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Depositors' Welfare, Deposit Insurance, and Deregulation

YUK-SHEE CHAN and KING-TIM MAK*

ABSTRACT

We develop an analytical model to address the question of optimal deposit insurance policy and to examine the impact of deregulation on depositors' welfare and the soundness of the insurance system. We find that the optimal level of regulation depends critically on the functional relationship between risk and return. We show that in general deregulation of bank activities and/or of deposit rate ceilings will involve tradeoff between depositors' welfare and the soundness of the insurance system. Our analysis also indicates that risk-sensitive premium and capital requirement schedules may not be efficient in managing the risk of banks.

THE REFORM OF THE deposit insurance system and the deregulation of the banking industry have recently received considerable attention from the finance and economics professions.[1] Prompted by the imminent deregulation of deposit rate ceilings and the prospective relaxation of banking restrictions, discussions have been focused on the needed reforms of the deposit insurance system, in particular, how banks should, if at all, be regulated. The purpose of this paper is to add to these discussions by formally analyzing the connections between depositors' welfare, deregulation, and the soundness of the insurance system.

According to conventional wisdom, the prevailing fixed insurance premium structure necessitates bank regulation: without regulation, banks will take excessive risk and may thereby bankrupt the insurance system (see, e.g., Kareken and Wallace [12] and Edwards and Scott [6]); therefore, restrictions on bank activities were imposed to reduce risk-taking. One wonders then about the real reasons for the current clamor for deregulation. Is it because the existing insurance system, with its rather rigid policy, is inherently inefficient? Is it because the welfare of depositors will be better served by deregulation? Or is it because the banking environment has changed so much that to ensure the competitiveness of the banks, deregulation is warranted? To understand the issues better, let us turn to some of the arguments for deregulation.

Many argued that Regulation Q should be abolished because the rate ceiling shortchanges small savers who only have limited alternatives for investing their

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[1] See, e.g., Benston [1, 2], Campbell and Glenn [5], Campbell and Horvitz [4], Kane [10], Kareken [11], and Pyle [16, 17].

funds (see Pyle [15]). But if the ceiling were appropriately set, would its removal still benefit depositors?[2] If so, at whose cost?

Recently, nonbank institutions began to offer financial services which had been exclusively offered by banks. To maintain the competitiveness of the banks, some argued that banks should be allowed to expand their scope of operation into riskier, traditionally nonbank areas such as insurance underwriting. But will the deposit insurance system remain viable if restrictions on bank activities were lifted?

Many proponents of bank deregulation suggested that the soundness of the deposit insurance system would be better served by a risk-sensitive premium. It is generally perceived that the constant (risk-insensitive) premium policy is inefficient because of the incentive for banks to hold "riskier" assets. However, risk-sensitive schedules may not be practical because of the information the FDIC (we shall assume that the FDIC represents the regulators) would need to monitor the portfolios of the banks (see Greenbaum and Ricart i Costa [7]). Besides the issue of monitoring of the banks and the regulation of their activities, and even assuming away the possible problems of implementation, there remain the following fundamental questions: does a risk-sensitive premium necessarily lead to an "optimal" level of risk-taking? Does it necessarily improve the welfare of the depositors?

To the best of our knowledge, the issues raised in the last three paragraphs have not been formally analyzed. The model developed herein identifies and incorporates what we believe are the essential elements of bank deregulation: the objective of bank regulation; the market structure of the banking industry (competitive/noncompetitive); the risk-return opportunities of banks; the policy instruments of the regulator; and the monitoring of bank assets. To incorporate all these elements necessarily forces us to make simplifying and perhaps restrictive assumptions. We believe, nevertheless, that our simple framework to be outlined presently still sheds some light on the issues raised and suggests directions for future research.

There are three parties: the small savers; the banks; and the FDIC. The banking industry is assumed to be competitive. In regulating the banks to safeguard the welfare of the small savers, the FDIC has four policy instruments: the deposit rate ceiling (r); the insurance premium (p) it levies per dollar of deposit; the minimal capital (e) it requires the banks to maintain per dollar of deposit; and lastly, the restriction it imposes on the banks' choice of investments. We assume the FDIC's objective is to maximize the rate r by appropriately setting its policy, subject to the following constraints: (i) the probability that banks fail does not exceed an acceptable level; (ii) the FDIC will on average break even; and (iii) the banks will earn at least their cost of capital.[3] Constraint

[2] Since banks are assumed to be competitive, they will offer the ceiling rate as long as it is viable. We assume that the FDIC will set the ceiling rate such that at that rate, banks are viable. Therefore, the ceiling rate reflects the welfare of the small savers. Our model will not consider explicitly the payment-in-kind returns to the depositors; all forms of returns are impounded in the deposit rate.

[3] Other studies (Kahane [9] and Koehn and Santomero [13]) have examined the effectiveness of the minimum capital requirement and/or portfolio restrictions for achieving the goal of constraining the probability of bank insolvency. We are not sure that the risk of ruin should be the only concern for the FDIC. To examine the issues in a more general framework, we model the FDIC as having

(i) stipulates a maximal degree of regulatory tolerance for bank failures. It is implicitly a guarantee of social welfare. Together with constraint (ii), it reflects the minimal requirement for a sound deposit insurance system. Constraint (iii) is obviously needed for any banking system to be viable. For simplicity, we assume that both the FDIC and the banks are risk-neutral.[4]

Investments (assets) are ranked according to their expected return. It is assumed that a higher return always entails a greater risk. By fiat, the FDIC restricts banks to choose their investments from a subset which it deems to have acceptable risk.[5] These asset restrictions are similar to the portfolio restrictions in Kareken and Wallace's contigent claims model.

