Deposit Insurance and Bank Regulation: A Partial Equilibrium Exposition

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I. INTRODUCTION

The argument, elaborated most convincingly by Professor Friedman [2] is familiar to most if not all monetary economists. A fractional-reserve banking industry is "inherently unstable." That is what the U. S. Congress acknowledged, if somewhat belatedly, when in 1913 it created a lender of last resort, the Federal Reserve System. But the System, once hailed by Irving Fisher as the guarantor of perpetual prosperity, was a terrible disappointment. It failed miserably the test posed by the depression of 1929 (or had the System done what it was supposed to do, what would have been the recession of 1929). There was an epidemic of bank failures in 1930-31. And in 1932-33 there was another, even more serious, which culminated in the Banking Holiday of 1933. So the Congress, having discovered that the industry it thought it had made panic-proof was still panic-prone, established another agency of government, the Federal Deposit Insurance Corporation, to insure certain of the liabilities of commercial banks operating within U. S. boundaries. And if it did not do as well by U. S. citizens as it might have, what it did was extremely helpful. To quote Professor Friedman [1, p. 38]: "...federal deposit insurance has performed a signal service in rendering the banking system panic-proof..." In his view [1, p. 21], the introduction of federal deposit insurance was "the most important structural change in our monetary system in the direction of greater stability since the post-Civil War tax on state bank notes."

We, however, are not so sure that a fractional-reserve banking industry is inherently unstable, or therefore that the Congress, even though having discovered that the Federal Reserve was not to be trusted, was well-advised to introduce deposit insurance. It might simply have lived with its disappointment and let bankers and depositors do the same. That may seem a bizarre judgment. Yet, on certain assumptions, as we show in this paper, the liabilities of banks, although uninsured, are nevertheless safe, even when banks are not bound by a hundred percent reserve requirement. It is only required that creditors, actual and would-be, know what portfolios banks hold and that bankruptcy be costly. Then there is no risk of bankruptcy. Bank liabilities are safe--free, that is, of default risk. And deposit insurance is, in a word, unnecessary.

We get our conclusion using state-preference theory. And for some, we have no doubt, that will be comment enough on the theory (or on our use or misuse of the theory). Can we have read nothing of U. S. economic history? After all, in the years to 1934 there were several banking panics. But the last of those panics, that of 1930-33, causes us no difficulty. For the Federal Reserve was intended to be the lender of last resort--in effect, the insurer of bank liabilities. And our assumptions also imply that if bank liabilities are insured at a premium that is independent of portfolio risk, then banks hold the riskiest portfolios they are allowed to hold. More particularly, if banking regulations are not sufficiently stringent, then in some future states of the world banks fail. Thus, there is an explanation for the panic of 1930-33 that is consistent with our conclusion. With the Federal Reserve having been created, bank creditors thought--as it happens, mistakenly--that bank liabilities had been made safe.

And the panic of 1907? Those of the 19th century? Should they not give us pause? No doubt. But it is in our favor that in the U. S. governments began regulating banks long before 1914. And presumably so that depositors might rest easy.

There is, though, another explanation for the banking panic of 1930-33 and those of earlier years: bank creditors, even when they have not been lulled by government, are too casual in their examinations of banks; they do not know, not in sufficient detail anyway, what portfolios banks are holding, perhaps because it would cost too much to find out. And how to go from a lack of awareness to the failure from time to time of a large number of banks? With creditors who are quite unaware, a bank can without cost increase the riskiness of its portfolio and thereby its profit. So it holds the riskiest portfolio that it is allowed to hold and in consequence may in future go bust. To put the point another way, having creditors who are not fully informed is like having liabilities that are insured at a premium that is independent of portfolio risk.

Evidently then those who are willing to impute incomplete knowledge to bank creditors can argue that there is a need to make bank deposits safe. And for them it is not pointless to ask how that is best done. By insuring deposits, perhaps as Professor Meltzer [4] has suggested at a premium that depends on risk? Or by regulating banks, as Professor Friedman [1] has recommended? For us, though, since we incline toward the assumption of complete knowledge, it is pointless to ask. If insuring bank liabilities is unnecessary, so is regulating banks. Yet, in the pages that follow we do examine various bank regulations for their effects. That may strike some as strange, but there is an easy explanation.

