {} & \theta_1 \int_0^{\bar{y}} \{\hat{\theta}_2(\tilde{K}_2^s)[R(\tilde{\theta}_2) - \{1 - \tilde{K}_2^s\} r_f] - \tilde{K}_2^s r_f\} f(y)dy \\
& + [1 - \theta_1] \int_{y_c}^{\bar{y}} \{\hat{\theta}_2(\tilde{K}_2^f)[R(\tilde{\theta}_2) - \{1 - \tilde{K}_2^f\} r_f] - \tilde{K}_2^f r_f\} f(y)dy \\
& + [1 - \theta_1] \int_{z^*}^{y_c} \{\hat{\theta}_2(\tilde{K}_2^f)[R(\tilde{\theta}_2) - \{1 - \tilde{K}_2^f\} r_f]\} f(y)dy
\end{aligned}
\tag{10}
$$

Next define the function

$$\rho(\theta_1) \equiv \gamma \rho_g(\theta_1) + [1 - \gamma]\rho_b(\theta_1) \tag{11}$$

as the prior belief-weighted probability at $t = 0$ that the regulator will be able to ensure that the bank will choose θ_1^*. Since $\rho(\theta_1)$ is a convex combination of $\rho_g(\theta_1)$ and $\rho_b(\theta_1)$, each of which is a monotonically decreasing and continuously differentiable function of θ_1, we know that $\rho(\theta_1)$ is also continuously differentiable in θ_1 and $\partial\rho/\partial\theta_1 < 0$.

Defining $\phi(\theta) \equiv R(\theta) - \{1 - K_1\}r_f$, we can now write the bank's problem at $t = 0$ as that of choosing θ_1 to maximize

$$
\begin{aligned}
H(\theta_1, K_1) = {} & [1 - \rho(\theta_1)]\{\theta_1\phi(\theta_1) - K_1 r_f\} + \rho(\theta_1)\{\theta_1^*\phi(\theta_1^*) - K_1 r_f\} \\
& + [1 - \rho(\theta_1)]L(\theta_1, K_1) + \rho(\theta_1)L(\theta_1^*, K_1)
\end{aligned}
\tag{12}
$$

Thus, $\hat{\theta}_1$, the unique maximizer of $H(\theta_1, K_1)$, is a solution to the following equation

$$
\begin{aligned}
& [1 - \rho(\hat{\theta}_1)][\phi(\hat{\theta}_1) + \hat{\theta}_1\phi'(\hat{\theta}_1) + \partial L(\hat{\theta}_1, K_1)/\partial\theta_1] \\
& + \rho'(\hat{\theta}_1)[\theta_1^*\phi(\theta_1^*) - \hat{\theta}_1\phi(\hat{\theta}_1) + L(\theta_1^*, K_1) - L(\hat{\theta}_1, K_1)] = 0.
\end{aligned}
\tag{13}
$$

We shall assume that $\hat{\theta}_1 > 0.5$.

The next major step in the analysis is to examine the closure policy that the regulator adopts in a reputational equilibrium. Before we get to that, however, we want to explore a bank's incentive to restrain first-period risk taking in light of its potential effects on second-period rents. Since the first-period asset portfolio affects the second-period capital $\tilde{K}_2$ in a well-defined way, the question really is: what is the relationship between the bank's second-period rents and its second-period capital? Define the bank's second-period rents, conditional on being allowed to continue for a second period, as

$$M(\theta_2) \equiv \theta_2[R(\theta_2) - \{1 - \widetilde{K}_2\}r_f] - \widetilde{K}_2 r_f \tag{14}$$

and let $\hat{\theta}_2$ (given by (6)) represent the (unique) maximizer of $M(\theta_2)$. We are interested in the sign of $dM(\hat{\theta}_2)/d\widetilde{K}_2$.

Proposition 2: At the beginning of the second period, for a fixed insurance premium, the bank is better off with a lower second-period capital than with a higher second-period capital, conditional on being allowed to continue for the second period.

This result, perhaps a little surprising at first blush, obtains because the value of the "deposit insurance put option" to the bank's shareholders is decreasing in the bank's equity capital.[18] The importance of this result to us is that it indicates that the bank has *no* incentive at $t = 0$ to insure itself against low-capital states at $t = 1$. Note that, given the definition $\widetilde{K}_2$ in (4), the *expected value* of $\widetilde{K}_2$, assessed at $t = 0$ is

$$E_0(\tilde{K}_2 | K_1, \theta_1) = \int_0^{\bar{y}} y f(y) dy + \theta_1 R(\theta_1) - K_1[1 - r_f] \tag{15}$$

which attains its unique maximum with respect to θ_1 at θ_1^{**}. *If* the bank's second-period rents were *positively* affected by its second-period capital, then at $t = 0$ the bank would have an incentive to choose a higher θ_1 (lower risk) than it would in a single-period setting; this would move θ_1 closer to θ_1^{**} and increase $E_0(\widetilde{K}_2 | K_1, \theta_1)$. That is, a concern with the preservation of second-period rents would cause the bank to choose lower risk in the first period than it would like to in order to maximize the value of the *first-period* deposit insurance put option. However, Proposition 2 tells us that this is *not* so. At $t = 0$, the bank has an interest in *decreasing* $E_0(\widetilde{K}_2 | K_1, \theta_1)$, implying that the bank wishes to choose *more* first-period risk at $t = 0$ than it would in a single-period setting. The intuition again lies in the perverse incentives engendered by deposit insurance. Because the deposit insurance put option causes its second-period rents to be decreasing in its second-period capital, the bank has an interest in undertaking actions at $t = 0$ that result in lower *expected* second-period capital. Thus, first-period risk-taking incentives, already heightened by the bank's desire to exploit the deposit insurance put option in the first period, are escalated rather than retarded by considerations of future rents *per se*.

Note, however, that Proposition 2 is based on the condition that the bank is allowed to continue in the second period. If the bank knows that it can be closed at the end of the first period for having insufficient capital, then its concern with being allowed to continue in the second period will have a countervailing effect on its desire for taking risk in the first period. This clarifies the role of bank closure policy in terms of its incentive effect. An appropriately chosen closure policy can be used as a device to offset some of the perverse investment incentives created by deposit insurance. Regulation begets more regulation!

C. Closure Policy in the Reputational Equilibrium:

The regulator must choose z^* to maximize his objective function given in (1). We will begin by conjecturing that the regulator's closure policy in a reputational equilibrium closes the bank less often that the socially optimal closure policy, i.e., $z^* < \overline{K}_2 + [1 - K_1]r_f$. We will verify this conjecture later. To analyze how z^* is determined, we first need to compute some posterior beliefs.