Forced by the competition for deposits, banks will offer the highest possible deposit rate (set by the FDIC) provided they break even. It will be shown that subject to the restriction on their investment choice, banks will always hold the riskiest assets allowed. This result is consistent with the conventional wisdom that, under the constant premium scheme, banks are encouraged to take risks. It greatly simplifies the problem of the FDIC: knowing the response of the banks to its policy, the FDIC merely has to prescribe the proper restriction on banks' investment, set the premium rate p and the capital requirements so as to maximize the celing rate r, subject to the constraints described earlier.

In Section I, we first show that for each prescribed subset of allowable investments, if the constraint (i) on the probability of bank failures is ignored, then there exists a unique optimal choice for the policy parameters (r, p, e). Deregulation of banking activities may then be analyzed in terms of the tradeoff between the possible increase in the small savers' welfare (r) and the likelihood of bank failures. We find that the optimal level of regulation depends critically on the functional relationship between risk and return. It also depends on what is considered as a socially acceptable probability of bank failures. An important implication of this study is that issues of regulation or deregulation cannot be settled without specifying bank's risk-return technology.

The model analyzed in Section I is used in Section II to address bank deregulation issues. We consider two cases where deregulation may be warranted: when there is a favorable shift in the risk and return tradeoff and when the FDIC deems a higher probability of bank failures socially acceptable. We show that, in general, deregulation of bank activities will involve a tradeoff between small savers' welfare and the soundness of the insurance system.

We will also consider the deregulation of deposit rate ceilings and risk-sensitive premium. It is found that had the FDIC set the policy optimally, removing Regulation Q would have no effect on the banking industry. In other words, within our model, letting competitive banks set their own rate is meaningful only if the FDIC had been pursuing a suboptimal policy. The intuition behind this

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control over more policy instruments and that the risk of ruin is just one facet of its optimization problem. To the best of our knowledge, our model is the first attempt at examining the deregulation issues taking into account more relevant policy parameters.

[4] We should note here that risk neutrality is a fairly strong assumption. It intensifies the banks' propensity to risk-taking and thereby the necessity of regulation.

[5] Asset portfolios are categorized according to their expected return and risk; for instance, one specification may be 30% in real estate loans, 50% in commercial loans, and 20% in foreign loans. It is assumed that there is no identification problem for assets.

result is that since banks compete for deposits by offering the highest deposit rate that is viable for any given asset choice, they share the same objective of the FDIC; therefore, the FDIC may delegate the deposit rate decision (but keep the control over the other policy parameters) to the banks without affecting the depositors' welfare. This result implies that deposit rate ceilings are critical to small savers' welfare when the banking industry is monopolistic; as the market structure becomes competitive, its impact diminishes.

As for risk-sensitive premia, we find that they need not be efficient even if they are implementable. In particular, when the constraint on the probability of bank failures is binding, the plausible risk-sensitive schedule generated by our model will increase the probability of bank insolvency above the tolerable level because banks will take higher risk to earn an excess return given the chosen deposit rate ceiling.

I. Model and Analysis

A. Elements of the Model

We first describe the technology of and the participants in the banking industry.

Assets. Each asset (investment) is characterized by its (per dollar) expected return y and the risk Θ involved. We assume that $y \in [\alpha, \beta]$, and the risk Θ is an increasing function of the return y; i.e., $\Theta'(y) > 0$, and $\Theta(\alpha) > 0$. The technology of the banking industry as specified by the return-risk pairs $\{(y, \Theta(y)) \mid y \in [\alpha, \beta]\}$ is quite general. For mathematical tractability, however, we assume that the actual return from an asset $(y, \Theta(y))$ is a random variable uniformly distributed on the interval $[y - \Theta(y), y + \Theta(y)]$. We further assume that $\Theta(y) \leq y$; i.e., a bank at the worst will lose all its investment.[6] Without ambiguity, we shall identify an asset simply by its expected return y.

Depositors. The depositors are small savers with limited investment alternatives. They are assumed to be extremely risk-averse and will only invest in a risk-free asset. The FDIC is assumed to be the guardian of their welfare and takes on the responsibility of providing them deposit insurance which ensures a sure return.[7]

Banks. Banks compete for deposits and invest the proceeds and their own capital in assets available to them. We assume that potential bankers (the shareholders of the banks) are risk-neutral. Therefore, banks' cost of capital is β since their shareholders may elect not to invest in banks and divert their funds to the highest return asset β.[8] Banks are assumed to choose assets so as to

[6] The assumption of a uniform distribution may seem restrictive, but we conjecture that the parametric results in subsequent sections will hold for more general distributions which satisfy the Rothschild-Stiglitz [18] condition for increase in risk when the expected return increases.

[7] This is the "widows and orphans" argument or the birthright argument (see Kareken [11]).

[8] If bank shareholders are risk averse, they they will maximize the risk-adjusted expected return. It means that the regulation of bank activities need not be as rigid as in the case with risk neutrality. Also, in this model, we assume that the investors have the access to the same investment opportunity

maximize their expected profit subject to the regulated banking environment to be described shortly.

FDIC. The FDIC seeks to maximize the small savers' welfare by insuring their deposits, subject to the following conditions:

(i) *Bank Insolvency Constraint.* The probability of bank insolvency is less than some acceptable level $\hat{\pi}$.
(ii) *FDIC Solvency Constraint.* The FDIC at least breaks even on average.
(iii) *Bank Participation Constraint.* The capital put up by the banks earns at least an expected return of β.

The FDIC sets the deposit rate ceiling r. We assume (cf. footnote 2) the ceiling rate is such that banks are viable [i.e., constraint (iii) is satisfied]. Since banks are assumed to be competitive, they will offer the ceiling rate. Therefore, the ceiling rate reflects the welfare of the small savers.