As we said above, if bank liabilities are insured, as under the FDIC scheme, at a premium that is independent of portfolio risk and if banks are not regulated, then they hold risky portfolios and in some future states of the world there are numerous bankruptcies. But if (as we assume) there is a cost associated with bankruptcy, then under an FDIC-type deposit insurance scheme there is a misallocation of resources. A greater-than optimal amount of resources is devoted to, say, post-bankruptcy reorganization. Moreover, unless the risk-independent premium is set just right, at a unique critical value, a greater or less-than-optimal amount of resources is used in providing demand deposit services. So if bank liabilities are insured under an FDIC-type scheme, then regulation of banks is in a sense necessary. Regulation is not an alternative to deposit insurance, but rather a necessary complement. That is how distortions are eliminated, by regulating banks.

But as we show below, there are regulations and regulations. Some are effective. Others are not. And our conclusions about the regulations that we consider should be of interest even to those who insist on real-world relevance. For several are approximations of actual regulations and the others are approximations of regulations that have been proposed either by knowledgeable and serious academics or by worried bank regulators. There is one that requires a minimum cash reserve, another that requires a minimum (secondary) reserve of, say, near-term Treasury securities, another that limits the kinds of assets that banks may hold and yet another that specifies a minimum capital-asset ratio. We also consider a regulation that requires hard-pressed banks wanting discount-window loans to pay a penalty rate and another that limits "liability management" or "reliance on borrowed (negotiated or interest-sensitive) funds."

II. SOME PRELIMINARIES

In this section we set out some assumptions and definitions and, for the benefit of those if any who are not familiar with state-preference theory, describe what in this paper we take to be the economic process. Then in section III we set out other of our assumptions and derive the profit function that in its several variants we use in determining various banking industry equilibria.

The Economic Process

As we suppose, there are n possible states of the world, indexed by j ($j = 1,2,\ldots,n$). Or to put our assumption differently, there is some exogenous random variable θ that takes on any one of n distinct values. Ours, though, is a partial-equilibrium analysis, so herein θ may be interpreted as, say, an interest rate or an exchange rate, or as a vector of many dimensions, with interest and exchange rates and various other economic variables as its elements. For us, how banks fare depends on θ and any interpretation of θ that makes the dependency plausible serves well enough.

To elaborate, we sketch our conception of the economic process. There are two periods, the prestate period and the poststate period, separated by a random drawing that determines the actual state of the world. In the prestate period banks decide their balance sheets. In particular, they choose portfolios of earning assets. Then the actual state of the world is determined. God draws a number or maybe several from an urn. And then there is a settling up. In the poststate period banks get what their portfolios are worth and, to the extent that they are able, pay off their creditors.

But the poststate value of a portfolio depends on what state of the world has occurred. That is what we meant when above we said that how banks fare depends on θ. And it is the dependency of poststate portfolio values on what state of the world has occurred that the interpretation of θ should make plausible. So θ can be thought of as, for example, a vector representation of the Treasury yield curve. For a bank that has borrowed short and lent long does well or badly depending on which yield curve turns up.

The Nature of Securities

With our conception of the economic process, we naturally think of securities (or portfolios, which are simply bunches of securities) as being conditional claims. What the owner of a security gets depends on what state of the world has occurred. If state 1 has occurred, he gets a certain sum of dollars. If state 2 has occurred, he gets another or possibly the same sum of dollars. And so on for states 3 through n. We refer to those dollar sums, conditional on the state of the world, as state-specific payoffs. And for us a payoff includes not just an interest payment, perhaps negative, but the return of principal as well. Securities can then be represented as vectors of the form $X = (x_1, x_2, \ldots, x_n)$, where x_j is the state-j payoff for the security X, the payoff that is made when state j occurs.

We assume that the state-specific payoffs for each and every security are known to all. Still, there is risk. For in the prestate period, which is when portfolios are chosen, it is not known with certainty what state of the world will occur.

An elementary security is a security that pays one dollar if some particular state of the world occurs and nothing if any other state occurs. And as we assume, there are n such securities available, all different, represented by the vectors $i_1 = (1,0,\ldots,0)$, $i_2 = (0,1,\ldots,0),\ldots,$ $i_n = (0,0,\ldots,1)$. That assumption, undeniably strong, implies that any security or distribution of state-specific payoffs can be bought. Suppose that $n = 2$ and that the desired portfolio is $X = (100,200)$. The purchase of 100 elementary securities i_1 and 200 elementary securities i_2 gives the desired distribution of payoffs.

In our notation, the price of one unit of i_j is $p_j > 0$. And we take the p_j's as being fixed. In a general equilibrium analysis, they (their equilibrium values) would be determined in the prestate period. In our analysis, though, they are parameters. It is not only that an individual bank can buy or sell as many units of i_j as it wants at the price p_j. The banking industry can too. The interpretation is that there is nothing special about bank loans.