Note first that, given our conjecture about z^*, (R-2) guarantees that the bank will never be closed if $\widetilde{R}_1 = R_1(\theta_1) > 0$. Hence, the closure of a bank at $t = 1$ tells the market that $\widetilde{R}_1 = 0$ *and* $\widetilde{y} < z^*$. Letting "Pr" denote "probability" and "C" denote "closure", the market's posterior belief at t = 1 that the regulator is good, conditional on observing bank closure, can be obtained by using Bayes rule (in the expression below, the superscript "m" represents the market and the subscript represents time)

$$\begin{aligned}\gamma_1^m(C) &= \Pr(\text{regulator is good} \mid C \text{ at } t = 1) \\ &= \Pr(g \mid C) \\ &= \frac{\Pr(C \mid g)\Pr(g)}{\{\Pr(C \mid g)\Pr(g) + \Pr(C \mid b)\Pr(b)\}}\end{aligned} \tag{16}$$

where Pr(g) and Pr(b) are the prior beliefs that the regulator is good and bad, respectively. Now,

$$\begin{aligned}\Pr(C \mid g) &= \Pr(\tilde{R}_1 = 0 \text{ and } \tilde{y} < z^* \mid g) \\ &= [\rho_g\{1 - \theta_1^*\} + \{1 - \rho_g\}\{1 - \hat{\theta}_1\}]F(z^*).\end{aligned} \tag{17}$$

A similar expression can be written for $\Pr(C \mid b)$. Substituting (17) in (16) yields

$$\gamma_1^m(C) = \frac{\{\rho_g[1 - \theta_1^*] + [1 - \rho_g][1 - \hat{\theta}_1]\}\gamma}{\left[\begin{array}{l}\{\rho_g[1 - \theta_1^*] + [1 - \rho_g][1 - \hat{\theta}_1]\}\gamma \\ + \{\rho_b[1 - \theta_1^*] + [1 - \rho_b][1 - \hat{\theta}_1]\}\{1 - \gamma\}\end{array}\right]} \tag{18}$$

Similarly, if the bank is not closed (where "NC" represents "no closure") at t = 1, then the market knows that either: (i) $\tilde{R}_1 > 0$ *or* (ii) $\tilde{R}_1 = 0$ and $\tilde{y} \geq z^*$. Thus, using Bayes rule we can write

$$\gamma_1^m(NC) = \frac{\Psi_g \gamma}{\Psi_g \gamma + \Psi_b[1 - \gamma]} \tag{19}$$

where $\Psi_i \equiv \rho_i\theta_1^* + [1 - \rho_i]\hat{\theta}_1 + \{\rho_i[1 - \theta_1^*] + [1 - \rho_i][1 - \hat{\theta}_1]\}\{1 - F(z^*)\}$ for $i \in \{g,b\}$.

Now, the regulator starts out at t = 0 with the same belief as the market about his own quality. However, unlike the market, he observes the bank's capital $\tilde{K}_2$ at t = 1 and he knows whether the bank chose θ_1^* or $\hat{\theta}_1$. Let q(•) and Q(•) represent the PDF and CDF respectively for the random variable $\tilde{K}_2$. Since θ_1 can be either θ_1^* or $\hat{\theta}_1$, there are two PDF's and two CDF's, one each for θ_1^* and $\hat{\theta}_1$.

$$q(K_2|\hat{\theta}_1) = \hat{\theta}_1 f(K_2 - R(\theta_1) + [1 - K_1]r_f) + [1 - \hat{\theta}_1]f(K_2 + [1 - K_1]r_f)$$

$$q(K_2|\theta_1^*) = \theta_1^* f(K_2 - R(\theta_1^*) + [1 - K_1]r_f) + [1 - \theta_1^*]f(K_2 + [1 - K_1]r_f)$$

$$Q(K_2 \leq \hat{K}_2|\theta_1) = \theta_1 F(\hat{K}_2 - R(\theta_1) + [1 - K_1]r_f) + [1 - \theta_1]F(\hat{K}_2 + [1 - K_1]r_f) \text{ for } \theta_1 \in \{\theta_1^*, \hat{\theta}_1\}.$$

Letting the superscript "r" denote the regulator's own posterior belief about his quality at $t = 1$, we can write

$$\gamma_1^r(\theta_1) = \Pr(\text{regulator believes he is good}|\theta_1)$$
$$= \begin{cases} \Pr(g|\theta_1^*) & \text{if } \theta_1 = \theta_1^* \\ \Pr(g|\hat{\theta}_1) & \text{if } \theta = \hat{\theta}_1 \end{cases} \tag{20}$$

Using Bayes rule, we have

$$\Pr(g|\theta_1^*) = \frac{\rho_g\gamma}{\rho_g\gamma + \rho_b\{1-\gamma\}} \text{ and } \Pr(g|\hat{\theta}_1) = \frac{[1-\rho_g]\gamma}{\{1-\rho_g\}\gamma + \{1-\rho_b\}\{1-\gamma\}}$$

Now, when the market observes $\tilde{K}_2$, its posterior belief is:

$$\Pr(\theta_1^*|\tilde{K}_2) = \frac{q(\tilde{K}_2|\theta_1^*)[\rho_g\gamma + \rho_b\{1-\gamma\}]}{q(\tilde{K}_2|\theta_1^*)[\rho_g\gamma + \rho_b\{1-\gamma\}] + q(\tilde{K}_2|\hat{\theta}_1)[\{1-\rho_g\}\gamma + \{1-\rho_b\}\{1-\gamma\}]} \tag{21}$$

A similar expression can be written for $\Pr(\hat{\theta}_1|\tilde{K}_2)$. Now, when the market observes $\tilde{K}_2$ at $t=2$, its posterior belief about the regulator's type will be a weighted average of the regulator's posteriors in states θ_1^* and $\hat{\theta}_1$:

$$\gamma_2^m(NC,\tilde{K}_2) = \Pr(g|\theta_1^*)\Pr(\theta_1^*|\tilde{K}_2) + \Pr(g|\hat{\theta}_1)\Pr(\hat{\theta}_1|\tilde{K}_2)$$

and substituting (21) in this expression, we get

$$\gamma_2^m(NC,\tilde{K}_2) = \frac{\rho_g\gamma q(\tilde{K}_2|\theta_1^*) + [1-\rho_g]\gamma q(\tilde{K}_2|\hat{\theta}_1)}{q(\tilde{K}_2|\theta_1^*)[\rho_g\gamma + \rho_b\{1-\gamma\}] + q(\tilde{K}_2|\hat{\theta}_1)[\{1-\rho_g\}\gamma + \{1-\rho_b\}\{1-\gamma\}]} \tag{22}$$

With this we have sufficient analytical structure to prove our main result. We will say that the regulator's closure policy is "more lax" than the social optimum if $z^* < \overline{K}_2 + [1 - K_1]r_f$ and it is "less lax" than the social optimum if $z^* > \overline{K}_2 + [1 - K_1]r_f$.