The FDIC charges the banks a premium of p per dollar of deposits for the insurance. It is assumed that the net return on the premium held by the FDIC is zero after its operating cost has been accounted for.[9] To reduce the downside risk of payoff to cover bank insolvency, the FDIC requires each bank to provide a minimal level $\hat{e}$ of capital per dollar of deposits. Lastly, by selecting $\hat{y}$, $\hat{y} \leq \beta$, the FDIC restricts the banks' assets choice to the subset $\{y \mid y \leq \hat{y}\}$; i.e., banks are not allowed to hold an asset with risk exceeding $\Theta(\hat{y})$.

Note that the bank insolvency and FDIC solvency constraints impose direct costs on the use of bank resources. In order that the FDIC will break even on average, insurance premiums are required; however, the opportunity cost of the premium is the expected return it could have yielded had it been left with the banks. The aversion to high bank insolvency rate in turn necessitates restriction of bank activities and capital requirements. These restrictions are detrimental to the welfare of small savers since the bank shareholders are compensated with an expected return β while the return on bank investments is at most $\hat{y}$. In setting its policy $(r, p, \hat{e}, \hat{y})$, the FDIC chooses the parameters which satisfy the constraints with the least cost and thereby maximize the small savers' welfare.

B. Bank's Problem

Banks compete for deposits and offer the maximum deposit rate allowed. We shall, for simplicity, consider a representative bank with a deposit of one dollar.

Suppose the FDIC's policy is $(r, p, \hat{e}, \hat{y})$, and the bank chooses an asset y with risk Θ and puts up capital e. Let x be the random return from the asset y and define

$$z = r/(1 + e - p). \tag{1}$$

When $x \geq z$ the payoff (gross of its cost of capital βe) to the bank is $(1 + e - p)x$

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set of banks. If the risk-return opportunity set $\{y, \Theta(y)\}$ is bank-specific, then the required rate of return for bank shareholders will be the highest expected return he can obtain elsewhere.

[9] The net return could be positive without affecting our results as long as it is less than y. Otherwise, the FDIC should collect the deposits and do the investments by itself.

$-r$; when $x \leq z$, the bank goes bankrupt. It will be assumed that[10]

$$y - \Theta < z < y + \Theta. \tag{2}$$

Faced with the policy $(r, p, \hat{e}, \hat{y})$, the bank chooses $e \geq \hat{e}$ and $y \leq \hat{y}$ so as to maximize its expected excess profit

$$\begin{aligned} B &= \int_{z}^{y+\Theta} [(1 + e - p)x - r] \frac{dx}{2\Theta} - \beta e \\ &= \frac{1 + e - p}{4\Theta} [y + \Theta - z]^2 - \beta e. \end{aligned} \tag{3}$$

It is straightforward to verify that

$$\frac{\partial B}{\partial y} > 0, \frac{\partial B}{\partial \Theta} > 0, \frac{\partial B}{\partial e} < 0.$$

Hence we have the following:

Result 1: The optimal decision for the bank is to provide the minimal capital required ($e = \hat{e}$) and to invest in the riskiest asset ($y = \hat{y}$) allowed.

C. FDIC's Problem

Result 1 implies that the FDIC knows precisely the bank's response to its regulatory policy. For simplicity, henceforth e and y are understood to mean the capital requirement and the limit on asset choice set by the FDIC *and* chosen by the bank.

For a policy (r, p, e, y), the expected payoff to the FDIC is

$$\begin{aligned} F &= p + \int_{y-\Theta}^{z} [(1 + e - p)x - r] \frac{dx}{2\Theta} \\ &= p - \frac{(1 + e - p)}{4\Theta} [z - (y - \Theta)]^2. \end{aligned} \tag{4}$$

Using (1) and (4), the reader may verify that

$$\frac{\partial F}{\partial r} < 0, \frac{\partial F}{\partial y} > 0, \frac{\partial F}{\partial \Theta} < 0, \frac{\partial F}{\partial e} > 0, \frac{\partial F}{\partial p} \lesseqgtr 0.$$

Since the return to the bank's asset is uniformly distributed, the probability of bank insolvency (the FDIC having to pay off the depositors) is seen to be

$$\pi = \frac{z - (y - \Theta)}{2\Theta}. \tag{5}$$

The FDIC's problem is to maximize the ceiling rate guaranteed to the small

[10] It is obvious that $z \leq y + \Theta$ so that there are states of the world in which the banks can recover its capital. If $z < y - \Theta$, then the FDIC never has to pay off the depositors. In subsequent analysis, we show that at optimum the FDIC will always just break even, therefore $z \geq y - \Theta$. We assume that the strict inequalities hold.

savers while maintaining the soundness of the insurance system. Formally,

$$\begin{aligned}&\underset{\{r,p,e,y\}}{\text{Maximize}}\ r\\ &\text{subject to}\quad \text{(i)}\ \pi \le \hat{\pi},\quad \text{(ii)}\ F \ge 0,\quad \text{(iii)}\ B \ge 0.\end{aligned} \tag{6}$$