The prestate value of the security X, or in other words its purchase price, is then $\Sigma p_j x_j$, where Σ is the summation over all states of the world. Alternatively, the value of X can be represented as the inner product $p \cdot X$, where $p = (p_1,p_2,\ldots,p_n)$. To see that, suppose again that $n = 2$ and consider the portfolio $X = (100,200)$. That portfolio is made up of 100 units of i_1, the value or cost of which is $100p_1$, and 200 units of i_2, the cost of which is $200p_2$. More generally, the value or the cost of obtaining the payoff x_j is $p_j x_j$, since the payoff x_j is the payoff from x_j units of i_j.

A constant security pays the same amount whatever state of the world occurs. That is, if X is a constant security, then $x_j = x$ for all j. And for any constant security, other than some amount of cash, the per dollar payoff is r, which by definition satisfies the equation

$$(1) \qquad r \, \Sigma \, p_j = 1.$$

Since for us a payoff includes the return of principal as well as an interest payment, we assume that $r > 1$, from which it follows that $p_j < 1$ for all j.

Bank Assets and Liabilities

In the prestate period, banks choose their portfolios. Each selects a vector X of state-specific payoffs. Further, each issues deposit liabilities and, if permitted by law, other liabilities as well. And as required by law, each acquires a cash reserve. For the bank with deposit liabilities $D \geq 0$ and other liabilities $C \geq 0$, the cash reserve is R, given by the regulation

$$(R1) \qquad R = \alpha D + \beta C, \qquad 1 \geq \alpha \geq \beta \geq 0.$$ [1/]

So in the poststate period that bank has the sum $x_j + R$ available to meet its commitments, to be defined presently.[2/]

As we have already indicated, we admit of two types of bank liabilities: deposit liabilities, which are like the demand deposits of

U. S. commercial banks; and other liabilities, which can be likened to the time and savings deposits of those banks. Both types of liabilities are securities, though, in our sense of that word. What owners of deposit liabilities and owners of other liabilities get depends on what state of the world has occurred. Actually, as will soon be clear, deposit and other liabilities are quite like real-world bonds.

The state-j payoff per prestate dollar of deposit liabilities is d_j. So a dollar's worth of deposit liabilities is represented (if somewhat incompletely) by the vector $d = (d_1, d_2, \ldots, d_n)$. And the state-j payoff per prestate dollar of other liabilities being c_j, a dollar's worth of other liabilities is represented by the vector $c = (c_1, c_2, \ldots, c_n)$. The d_j's and c_j's, whatever they may be, are known to all in the prestate period.

For deposit and other liabilities, there are also what we refer to as promised payoffs. The purchaser of, say, a dollar's worth of deposit liabilities gets the conditional payoffs of the vector d and in addition is promised d^* dollars in the poststate period, whatever state of the world has occurred. The promised payoff d^* is, as we say, unconditional. The purchaser of a dollar's worth of other liabilities gets the vector c of conditional payoffs and the promise, also unconditional, of c^* dollars in the poststate period.[3/] Our promised payoffs d^* and c^* are then like bond coupons.

The promised payoffs are defined as follows: $d^* = \max d_j$; and $c^* = \max c_j$.[4/] And for a bank (or for banks) with deposit liabilities D and other liabilities C, $s = d^*D + c^*C$ is the promised total poststate payment to or the poststate commitment to the owners of D and C.

As we assume, the vectors d and c are restricted in the following way: if $x_j + R \geq s$, then $d_j = d^*$ and $c_j = c^*$. Or in words: if in state j a bank can afford to make the promised payoffs, then it does so. And that of course is precisely what anyone who has issued bonds does. If he can, he pays what was promised, the coupon amount.

Bankruptcy, Subordination and Payoffs

It will surprise no one that we use the two sums $x_j + R$ and s to distinguish bankruptcy and nonbankruptcy states. If $x_j + R \geq s$, then j is a nonbankruptcy state; and if $x_j + R < s$, then j is a bankruptcy state. In our notation, S_1 is the set of all nonbankruptcy sets and S_2, the complement of S_1, is the set of all bankruptcy states. We will on occasion say that j is in S_1 (S_2) to indicate that j is a nonbankruptcy (bankruptcy) state.

We assume that bankruptcy is costly. There is a reorganization cost σs, where $1 > \sigma > 0$. And that cost is unavoidable. The claims of the owners of deposit and other liabilities are subordinate to the bankruptcy cost.[5/] So if state j is a bankruptcy state, then what a bank has available to meet its commitment to the owners of deposit and other liabilities is the sum $x_j + R - \sigma s$.