<u>**Proposition 3:**</u> In a reputational (subgame perfect) Nash equilibrium, the regulator's (privately) optimal bank closure policy is more lax than the socially optimal closure policy.

The intuition is as follows. Although the market's inference is noisy, closure of the bank at $t = 1$ means that the bank's capital was inadequate. Since this is more likely when $\hat{\theta}_1 < \theta_1^*$ (a more risky project) was chosen by the bank, the low capital realization at $t = 1$ tells the market something about the quality of the regulator. The market knows that a good regulator is more likely to have enforced a choice of θ_1^* than a bad regulator. So the closure decision causes the market to revise downward its belief that the regulator is good. That is, the closure of a bank always conveys bad news about the regulator. How bad the news would depend, one would think, on the value of $\widetilde{K}_2$, which the market does not know precisely. However, if the regulator was "completely selfish" and cared only about his own reputation, then there is an Akerlofian lemons effect at work here. To see this, suppose there is a range of values of $\widetilde{K}_2$ for which the "completely selfish" regulator closes the bank, and lower values of $\widetilde{K}_2$ (if these were known to the market) convey progressively worse news about the regulator's quality. Then there must be a value of $\widetilde{K}_2$, call it $\overline{\overline{K}}_2$, which is the highest capital the bank can have and yet be closed. Since the information conveyed upon closure about the regulator of a bank with $\widetilde{K}_2 = \overline{\overline{K}}_2$ is just as adverse as that for a regulator of a bank with $\widetilde{K}_2 < \overline{\overline{K}}_2$, a regulator whose bank has capital $\overline{\overline{K}}_2$ will wish to distinguish himself from those with lower $\widetilde{K}_2$ realizations by not closing the bank. This argument applies sequentially for every $\widetilde{K}_2$, so that there is an unraveling from the top down.

Thus, if the regulator is "completely selfish", he *never* closes the bank at $t = 1$. On the other hand, if the regulator was "completely selfless", he would follow the socially optimal bank closure policy. A regulator who maximizes (1) will, therefore, choose $z^* \in (0, \overline{K}_2 + [1 - K_1]r_f)$.

The import of this proposition is that it shows how even a little uncertainty about the regulator's ability to regulate -- note that the *qualitative* nature of the result in Proposition 3 does not depend on the magnitude of γ -- can distort the regulator's bank closure policy. The consequences of this distortion are twofold. First, as we have shown, the threat of future closure is the principal factor limiting the bank's risk-taking incentive in the first period. As closure policy becomes more lax, the bank generally takes more risk in the first period, increasing the investment distortion away from first best in that period. Second, any distortion away from the socially optimal bank closure policy means that there is a positive probability that the bank will make a negative NPV asset portfolio choice in the second period; the more lax the regulator's closure policy relative to the social optimum, the greater is this probability. Thus, viewed from an *ex ante* perspective (at $t = 0$), the pursuit of reputation by the regulator increases the deposit insurer's liability on both first- and second-period deposits.

We will define the *total distortion in social welfare* (TDSW) as the sum of the social loss from the bank's choice of $\hat{\theta}_1$ as opposed to θ_1^* and the social loss from the bank's choice of a negative NPV asset portfolio in the second period. The higher is the TDSW, the greater is the loss on the deposit insurance fund. Assume now that $\rho_g(\underline{\theta}) = \overline{\rho}_g \in (0,1)$, $\rho_b(\underline{\theta}) = \overline{\rho}_b \in (0,1)$, $\overline{\rho}_g > \overline{\rho}_b$, $\rho_g(\theta_1) > \rho_b(\theta_1) \ \forall \ \theta_1 \in [\underline{\theta}, \theta_1^*)$, and $\rho_g(\theta_1^*) = \rho_b(\theta_1^*) = 0 \ \forall \ \theta_1 \in [\theta_1^*, \overline{\theta}]$. This leads us to the following result.

<u>**Proposition 4:**</u> The lower the perceived quality of the regulator at the outset, the higher is the TDSW in a reputational equilibrium.

This proposition implies that *perceptions* of the abilities of regulators are important. The lower the assessment that banks (and the market) have of their regulators, the more severe will be the problems of deposit insurance. These problems will be manifested in both an increase in bank portfolio risk *and* lower bank capital levels on average. Moreover, there will also be an increase in the number of instances in which banks with inadequate capital will be allowed to continue.

IV. POLICY IMPLICATIONS:

Our analysis has numerous policy implications, which are discussed in this section.

A. Consolidation Versus Separation of Regulators:

The reason why bank closure policy is distorted away from the social optimum in our model is that the regulator is responsible for both the monitoring of asset quality and the closure decision. Thus the closure decision is manipulated to obscure possible regulatory ineptitude in asset quality monitoring. An obvious way to eliminate the closure policy distortion is to *separate* responsibility for bank closures from that for asset quality monitoring. Under the current system, even though there are numerous regulatory agencies, some of them conduct bank examinations in addition to having a say in whether or not a bank should be closed. According to our model, this is a source of inefficiency that could be eliminated by regulatory restructuring. There are, however, some subtleties involved here. Simply delineating the monitoring and closure decisions within the same regulatory body will not necessarily improve the situation. For example, the closure and monitoring decisions could be delegated to separate divisions within the OCC. This will not necessarily eliminate distortions because the OCC may be concerned about its reputation as an *entity*.

B. Duration of a Regulator's Appointment:

We have ignored effort-related moral hazard in regulatory monitoring, which has been formally analyzed by Campbell, Chan and Marino (1990), for instance. If the regulator could also shirk in the provision of monitoring, then the standard approach to resolving such moral hazard is to give the regulator a long-term contract with sufficiently long duration (see, for example, Rogerson (1985)). Such a contract would make the regulator's future payoffs dependent on current effort expenditure on monitoring and would thus provide a partial attenuation of moral hazard. However, our analysis here suggests that when the problem of regulatory reputation building must be considered *in conjunction* with moral hazard, the long-term contracting solution may *not* be efficient. The reason is that long-term contracting *increases* the informativeness of a bank closure decision since that decision reflects an outcome influenced by possibly many past monitoring actions of the regulator. Distortionary closure incentives of the regulator may be exacerbated as a result. Of course, if the monitoring and closure decisions were separated, long-term contracting would *not* have this undesirable consequence. Hence, separating these two activities could help implement the efficient contracting solution to moral hazard.

C. The Reappointment Process for Regulators:

The regulatory objective function that we have posited assumes that the reappointment of a regulator depends in part on the perceived ability of the regulator. Moreover, the regulator himself is assumed to have some concern for social welfare. This allows us to show that the regulator would be lax in closing banks *even though issues related to potentially unethical links between the regulator and the regulated banks* -- such as those mentioned in the quote in the Introduction -- *are absent*. It is easy to see that if the regulator's objective function was contaminated by such links, then the distortions would be even more severe. The introduction of political factors in the appointment decision increases the likelihood of such links. Thus, at the very least, the *politicizing* of the process by which bank regulators are appointed and reappointed is something that our analysis strongly suggests should be avoided.