D. The FDIC's Problem Modified

Since the FDIC's problem involves quite a number of decision variables and constraints, we shall examine a simpler modified problem. We shall ignore temporarily the bank insolvency constraint (i). At the moment, we further hold y and the associated risk $\Theta = \Theta(y)$ fixed. Substituting (1) into (3) and (4), we obtain the break-even conditions ($B = 0$ and $F = 0$) for the bank and the FDIC, respectively, as

$$r_B = (1 + e - p)\{(y + \Theta) - 2[\Theta\beta e/(1 + e - p)]^{1/2}\}, \tag{7}$$

$$r_F = (1 + e - p)\{(y - \Theta) + 2[\Theta p/(1 + e - p)]^{1/2}\} \tag{8}$$

where r_B and r_F, respectively, denote the highest deposit rate the bank and the FDIC can sustain if the deposit insurance premium and capital requirement were set to be p and e. Now, if we further hold e to be fixed, then r_B and r_F are functions of p alone, and it can be shown that $\partial r_B/\partial p < 0$ and $\partial^2 r_F/\partial p^2 < 0$ and the graphs of the functions $r_B(\cdot)$ and $r_F(\cdot)$ cross exactly once as p ranges over the interval $[0, 1]$;[11] see Figure 1. Therefore, for fixed (e, y, Θ), the maximum deposit rate that the FDIC can offer subject to the constraints (ii) and (iii) is at the intersection of the two graphs. In other words, the optimal solution to the modified problem must satisfy $r_B = r_F$; or [from Equations (7) and (8)],

$$[\Theta(1 + e - p)]^{1/2} = (\beta e)^{1/2} + p^{1/2}. \tag{9}$$

Taking the fixed Θ as a parameter, the identity (9) may be regarded as giving p as a function of e:

$$p = \frac{\Theta(1+\Theta)(1+e) + \beta e(1-\Theta) - 2\{\beta e\Theta[(1+\Theta)(1+e) - \beta e]\}^{1/2}}{(1+\Theta)^2} \tag{10}$$

Hence, with (y, Θ) fixed, the modified FDIC's problem is reduced to maximizing the ceiling rate r ($= r_F = r_B$) as a function of e (always maintaining $B = 0 = F$). By (3), $B = 0$ means

$$\frac{1 + e - p}{4\Theta}[y + \Theta - z]^2 = \beta e. \tag{11}$$

Differentiating (11) with respect to e and using (1), we derive:

$$\frac{dr}{de} = \frac{1}{2}(y + \Theta + z)\left(1 - \frac{dp}{de}\right) - \frac{2\Theta\beta}{(y + \Theta - z)}, \tag{12}$$

$$(y + \Theta - z)\frac{d^2r}{de^2} = \frac{1}{1 + e - p}\left\{\left(1 - \frac{dp}{de}\right)z - \frac{dr}{de}\right\}^2 - \frac{1}{2}[(y + \Theta)^2 - z^2]\frac{d^2p}{de^2}. \tag{13}$$

[11] It can be shown that for any (e, y, Θ), $r_B > r_F$ at $p = 0$ but $r_F > r_B$ at $p = 1$. Since $\partial r_B/\partial p < 0$ and $\partial^2 r_F/\partial p^2 < 0$, the two curves will cross only once.

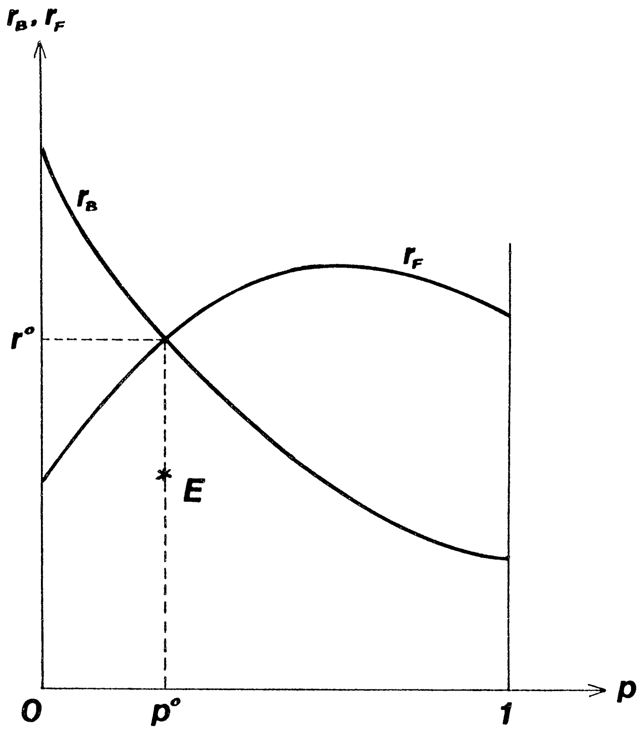

Figure 1. r_B and r_F for given (e, y, Θ)

Now differentiating (9) with respect to e yields:

$$\frac{dp}{de} = \frac{(\Theta - \beta)(pe)^{1/2} - p\beta^{1/2}}{[(1 + \Theta)p^{1/2} + (\beta e)^{1/2}]e^{1/2}}, \tag{14}$$

$$\frac{d^2p}{de^2} = \frac{(\beta e)^{1/2}}{2p[(1 + \Theta)p^{1/2} + (\beta e)^{1/2}]}\left(\frac{p}{e} - \frac{dp}{de}\right)^2. \tag{15}$$

Substituting (14) and (15) into (13) and after some lengthy manipulations, it can be shown that $d^2r/de^2 < 0$ (proofs of Results 2 and 3 are contained in an Appendix available from the authors). Thus, we have

Result 2: For each specified restriction (y, Θ) on the bank's choice of assets, if the bank insolvency constraint (i) is ignored, then there exists a unique solution (r^*, p^*, e^*) to the (modified) FDIC's problem.

The solution (r^*, p^*, e^*) may be explicitly derived as follows. Since it must satisfy the first-order condition: $dr/de = 0$, using (12) and (14), it can be shown that the following condition must hold:

$$AC = W(\beta\Theta)^{1/2} \tag{16}$$

where

$A = y + \Theta p^*/(1 + e^* - p^*)$; $C = (\beta p^*)^{1/2} + (e^*)^{1/2}$; and

$W = (\Theta p^*)^{1/2} + (1 + e^* - p^*)^{1/2}$.

The optimal solution also must satisfy identity (9). Hence,

$$[\Theta(1 + e^* - p^*)]^{1/2} = (\beta e^*)^{1/2} + (p^*)^{1/2}. \tag{17}$$

The p^* and e^* can be obtained as functions of Θ and y by solving (16) and (17). The optimal ceiling may then be determined via (7) or (8). Since $B = 0 = F$ at the optimum, r^* may also be obtained from the "law of conservation"[12]

$$r^* = (1 + e^* - p^*)y + p^* - \beta e^*. \tag{18}$$

With the optimal policy (r^*, p^*, e^*) thus determined, the corresponding probability of bank insolvency is given [cf. (5)] by

$$\pi^* = \frac{z - (y - \Theta)}{2\Theta} = \frac{1}{2}\left\{1 + \frac{r^* - y(1 + e^* - p^*)}{\Theta(1 + e^* - p^*)}\right\}.$$

Using (18) then (17), π^* is simplified to have the form

$$\pi^* = \frac{1}{1 + (\beta e^*/p^*)^{1/2}}. \tag{19}$$

This π^* may be larger or smaller than the acceptable level $\hat{\pi}$ of probability of bank insolvency. In any event, we note that π^* increases if and only if e^*/p^* decreases.

E. Sensitivity Analysis

Still ignoring the bank insolvency constraint, we proceed to consider the consequences of allowing the bank to invest in riskier assets. Differentiating (16) and (17) with respect to y and Θ, after rather tedious computations, we obtain the following results (see Appendix available from the authors):

Result 3:

$$\text{(i)}\ \frac{\partial p^*}{\partial \Theta} > 0,\ \frac{\partial e^*}{\partial \Theta} > 0,\ \frac{\partial r^*}{\partial \Theta} < 0,\ \frac{\partial \pi^*}{\partial \Theta} > 0;$$

$$\text{(ii)}\ \frac{\partial p^*}{\partial y} < 0,\ \frac{\partial e^*}{\partial y} > 0,\ \frac{\partial r^*}{\partial y} > 0,\ \frac{\partial \pi^*}{\partial y} < 0.$$

Since r^*, p^*, e^* and π^* are all ultimately functions of y (which uniquely determines Θ), to analyze the impact of deregulating bank activities, we shall have to consider their total differentials with respect to y (the signs of the partials are given in parentheses):

$$\frac{de^*}{dy} = \underset{(+)}{\frac{\partial e^*}{\partial y}} + \underset{(+)}{\frac{\partial e^*}{\partial \Theta}} \cdot \underset{(+)}{\frac{\partial \Theta}{\partial y}}, \tag{20a}$$

$$\frac{dr^*}{dy} = \underset{(+)}{\frac{\partial r^*}{\partial y}} + \underset{(-)}{\frac{\partial r^*}{\partial \Theta}} \cdot \underset{(+)}{\frac{\partial \Theta}{\partial y}}, \tag{20b}$$

[12] Equation (18) is simply the law of conservation: the total expected return obtained by all the agents is exactly equal to aggregate output. Since $F = 0$ and $B = 0$ at the optimum, $r^* + \beta e^* = (1 + e^* - p^*)y + p^*$.

$$\frac{d\pi^*}{dy} = \underset{(-)}{\frac{\partial \pi^*}{\partial y}} + \underset{(+)}{\frac{\partial \pi^*}{\partial \Theta}} \cdot \underset{(+)}{\frac{\partial \Theta}{\partial y}}, \tag{20c}$$

$$\frac{dp^*}{dy} = \underset{(-)}{\frac{\partial p^*}{\partial y}} + \underset{(+)}{\frac{\partial p^*}{\partial \Theta}} \cdot \underset{(+)}{\frac{\partial \Theta}{\partial y}}. \tag{20d}$$

Remark: From (20a), $de^*/dy > 0$. This supports the conventional wisdom that *with deregulation banks should be required to put up more of their own capital.* Since a bank will invest in riskier assets when allowed to do so (Result 1), to safeguard the viability of the insurance system, the FDIC must counteract by raising the capital requirement. The effect of deregulation on r^*, p^*, and π^* is not so clear. It depends critically on the tradeoff $d\Theta/dy$ between a higher return and the accompanying increase in risk.

F. Solution to FDIC's Problem

We would like to point out that the actual tradeoff $d\Theta/dy$ is essentially an empirical question. It probably cannot be settled by theorizing. We, however, will consider the following three interesting cases:

Case A: $0 < \dfrac{d\Theta}{dy} < \varepsilon$ for all $y \in [\alpha, \beta]$ where ε is very small.

Case B: $\dfrac{d\Theta}{dy} > \Delta > 0$ for all $y \in [\alpha, \beta]$ where Δ is very large.[13]

Case C: The derivative $\Theta'(y)$ is strictly increasing and $\Theta'(\alpha) < \varepsilon$, $\Theta'(\beta) > \Delta$.

In Case A, the increases in risk associated with higher returns are insignificant. Hence, we may conclude [from (20b) and (20c)] that $dr^*/dy > 0$ and $d\pi^*/dy < 0$ for all y. Therefore, the FDIC should not restrict bank activities at all and the bank insolvency constraint (i) in (6) is in all likelihood superfluous.

In Case B, the increases in risk associated with higher returns are significant and letting the bank choose a higher return leads to unfavorable outcomes since $dr^*/dy < 0$ and $d\pi^*/dy > 0$ for all y. Therefore, the FDIC should impose an extremely rigid restriction on the bank's asset. Indeed, the bank should only be allowed to invest in the lowest return asset α.