A somewhat more subtle issue is that related to the noise introduced by the politicizing of the appointment process. If the appointment of regulators was professionally done and therefore completely apolitical, then one could even argue that the regulator's implicit compensation contract could be at least partly insulated from reputational effects. This would reduce λ_1 relative to λ_2 in the regulatory objective function specified in (1), thereby resulting in less distortion in closure policy even if the monitoring and closure functions were assigned to the same regulator. When a regulator knows that his reappointment decision will be based partly on political considerations, he perceives greater noise in that decision and becomes more concerned about his reputation. This increases λ_1 relative to λ_2 and causes greater distortion in bank closure policy.[19]

D. Regulatory Latitude in Bank Closure Decisions:

It is clear that regulators of depository institutions have enjoyed considerable latitude in their decisions of when to close these institutions.[20] A rather simple way to minimize distortions in bank closure policy is to stipulate a minimum (positive) amount of book capital that the bank must have in order to be allowed to continue. In our model, this capital is not observable publicly at the time that the closure decision is made; this assumption is meant in part to reflect the practical reality that capital is often hard to measure accurately under RAP and GAAP accounting (see White (1988)). Clearly, observability and measurement problems would represent an impediment to implementing such a rigid closure policy, but not an insurmountable one since even informative and noisy signals of this capital available at some possibly later date would be useful in judging whether or not the regulator performed his designated task assiduously. Indeed, we advocate rules rather than discretion in regulation. Our explanation complements that of Kydland and Prescott (1977) who show that rules may serve as a precommitment to ex ante efficient decisions. Rules can thus improve social welfare because they are not subject to the time-consistency requirements of discretionary policies.

E. Asset Portfolio Restrictions:

A key factor leading to the pursuit of reputation by the regulator is that there is uncertainty about his ability to monitor bank asset quality. At one extreme, if the set Θ was a singleton, the monitoring issue would be moot. In general, the smaller the (Lebesgue) measure of the set Θ, the more effective will a regulator of given ability be in monitoring the bank's asset quality. To the extent that it is common knowledge that the regulator is relatively efficient in monitoring a *limited* set of assets, the observed closure of a bank will be less important as a signal of the regulator's quality and there will be lesser distortion in bank closure policy. This will induce the bank to choose lower asset portfolio risk at the outset. Thus, asset portfolio restrictions on banks may have an *indirect role* in reducing the liability of the deposit insurance fund as well.[21]

This observation has implications for the current push to deregulate and selectively eliminate Glass-Steagall restrictions on banks' investment choices. Such banking reforms may well expand the investment opportunities of banks in such a way that the regulatory task of monitoring bank asset quality is made significantly more difficult. Our analysis implies that this could result in greater regulatory distortions than in the past, *ceteris paribus*.

F. The Management of Public Perceptions:

The importance of beliefs in our reputational equilibrium is transparent. If banks and the market have a great deal of confidence in the regulator's quality, then the regulator will sense a lesser need to positively influence perceptions about his quality by not closing a bank that he should close. Thus bank closure policy will be closer to the social optimum. As we pointed out in Proposition 4, this reduces distortions. Although it may be impossible to "manage" perceptions in an artificial way, the careful selection of high quality regulators should facilitate the fostering of public confidence in the long run. For example, as with many professional occupations, we could require *certification* of regulators.

A related issue is the public availability of information. In our model, if the market is as well informed about the bank's financial condition as the regulator, then the regulator has *no* incentive to pursue a closure policy that deviates from the social optimum *at that point*. This seems to be borne out by the recent depository institution crisis in Rhode Island, for instance, during which many institutions were quickly closed *after* panic among depositors led to runs and it was obvious that regulators were no longer privileged possessors of information about the precarious financial condition of these institutions. This suggests that perhaps greater attempts should be made to bring market pressure to bear *on regulators* by making information about banks available more freely to the market.

V. CONCLUDING THOUGHTS

In this paper we have taken the view that there may be much to learn by modeling the bank regulator as a self-interested agent who has an incentive to build a reputation as a capable regulator. This view can explain how the perversities created by deposit insurance interact with the personal ambitions of the regulator to give rise to potentially significant distortions in the asset portfolio choices of banks and the decisions of when these banks should be closed. Since these distortions arise our model due to the fact that the same regulator is entrusted with the tasks of monitoring bank portfolio choice and bank closure, our analysis permits us to say something about the existing regulatory structure and reform proposals. The weaknesses in the current structure are essentially twofold. First, the regulatory bureaucracy is overly cumbersome, with massive overlaps in functions. There are five federal agencies monitoring depository institutions, and at least 50 separate state agencies doing the same. Moreover, many of these regulatory agencies are buried in departments each of which has a multitude of responsibilities. The lack of agility arising from bureaucratic redundancy and size has been well recognized.[22] Second, as we mentioned earlier, the current system entrusts each of the principal regulators with the dual tasks of monitoring and closure. Our analysis has highlighted this as a weakness that has not received much attention.

The FIDICIA of 1991 partly addressed the first of the two weaknesses in the current system -- the minimization/elimination of overlapping jurisdiction. But it did not address the second weakness. As long as the two key tasks of monitoring asset quality and bank closure are assigned to the same regulator, reform of the nation's banking regulatory structure will remain incomplete. Thus, our analysis not only provides a possible perspective on the recent history of the performance of the U.S. banking system, but it also suggests numerous directions for future reform. Since perhaps the only meaningful distinction between man and machine is moral hazard, it may be too much to ask that banking reform eliminate *all* self-interested regulatory behavior. However, just the mere recognition of the possibility of self interest on the part of regulators is, we believe, a useful start.

FOOTNOTES

1) We will use the term "bank" to generically describe all depository institutions.

2) See, for example, Besanko and Thakor (1992), Black, Miller and Posner (1978), Chan and Mak (1985), Cummins (1988), Edwards and Scott (1979), Giammarino, Lewis and Sappington (1990), Kane (1982), Kim and Santomero (1988), Kareken and Wallace (1978), McCulloch (1985), and Pennachi (1984).

3) See, for example, Chan, Greenbaum and Thakor (1992).

4) See, for example, Besanko and Thakor (1992).

5) While the problem has become a full-blown crisis in the S&L industry, banking may not be in significantly better shape, as the following quite indicates,

> *"It's deja vu all over again", said R. Dan Brumbaugh, senior research scholar at Stanford University's Center for Economic Policy Research. He contends that federal bank regulators are masking the industry's ills in much the same way thrift regulators hid S&L problems in the 1980s.* Trigaux (1990).