Cases A and B are extreme cases. Case C seems more realistic. Let us consider a subcase of C where the technology leads to [cf. (20b) and (20c)]

$$\pi^*(\alpha) \leq \hat{\pi}, \quad \frac{d^2 r^*}{dy^2} < 0 \quad \text{and} \quad \frac{d^2 \pi^*}{dy^2} > 0. \tag{21}$$

Equation (21) means that the bank insolvency constraint is satisfied at the least

[13] Case (B) is true if α is close to β and $\Theta(\beta)$ is large (but note that $\Theta(y) \leq y$ for all y, therefore $\Theta(\beta) < \beta$) so that the tradeoff between additional returns and risk is extremely unfavorable.

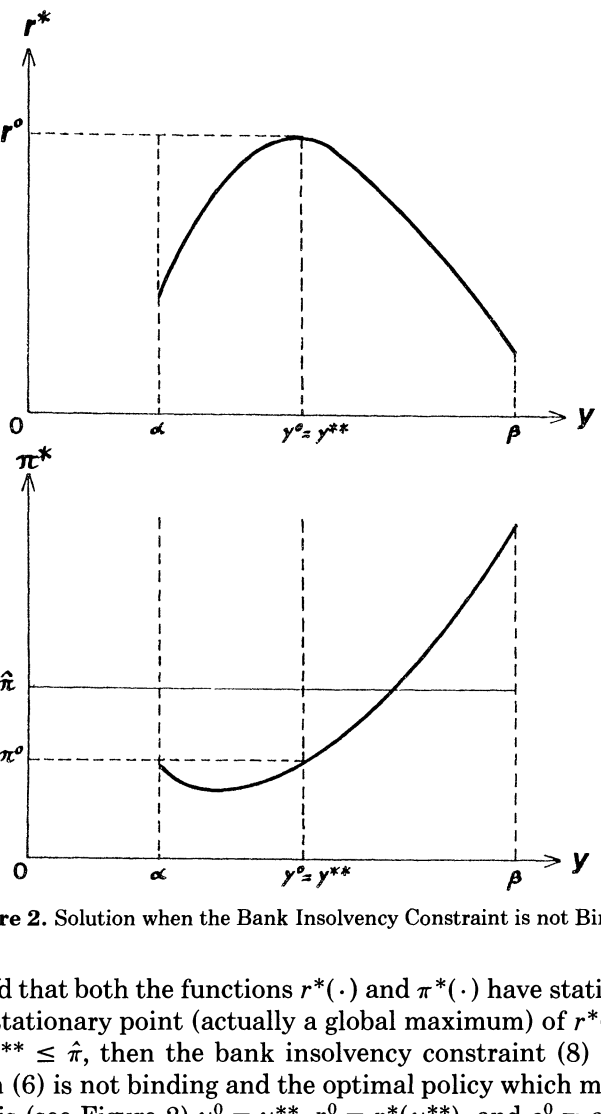

Figure 2. Solution when the Bank Insolvency Constraint is not Binding

risky asset α and that both the functions $r^*(\cdot)$ and $\pi^*(\cdot)$ have stationary points.[14] Let y^{**} be the stationary point (actually a global maximum) of $r^*(\cdot)$. Define $\pi^{**} = \pi^*(y^{**})$. If $\pi^{**} \leq \hat{\pi}$, then the bank insolvency constraint (8) in the original FDIC's problem (6) is not binding and the optimal policy which maximizes small savers' welfare is (see Figure 2) $y^0 = y^{**}$, $r^0 = r^*(y^{**})$, and $e^0 = e^*(y^{**})$. On the other hand, if $\pi^{**} > \hat{\pi}$, then in order not to violate the bank insolvency constraint, the ceiling rate must be set lower than $r^*(y^{**})$. The optimal solution to the FDIC's problem (6) is (cf. Figure 3) given by $y^0 = \pi^{*-1}(\hat{\pi})$, $r^0 = r^*(y^0)$, $p^0 = p^*(y^0)$, $e^0 = e^*(y^0)$, and the probability of bank insolvency is at the highest acceptable level $\hat{\pi}$.

[14] If $d\Theta/dy$ is small for y close to α and larger for y close to β, the impact of y will dominate that of Θ for y close to α ($dr^*/dy > 0$, $d\pi^*/dy < 0$), but is dominated by that of Θ for y close to β ($dr^*/dy < 0$, $d\pi^*/dy > 0$). If condition (21) holds, then $r^*(y)$ is concave and $\pi^*(y)$ convex in y. The stationary points for $r^*(y)$ and $\pi^*(y)$ in general do not coincide; the stationary point of π^* may either be smaller or greater than that of r^*. Since the analyses are essentially the same in both cases, we restrict our study to the second case.