6) Shortcomings in the process of bank regulation have been recognized by prominent politicians. For example, Secretary of the Treasury, Nicholas F. Brady, was quoted as saying,

> *I'm referring to the legal and regulatory structure of our financial system. It is outmoded, burdensome and inefficient. Its flaws are an unseen contributor to our financial institutions' current difficulties.* Brady (1991).

7) There has been much recent discussion about the *quality* of bank regulation. Indeed, L. William Seidman, chairman of the FDIC, was quoted in the *American Banker* (10-24-1990) as saying,

> *Supervision is not working well enough to prevent excessive losses. We need a greatly enhanced supervisory system, and the time to move on is soon. We add 500 to 600 staffers a year, but this is not enough.*

8) Regulators have been recently quite defensive about the timing of their intervention in the affairs of troubled banks. For example, when they were criticized for being too late in closing the Bank of New England, Comptroller of the Currency Robert L. Clarke and FDIC Chairman L. William Seidman were quoted as saying that they did not act until early January, 1991 because only then was it certain that the bank "had no chance to survive" (see Rehm and Atkinson (1991)).

9) Under the current regime, commercial banks are monitored by three *major* regulatory agencies (there are five agencies in all) and state bank supervisors. The Office of the Comptroller of the Currency (OCC) examines national banks, the Fed examines state member banks, and the FDIC examines insured, nonmember banks. The state bank examiners normally monitor state-chartered banks in coordination with the Fed and the FDIC. When the examination is completed, the examiner submits a confidential summary report to the bank but does not convey its composite (CAMEL) rating. If problems exist, these are discussed with the bank's management, and the bank's progress in correcting these problems is closely monitored, with possible resort to administrative orders in severe cases (e.g. OCC action in August 1982 against Penn Square Bank N.A.). Many have claimed that bank examination is highly inefficient (see, for example, Dince (1984)).

Officially, a bank can only be closed by the regulatory authority that granted its charter (i.e., OCC or state regulator). Thus, although the Fed and the FDIC have played critical roles in bank monitoring, they have lacked legal bank closure authority. In practice, however, the FDIC often makes the initial case for closing a federally insured bank, so that the regulator in our model who performs both the monitoring and closure functions corresponds roughly to any of the three principal regulators. The recent Treasury Proposal (1991) calls for a significant revamping of this structure.

10) We assume that when a bank is deemed by the regulator to have failed and thus qualifying for closure, the method of disposal chosen is *depositor payoff*. Thus, we do not deal with the four other disposal methods: purchase and assumption (merger with a healthy bank), provision of financial aid (normally provided by the FDIC to allow the bank to continue), charter of a Deposit Insurance National Bank (this is the chartering of a bank by the FDIC to provide temporary payment services to the community until the troubled bank is closed or merged with another bank), and reorganization (does not require FDIC intervention and is almost never used). The two most commonly used disposal methods are depositor payoff and purchase and assumption.

11) The usual approach is to solve for the first best by relaxing informational constraints rather than financial constraints (such as those on the debt-equity ratio). That is, we should solve for the asset portfolio choice under the assumption that this choice is observable. This, however, would be the choice that maximizes the social surplus, i.e., one that obtains if the bank is all-equity financed and makes a (possibly unobserved) choice.

12) Bank closure policies have also been studied by Acharya and Dreyfus (1989). Assuming competitive conditions, they show that the threshold assets-to-deposits ratio below which the socially optimal policy calls for bank closure is greater than or equal to one.

13) This may be viewed as an indictment of deposit insurance.

14) See, for example, Trigaux (1991). Many bankers apparently claim that this element in the Treasury Proposal (1991) is another signal of the creeping nationalization of U.S. banks.

15) There are possibly many ways to think about how θ_1^* is determined, depending in part on how we interpret regulatory monitoring activity. For example, if we assume that the regulator can never observe the bank's portfolio choice but wishes to maximize social surplus, *conditional on the bank having chosen* θ_1^* *and* conditional on the regulator's own closure policy, then he will solve

$$\max_{\theta_1^*} R(\theta_1^*) + \theta_1^* \int_{Y_s} \hat{\theta}_2(\tilde{K}_2^s)R(\hat{\theta}_2)f(y)dy + [1-\theta_1^*]\int_{Y_f} \hat{\theta}_2(\tilde{K}_2^f)R(\hat{\theta}_2)f(y)dy$$

$$\text{subject to } \hat{\theta}_2(\tilde{K}_2) \in \underset{\theta_2[\underline{\theta},\theta]}{\operatorname{argmax}}\{\theta_2(\tilde{K}_2)[R(\theta_2) - \{1-\tilde{K}_2\}r_f]\}$$

where Y_s is the set of values of $\tilde{y}$ such that the regulator would allow the bank to continue in the second period, conditional on a successful payoff on the first-period asset portfolio, and Y_f is the set of values of $\tilde{y}$ such that the regulator would allow the bank to continue in the second period, conditional on a zero payoff on the first-period asset portfolio. The symbols $\tilde{K}_2^s$ and $\tilde{K}_2^f$ represent the bank's second-period book capital conditional on success and failure respectively of the first-period asset portfolio.

Alternatively, we might assume that the regulator is simply instructed to attempt to enforce a choice of $\theta_1^* = \theta_2^*$, which would maximize the single-period social surplus from the first-period asset portfolio. A third possibility is that the regulator chooses θ_1^* to maximize (1), his personal objective function. This would introduce yet another delegation problem.

16) Although we do not dismiss this possibility outright, we think that it is very unlikely.

17) If the regulator follows the socially optimal bank closure policy, then $z^* = \overline{K}_2 + [1 - K_1]r_f$.

18) See also Merton (1977).

19) There are some who believe that the appointments of members (and the chairman) of the FHLBB are more politicized than the appointments of member of the Board of Governors of the Federal Reserve, and that this accounts in part for the poor performance of S&L's relative to banks. Our assumption here is that the information set of politicians is similar to that of the market, whereas professional appointments would be based on the information possessed by the regulator himself.

20) In defending the FHLBB's decision not to close S&L's when they were initially deemed economically insolvent, former chairman Richard T. Pratt was quoted as saying (see Cope(1990)),

> *Had we liquidated the S&L industry in 1981, it would have cost $178 billion - $380 billion in today's dollars. It would have been the most foolish public policy that could have possibly been undertaken.*

21) The direct effect of asset portfolio restrictions is simply to exclude some risky assets from the bank's investment opportunity set.

22) For example, in criticizing the existing regulatory structure, Rep. Henry Gonzales (1991) said,

> *At the moment, three of the federal regulatory agencies are buried in departments or agencies with a massive array of other functions. The Office of Thrift Supervision (OTS) and the Office of the Comptroller of the Currency (OCC) are subunits of the Treasury Department, a department that is not only a political arm of any administration, but which has a multitude of disparate responsibilities.*

APPENDIX

Proof of Lemma 1: The first order condition determining θ_2^* is

$$\theta_2^* R'(\theta_2^*) + R(\theta_2^*) = 0 \qquad \text{(A-1)}$$

and the first order condition determining $\hat{\theta}_2$ is

$$R(\hat{\theta}_2) - \{1 - \tilde{K}_2\}\, r_f + \hat{\theta}_2 R'(\hat{\theta}_2) = 0. \qquad \text{(A-2)}$$

Substitute θ_2^* in place of $\hat{\theta}_2$ in (A-2) to get

$R(\theta_2^*) + \theta_2^* R'(\theta_2^*) - \{1 - \tilde{K}_2\}r_f = -\{1 - \tilde{K}_2\}r_f < 0$, which implies that (A-2) is negative at $\theta = \theta_2^*$ and zero at $\theta = \hat{\theta}_2$. Thus, $\theta_2^* > \hat{\theta}_2$ since the objective function $\theta_2[R(\theta_2) - \{1 - \tilde{K}_2\}r_f]$ has an interior maximum. Q.E.D.

Proof of Proposition 1: Define $\bar{\bar{\theta}}_2$ as the minimum value of θ_2 (or the maximum risk) such that the bank's second-period asset portfolio has positive NPV if $\theta_2 > \bar{\bar{\theta}}_2$. Thus, $\bar{\bar{\theta}}_2$ is a solution to the equation

$$\bar{\bar{\theta}}_2 R(\bar{\bar{\theta}}_2) = r_f \qquad \text{(A-3)}$$

Since the function $\theta_2 R(\theta_2)$ is concave in θ_2 with a unique maximum at θ_2^*, there are two values of θ_2 that satisfy (A-3). Let these values be $\bar{\bar{\theta}}_2^A$ and $\bar{\bar{\theta}}_2^B$. Then, $\bar{\bar{\theta}}_2^A < \theta_2^* < \bar{\bar{\theta}}_2^B$. The "correct" solution to (A-3) is, by definition, $\bar{\bar{\theta}}_2^A \equiv \bar{\bar{\theta}}_2$.

Now define $\Omega(\hat{\theta}_2) \equiv R(\hat{\theta}_2) + \hat{\theta}_2 R'(\hat{\theta}_2)$. Note that $\partial\Omega(\theta_2)\, \partial\theta_2 < 0$. Moreover, at $\theta_2 = \hat{\theta}_2$, (see (A-2)), we have $\Omega(\hat{\theta}_2) = [1 - \tilde{K}_2]r_f$, and the higher the $\tilde{K}_2$, the smaller is $\Omega(\hat{\theta}_2)$, i.e., the higher is $\hat{\theta}_2$. Thus, $\partial\hat{\theta}_2/\partial\tilde{K}_2 > 0$. Thus, $\exists$ some critical capital level, $\bar{K}_2 \ni \hat{\theta}_2 \geq \bar{\bar{\theta}}_2$ if $\tilde{K}_2 \geq \bar{K}_2$ and $\hat{\theta}_2 < \bar{\bar{\theta}}_2$ if $\tilde{K}_2 < \bar{K}_2$.

Finally, $\partial\bar{\bar{\theta}}_2/\partial r_f = \{\bar{\bar{\theta}}_2 R'(\bar{\bar{\theta}}_2) + R(\bar{\bar{\theta}}_2)\}^{-1} \equiv [\Omega(\bar{\bar{\theta}}_2)]^{-1}$. We know that $\bar{\bar{\theta}}_2 < \theta_2^*$. Thus, by the concavity of $\theta R(\theta)$, the definition of $\Omega(\bullet)$ and (A-1), we have $\Omega(\bar{\bar{\theta}}_2) > 0$ and $\partial\bar{\bar{\theta}}_2/\partial r_f > 0$. Since $\partial\hat{\theta}_2/\partial\tilde{K}_2 > 0$, we know that $\bar{K}_2'$ increases as $\bar{\bar{\theta}}_2$ increases. Hence, $\partial\bar{K}_2/\partial r_f > 0$, and $\exists$ r_f

large enough, say $\bar{r}_f$, such that $\bar{K}_2 > 0 \;\forall\; r_f > \bar{r}_f$. Q.E.D.

Proof of Proposition 2: Write (6) as

$$\hat{\theta}_2(\tilde{K}_2) = \frac{R(\hat{\theta}_2) - \{1 - \tilde{K}_2\}r_f}{-R'(\hat{\theta}_2)} \tag{6'}$$

From (6') we have

$$\partial\hat{\theta}_2/\partial\tilde{K}_2 = \frac{r_f}{-2R'(\hat{\theta}_2) - \hat{\theta}_2 R''(\hat{\theta}_2)} \tag{A-4}$$

Substitute (6') in (14) to obtain

$$M(\hat{\theta}_2) = -[\hat{\theta}_2]^2 R'(\hat{\theta}_2) - \tilde{K}_2 r_f. \tag{A-5}$$

Differentiating (A-5) and using the Envelope Theorem yields

$$\frac{dM(\hat{\theta}_2)}{d\tilde{K}_2} = -2\hat{\theta}_2 R'(\hat{\theta}_2)[\partial\hat{\theta}_2/\partial\tilde{K}_2] - [\hat{\theta}_2]^2 R''(\hat{\theta}_2)[\partial\hat{\theta}_2/\partial\tilde{K}_2] - r_f \tag{A-6}$$

Substituting (A-4) in (A-6) now gives us

$$\frac{dM(\hat{\theta}_2)}{d\tilde{K}_2} = \hat{\theta}_2 r_f - r_f = -[1 - \hat{\theta}_2]r_f < 0.$$ Q.E.D.

Proof of Proposition 3: Suppose the optimal closure policy for the regulator is $z^* \in (0, \bar{K}_2 + [1 - K_1]r_f)$. We will first show that $\gamma_1^m(NC) > \gamma_1^m(C)$ for any $z^* > 0$. Note that since $\hat{\theta}_1 > 0.5$, $\rho_g > 0.5$ and $\rho_g > \rho_b$, we have

$$\rho_g\theta_1^* + [1 - \rho_g]\hat{\theta}_1 > \rho_g[1 - \theta_1^*] + [1 - \rho_g][1 - \hat{\theta}_1],$$

and $\rho_b[1 - \theta_1^*] + [1 - \rho_b][1 - \hat{\theta}_1] > \rho_g[1 - \theta_1^*] + [1 - \rho_g][1 - \hat{\theta}_1]$.

Some tedious algebra can now be used to establish that $\gamma_1^m(NC) > \gamma_1^m(C)$ for any $z^* > 0$. Note that if $z^* = 0$, then $F(z^*) = 1$ and we get $\gamma_1^m(NC) = \gamma_1^m(C)$, i.e., the bank's closure policy is noninformative.