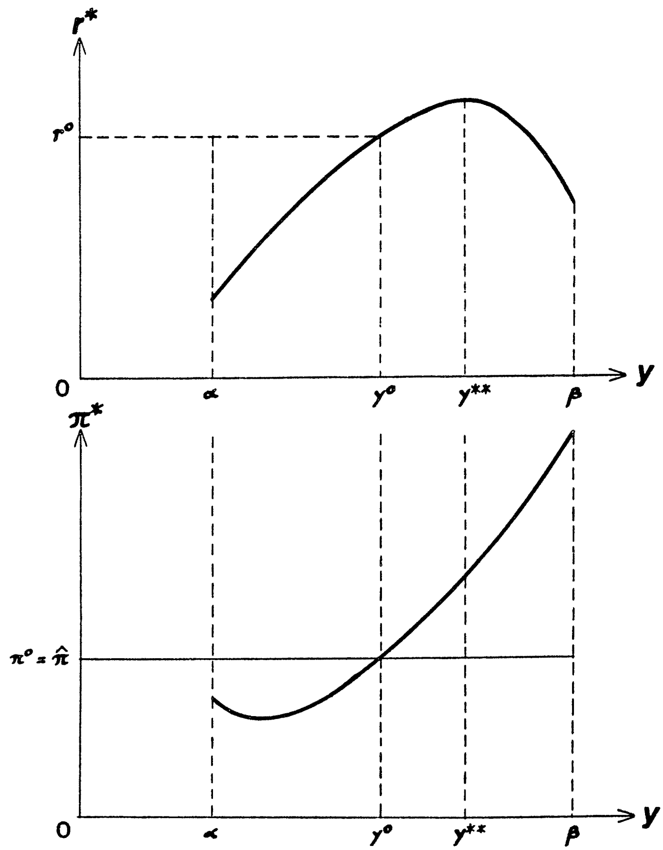

Figure 3. Solution when the Bank Insolvency Constraint is Binding

II. Deregulation

We now use the analysis of the last section to address deregulation issues. In the discussions to follow, we assume the banking technology is such that (21) holds and thus the optimal FDIC policy is as characterized in Section I.E. We remind the reader that the optimal policy depends crucially on the technology of investment. Indeed, we believe that the validity of any proposition on deregulation must be judged in accordance with the technology assumed.[15]

A. Deregulation of Bank Activities

Recently, both the public and the Congress have been clamoring for deregulation. We are concerned with the effect of deregulating bank activities on the depositors' welfare and the banks' solvency. Based on our model of the last section, two (not mutually exclusive) scenarios appear to warrant deregulating bank activities. We discuss them in turn.

[15] Let us reiterate that technology is inherently an empirical issue. We believe that with a better grasp on what the investment technology really is, some of the controversies regarding deregulation will be readily resolved.

Scenario 1: Due to some fortuitious changes in external market factors, some of the higher return assets are not as risky as they were previously. In other words, the market now offers a more favorable tradeoff between risks and return.[16]

Under Scenario 1, the graph of the function $r^*(\cdot)$ shifts upward while that of the function $\pi^*(\cdot)$ shifts down as shown in Figure 4. The analysis in Section I.E. applies[17] to establish the following:

PROPOSITION 1. *If the tradeoff between risk and return became more favorable, then deregulating bank activities will improve depositors' welfare.*

Remark: We note that even though deregulation will lead to a higher optimal deposit rate r^0, it is not clear whether it is to be achieved with a higher capital requirement and/or higher premium.[18] Further, we note that it is possible that deregulation will actually decrease the probability of bank insolvency (cf. Figure 4).

Scenario 2: Prompted by changes in economic conditions which render the adverse impact of bank insolvency less acute than before, the FDIC opts for a higher acceptable probability of bank insolvency.

We first note that if the bank insolvency constraint (i) was not binding, then deregulation of bank activities is not warranted. This is because with deregulation banks will invest in higher risk assets, thus lowering the deposit rate r^* (cf. Figure 2) and raising the probability of bank insolvency at the same time.

In contrast, if the bank insolvency constraint was originally binding (cf. Figure 3), then deregulating bank activities will raise the optimal deposit rate but at the same time increase the probability π^0 of bank insolvency. The tradeoff between these two effects leads to the following:

PROPOSITION 2. *Only if the bank insolvency constraint was binding and only if the improvement of small savers' welfare outweighs the social cost of more likely (frequent) bank insolvency is deregulating bank activities warranted.*

Remark: Proposition 2 highlights the fact that the improvement of the depositors' welfare may not come free. The optimal regulatory policy is sensitive to the relative weights the FDIC places on the "private" and "social" welfare. By (20a), deregulating bank activities, if warranted, must be accompanied by an increase in the minimal capital requirement. It is not clear, however, how the premium must be adjusted.

B. Deregulation of Deposit Rate Ceiling

There has been much criticism of Regulation Q (see, e.g., Pyle [15]). Many argued that the deposit rate ceiling precludes competitive banks from offering higher deposit rates, thereupon the welfare of the small savers is compromised.

[16] Opposite effects can be inferred from the unfavorable movements.

[17] We assume that the new technology also leads to (21).

[18] The analysis needed to settle this issue appears very difficult; in addition to worrying about the total differential in (20a) to (20d), one must consider the effects of perturbing the whole function $y \rightarrow \Theta(y)$.

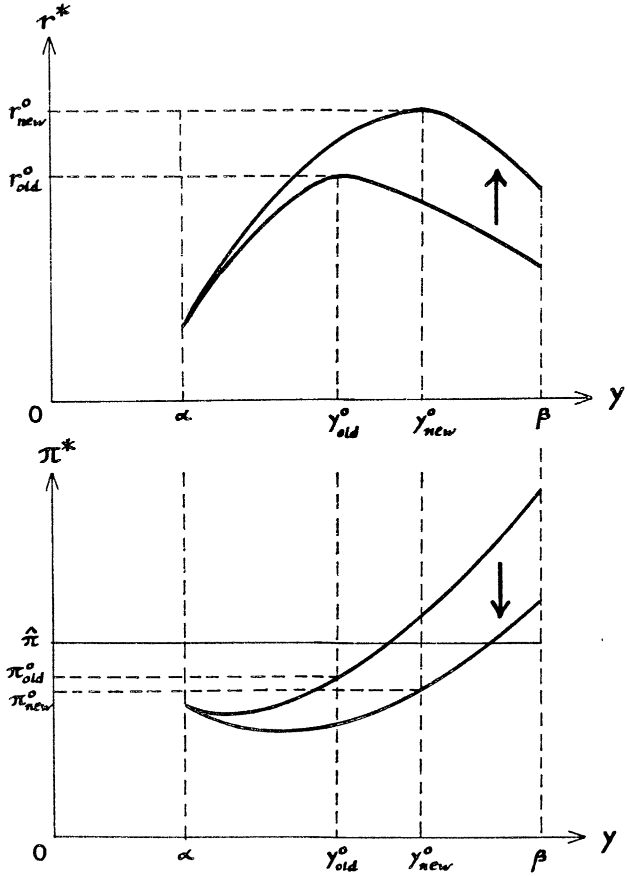

Figure 4. Favorable Change in Tradeoff Between Risk and Expected Return

In opposition to deregulation, some had argued that without the ceiling banks would be inclined to offer such extremely high deposit rates that the insurance system might be bankrupted. Is either argument necessarily valid? Let us use our model to examine the consequence of removing the ceiling.

Suppose the FDIC's optimal policy is (r^0, p^0, e^0, y^0). Suppose the FDIC now only announces the policy (p^0, e^0, y^0) and allows the banks to set their own deposit rate. The banks, if truly competitive, will offer the highest rate possible as long as they can still earn their cost of capital (i.e., break even). Referring back to Figure 1, we see that the maximum rate they can offer is r^0 which is the optimal ceiling the FDIC would have offered!

PROPOSITION 3. *If the market for deposits is competitive, and if FDIC's policy is optimally chosen, then deregulating the deposit rate ceiling will have no effect on the depositors' welfare or on the solvency of the insurance system.*

Remark: According to our model, the ceiling per se does not shortchange the small savers. However, they would be indeed shortchanged whenever the ceiling rate is set below the optimal level. In such a situation (cf. point E in Figure 1), the banks earn a positive excess profit, and the FDIC enjoys a higher than fair premium, both at the expense of the small savers.

C. Risk-sensitive Premium

It is generally perceived that under a fixed premium scheme, banks would be tempted to take unnecessary risk. To redress this so called "efficiency" problem of the present insurance system, risk-sensitive premium schemes have often been proposed. If a risk-sensitive premium schedule could be implemented,[19] then it may very well be used as a mechanism for guiding bank activities without outright regulation. It is not possible to consider all plausible risk-sensitive schedules. Our objective here is to illustrate the effect of a risk-sensitive schedule generated by our model.

Suppose the FDIC's optimal policy is (r^0, p^0, e^0, y^0). Suppose the FDIC now still sets the ceiling r^0 but lets the banks freely choose their investments y for which they will be charged the risk-sensitive premium $p*y)$ and have to put up capital $e^*(y)$ [recall that $p^*(\cdot)$ and $e^*(\cdot)$ are derived as optimal solution functions to the FDIC's modified problem in Section I.D]. The question is whether the bank will choose the optimal portfolio when offered $\{r^0, p^*(\cdot), e^*(\cdot)\}$; i.e., will $y = y^0$? The answer is somewhat surprising: risk-sensitive schedule may be inefficient in risk management.

PROPOSITION 4. *If at the optimal solution (r^0, p^0, e^0, y^0) the bank insolvency constraint is not binding, then the bank will choose the optimal risky asset y^0 when offered the risk-sensitive premium and capital requirement schedule $\{p^*(\cdot), e^*(\cdot)\}$ and the ceiling rate r^0. However, if the bank insolvency constraint is binding, the risk-sensitive premium and capital schedule $\{p^*(\cdot), e^*(\cdot)\}$ will encourage the bank to take higher risk, increasing its expected payoff and that of the FDIC at the expense of the small savers and increasing the likelihood of bank insolvency.*

To establish the above result, we argue as follows. Recall that for each $y \in [\alpha, \beta]$ the solution $\{r^*(y), p^*(y), e^*(y)\}$ to the modified FDIC problem is arrived at subject to the break-even conditions $B = 0$ and $F = 0$. Whenever the bank insolvency constraint is not binding, the ceiling r^0 is such that $r^0 = r^*(y^0) = \max\{r^*(y) \mid y \in [\alpha, \beta]\}$, and the bank can break even if it chooses $y = y^0$. Under the risk-sensitive premium and capital schedule $\{p^*(\cdot), e^*(\cdot)\}$, the bank will not be able to afford the deposit rate for all other choice of $y (\neq y^0)$. In contrast, when the bank insolvency constraint is binding, $r^0 < r^*(y)$ for some $y \in (y^0, y^{**}]$ (cf. Section I.F.). In this case, the bank will choose some $y > y^0$ and make a positive excess profit if the ceiling rate is set at r^0.

We note that when the bank does choose $y \in (y^0, y^{**}]$ the FDIC also earns a profit since $r^0 < r^*(y)$ for all $y \in (y^0, y^{**}]$. That is, the premium $p^*(y)$ is excessive for guaranteeing the deposit rate r^0. We note further that corresponding to the higher risk asset y, the probability of bank insolvency will exceed this stipulated acceptable level $\hat{\pi}$.

[19] Whether risk-sensitive premium schemes are feasible is by no means a settled issue (see Horvitz [8] and Peterson [14]). It is not at all clear whether the riskiness of a bank's portfolios can be meaningfully and accurately evaluated or if the cost of monitoring banks' portfolios would be justified.

Remark: The above result can be viewed as an illustration that risk-related premium may not improve the efficiency in risk management of the insurance system. But this result should be interpreted with caution. It says that when all banks have identical risk-return opportunities and the FDIC can accurately categorize the investments of banks (i.e., monitoring is perfect and costless), then some risk-sensitive schedules are superfluous and possibly harmful. The question of whether risk-sensitive schedules are desirable when banks have access to different risk-return opportunities or when monitoring is imperfect and costly remains an interesting topic for future research.

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