Consider now the problem of a "completely selfish" regulator who maximizes $\gamma_1^m + \delta\gamma_2^m$. If he closes the bank at t = 1, his expected utility is

$$\gamma_1^m(C) + \delta\gamma_1^m(C) \qquad \text{(A-7)}$$

since closure means that the market's information set at t = 2 is the same as its information set at t = 1. If he allows the bank to continue for a second period, his expected utility is

$$\gamma_1^m(NC) + \delta\gamma_2^m(NC,\widetilde{K}_2), \qquad \text{(A-8)}$$

where $\gamma_2^m(NC,\widetilde{K}_2)$ is given by (22).

Now consider the problem of a regulator who observes $\widetilde{K}_2 \leq z^* - [1 - K_1]\, r_f$. Given our conjecture about z^*, such a regulator knows that $\widetilde{R}_1 = 0$ when he observes $\widetilde{K}_2$ in this range, and that at t=2 the market will also infer that $\widetilde{R}_1 = 0$. Thus,

$$\gamma_2^m(NC,\widetilde{R}_1 = 0) = \Pr(g\,|\,\theta_1^*)\,\Pr(\theta_1^*\,|\,\widetilde{R}_1 = 0) + \Pr(g\,|\,\hat{\theta}_1)\Pr(\hat{\theta}_1\,|\,\widetilde{R}_1 = 0) \qquad \text{(A-9).}$$

Simplifying (A-9) shows that $\gamma_2^m(NC,\widetilde{R}_1 = 0) = \gamma_1^m(C)$. Since $\gamma_1^m(NC) > \gamma_1^m(C)$, we see now by comparing (A-7) and (A-8) that the "completely selfish" regulator *always* prefers *not* to close the bank. Thus, if the regulator is "completely selfish", then it can never be a Nash equilibrium for $z^* > 0$; given a positive z^*, the regulator's behavior is inconsistent with the market's belief that the bank will be closed if $\widetilde{K}_2 < z^* - [1-K_1]r_f$. Thus, the only Nash equilibrium is one in which the "completely selfish" regulator never closes the bank and the market believes that $z^* = 0$. Given this, $\gamma_1^m(NC) = \gamma$ and the regulator's equilibrium utility is $\gamma + \gamma_2^m(NC,\widetilde{K}_2)$ for a given $\widetilde{K}_2$.

At the other extreme, suppose the regulator is "completely selfless". Then he sets $z^* = \overline{K}_2 + [1 - K_1]r_f$. Since the problem of our regulator is a linear combination of the problems of the "completely selfless" and "completely selfish" regulators, he will set $z^* \in (0, \overline{K}_2 + [1 - K_1]r_f)$. For this to be a Nash equilibrium, investors must infer that closure implies that $\widetilde{R}_1 = 0$ and $\widetilde{y} < z^*$, so that we will have $\gamma_2^m(NC,\widetilde{R}_1 = 0) = \gamma_1^m(C)$. It is easy to verify that this Nash equilibrium is unique in pure strategies, i.e., it cannot be a Nash equilibrium for the regulator to set $z^* \geq \overline{K}_2 + [1 - K_1]r_f$.

The only out-of-equilibrium move is for the regulator not to close the bank even though $\tilde{y} + \tilde{R}_1 < z^*$. The market will discover at $t = 2$ that the regulator chose an out-of-equilibrium move. But there is nothing to be learned from this since at $t = 2$ the market observes $\tilde{K}_2$ and the regulator has no private information about his type relative to the market at $t = 2$. However, the particular choice of z^* balances the reputational effect and the social wealth effect, i.e., the potentially positive reputational effect of deviating from the equilibrium is offset by the (negative) social wealth effect. Therefore, by the definition of the equilibrium (namely that the regulator seeks to maximize his expected utility in equilibrium), the regulator will not choose this out-of-equilibrium move, given that the market's (equilibrium) belief at $t = 1$ was that no closure implied $\tilde{y} + \tilde{R}_1 \geq z^*$. It is transparent that this equilibrium is subgame perfect, since the regulator's strategy is chosen explicitly to maximize his expected utility over the second-period subgame. Q.E.D.

<u>Proof of Proposition 4:</u> The proof involves showing that (i) $\partial\hat{\theta}_1/\partial\gamma > 0$ and (ii) $\partial z^*/\partial\gamma > 0$, and a proof of the sufficiency of (i) and (ii) for the result in the proposition.

<u>A. If (i) $\partial\hat{\theta}_1/\partial\gamma > 0$ and (ii) $\partial z^*/\partial\gamma > 0$, then Proposition 4 holds:</u> Note that (i) implies that a lower γ increases the probability $(1-\hat{\theta})$ of realizing $\tilde{R}_1 = 0$. Holding z^* fixed and recalling that $\tilde{y}$ is independent of $\hat{\theta}_2$ and that closure should only occur if $\tilde{R}_1 = 0$, our arguments imply that a lower γ is associated with a higher probability that $\tilde{K}_2 \in (z^* - [1-K_1]r_f, \overline{K}_2)$, the "distorted closure policy range". The higher probability that $\tilde{K}_2$ falls within the "distorted closure policy" range implies a higher social welfare loss for a given closure policy z^*.

Observe next that (ii) implies that a lower γ will further distort the closure policy, which increases the social welfare loss even more. Thus, (i) and (ii) imply that the TDSW is decreasing in γ.

B. Proof of $\partial\hat{\theta}_1/\partial\gamma > 0$: Define

$$K(\theta_1) \equiv \theta_1\phi(\theta_1) - K_1 r_f + L(\theta_1,K_1).$$

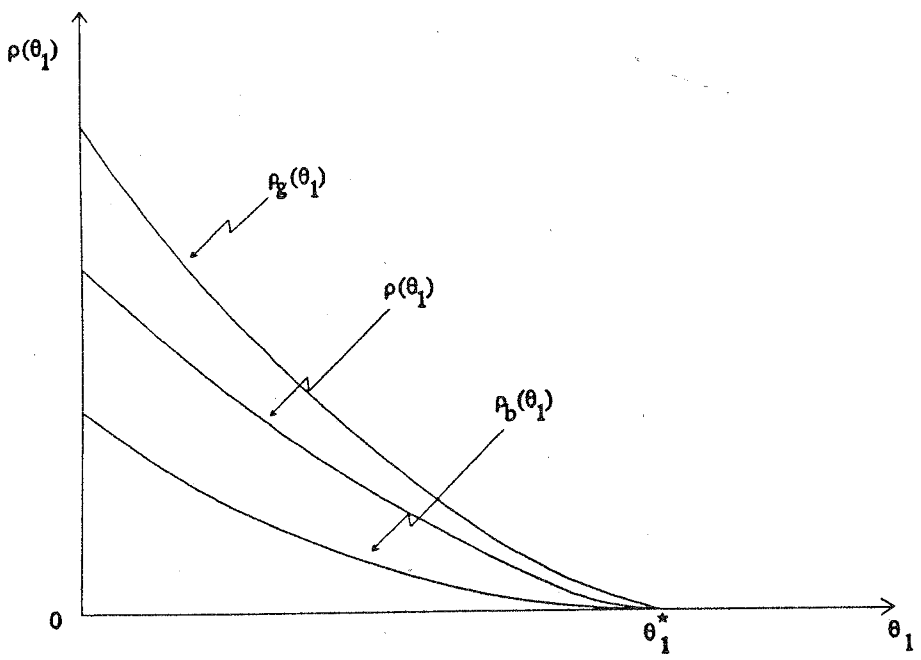
We assume that $K''(\theta_1) < 0$, a sufficient condition for which is

$$L''(\theta_1,K_1) < -\{2R'(\theta_1) + R''(\theta_1)\theta_1\}.$$

We may write (13) as:

$$\rho'(\hat{\theta}_1)\{K(\hat{\theta}_1) - K(\theta_1^*)\} + [1-\rho(\hat{\theta}_1)]K'(\hat{\theta}_1) = 0. \tag{A-10}$$

The following figure sketches the $\rho(\theta_1)$, $\rho_g(\theta_1)$ and $\rho_b(\theta_1)$ functions. We have $\rho'(\bullet) < 0$ and $\rho''(\bullet) > 0 \ \forall \ \theta_1 \in (\underline{\theta},\theta_1^*)$. Also, $\rho_g(\theta_1^o) > \rho_b(\theta_1^o)$ and $\rho_g'(\theta_1^o) < \rho_b'(\theta_1^o) \ \forall \ \theta_1^o \in (\underline{\theta},\theta_1^*)$.



By the definition of $\hat{\theta}_1$, it follows that $K(\hat{\theta}_1) > K(\theta_1^*)$. From (A-10), we see that $K'(\hat{\theta}_1) < 0$. Using (11), $\rho_g(\theta_1^o) > \rho_b(\theta_1^o)$ and $\rho_g'(\theta_1^o) < \rho_b'(\theta_1^o)$, we get $\partial\rho'(\theta_1)/\partial\gamma < 0$ and $\partial\rho(\theta_1)/\partial\gamma > 0$. Thus, holding $\hat{\theta}_1$ fixed, we get

$$\partial\{-\rho'(\hat{\theta}_1)[K(\hat{\theta}_1) - K(\theta_1^*)] + [1-\rho(\hat{\theta}_1)]K'(\hat{\theta}_1)\}/\partial\gamma > 0.$$

Therefore, for a lower value of γ than the one for which (A-10) holds, the LHS of (A-10) will become negative. Given the concavity of the objective function $H(\theta_1,K_1)$ (see (12)), the equality in (A-10) can be restored by reducing $\hat{\theta}_1$. Thus, $\partial\hat{\theta}_1/\partial\gamma > 0$. (It is straightforward to verify that $H(\theta_1,K_1)$ is indeed concave).

C. Proof of $\partial z^*/\partial\gamma > 0$: Note that at z^*, the (negative) reputational effect of closure precisely offsets the (positive) social wealth of closure for the regulator in the computation of his private optimum. Now, lower γ and hold z^* fixed. For this lower value of γ, the social wealth effect of closure *vs.* no closure at z^* does not change, i.e., the social benefit of closing a bank to prevent a suboptimal second-period project choice has not changed for any given a realization of $\tilde{y}+\tilde{R}_1$. However, the reputational effect does change. Assume that the regulator observes a realization $\tilde{y}+\tilde{R}_1$ equal to z^*. Since this implies that $\tilde{R}_1 = 0$, he now compares

$$\gamma_1^m(C) + \delta\gamma_2^m(C) \tag{A-11}$$

with

$$\gamma_1^m(NC) + \delta\gamma_2^m(NC, \tilde{R}_1 = 0). \tag{A-12}$$

From the proof of Proposition 3, we know that $\gamma_1^m(C) = \gamma_2^m(C) = \gamma_2^m(NC, \tilde{R}_1 = 0)$. Thus, the reputational effect can be measured by

$$\gamma_1^m(NC) - \gamma_1^m(C) \tag{A-13}$$

If $\partial\{\gamma_1^m(NC) - \gamma_1^m(C)\}/\partial\gamma < 0$, then at z^*, no-closure becomes more attractive at *lower* levels of γ. From (18) and (19) we then see that a downward adjustment in z^* is needed. This will make non-closure less attractive for reputational reasons (see (19)) and destroy social wealth even further (i.e., the closure policy will be even more socially inefficient). The downward adjustment in z^* should then continue until both effects would then offset the positive effect of a smaller γ on (A-13). Thus, conditional on showing that $\partial\{\gamma_1^m(NC) - \gamma_1^m(C)\}/\partial\gamma < 0$, we know that $\partial z^*/\partial\gamma > 0$.

To show that $\partial\{\gamma_1{}^m(NC) - \gamma_1{}^m(C)\}/\partial\gamma < 0$, write (18) as follows

$$\gamma_1^m(C) = \frac{\gamma A_g}{\gamma A_g + [1-\gamma]A_b} \qquad \text{(A-14)}$$

where $A_g \equiv \rho_g[1-\theta_1^*] + [1-\rho_g][1-\hat{\theta}_1]$

$A_b \equiv \rho_b[1-\theta_1^*] + [1-\rho_b][1-\hat{\theta}_1]$

Now using (A-14) and (19) implies that

$$\partial\{\gamma_1^m(NC) - \gamma_1^m(C)\}/\partial\gamma = \frac{\Psi_g\Psi_b}{\{\gamma\Psi_g + [1-\gamma]\Psi_b\}^2} - \frac{A_gA_b}{\{\gamma A_g + [1-\gamma]A_b\}^2}. \qquad \text{(A-15)}$$

From (A-15) it follows that

$\partial\{\gamma_1^m(NC) - \gamma_1^m(C)\}/\partial\gamma < 0$ if

$$\frac{A_gA_b}{\Psi_g\Psi_b} > \frac{\{\gamma A_g + [1-\gamma]A_b\}^2}{\{\gamma\Psi_g + [1-\gamma]\Psi_b\}^2}. \qquad \text{(A-16)}$$

Since $\theta_1^* > \hat{\theta}_1 > 0.5$ and $\rho_g > \rho_b$, we can use (A-14) and (19), and note that $F(z^*) \leq 1$, to show that

$$\Psi_g > A_g,\ \Psi_b > A_b. \qquad \text{(A-17)}$$

Given (A-17) and $\{A_g, A_b, \Psi_g, \Psi_b, \gamma\} \in \prod_{i=1}^{5} (0,1)_i$, tedious algebra shows that (A-16) holds. □

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