We have already set out the first of our subordination rules. But to repeat, it says that the claims of the owners of deposit and other liabilities, which add to the total s, are subordinate to the bankruptcy cost. The second rule says that the claims of those owners are senior to the claims of any other creditors. And those two rules, taken together, restrict bank portfolios as follows: for all j

$$(2) \qquad x_j \geq \begin{cases} s - R & \text{if } R > s \\ 0 \text{ if } & \sigma s \leq R \leq s \\ \sigma s - R & \text{if } R < \sigma s. \end{cases}$$

The interpretation of $x_j < 0$ is easy enough: a bank has chosen a portfolio such that in state j it makes a net payment to someone other than the owners of its deposit and other liabilities.[6/] And now suppose that $R > s$. If $x_j < s - R$ for some j, then $x_j + R < s$ for some j and there is a violation of our second subordination rule. Another creditor is paid, even though the owners of deposit and other liabilities are not paid what was promised.

Similar arguments establish the second and third parts of inequality (2).

Our third subordination rule says that if j is a bankruptcy state and no bank liabilities are insured, then the owners of deposit liabilities and the owners of other liabilities have equal claim on what is available to pay them--namely, $x_j + R - \sigma s$. The two groups share that sum, which by inequality (2) is nonnegative, in proportion to their promised payments, respectively d^*D and c^*C. Appealing to the above-mentioned restriction on the vectors d and c and our first and third subordination rules, we may then write

$$(3) \qquad d_j/d^* = c_j/c^* = \begin{cases} 1 \quad \text{if } x_j + R \geq s \\ \\ (x_j + R - \sigma s)/s \quad \text{if } x_j + R < s. \end{cases}$$

Our fourth and final subordination rule says that if bank liabilities are insured, then in bankruptcy states the insurer gets what with all liabilities uninsured the owners of the insured liabilities would have got. Thus, with only deposit liabilities insured, the insurer gets

$$d_jD = d^*D(x_j + R - \sigma s)/s$$

if j is a bankruptcy state. So c_j/c^* is given by the second of equations (3). Of course, with deposit liabilities insured, $d_j = d^*$ for all j. That is what it means that deposit liabilities are insured.[7/]

We take banks to be corporations, so owners have limited liability. It follows, since owners are residual claimants, that for all j

$$(4) \qquad e_j = \max\,(0,\ x_j + R - s)$$

where e_j is the state-j payoff to the owners of the bank and, as we note for future reference, the j^{th} element of the owners payoff vector E.

<u>Demands for Bank Liabilities</u>

We assume that owners of deposit liabilities are provided certain payments services. That is why, as we remarked above, those liabilities are like real-world demand deposits. But owners of other liabilities are not provided services. So although deposit liabilities are unique, other liabilities are not. They are just like all other securities (all, that is, save deposit liabilities).

We also assume that the banking industry is a monopoly supplier of payments services and therefore of deposit liabilities. But as a supplier of other liabilities, the industry is "small." It is a perfect competitor in the market for all securities other than demand liabilities.

The demand equation for deposit liabilities is

$$(5) \qquad D = f(p \cdot d).$$

The domain of f is $[0,1)$. And f satisfies the following conditions: (i) $f(0) = 0$; (ii) f and $f' \to \infty$ as $p \cdot d \to 1$; and (iii) $(p \cdot d) f'(p \cdot d) > f(p \cdot d)$ for all $p \cdot d > 0$. The inverse of f is g. That is, $p \cdot d = g(D)$.

The demand equation for other liabilities, our version of the perfectly elastic demand curve faced by competitive firms, is

$$(6) \qquad p \cdot c = 1.$$

It is to be taken as a restriction on the c_j's.

It may help in interpreting equations (5) and (6) to consider an individual who has, say, one dollar to invest. With that dollar, he can acquire a portfolio of elementary securities that is worth one dollar. So he will not turn his dollar over to a bank, or buy a dollar's worth of other liabilities, if he does not get in exchange a distribution of state-specific payoffs the value of which is one dollar. That is what equation (6) says.

The individual may, however, buy a dollar's worth of deposit liabilities even if in exchange he gets a distribution of state-specific payoffs that is worth less than one dollar. For he gets not only the distribution of payoffs, but services as well. And presumably he (and everyone else) will want more and more deposit liabilities as the value of the payoffs increases. An increase in that value is a decrease in the cost of the deposit services. So the demand for deposit liabilities is upward sloping. And in the limit, as the value of the payoffs approaches one dollar, the demand becomes perfectly elastic. That too would seem a reasonable assumption. If the payoffs were worth one dollar, then deposit liabilities would dominate all other securities, other liabilities included.

Some Other Banking Regulations

And now, as a last preliminary, we set out those banking regulations that we consider in section V. We think of regulation R1 as always applying, if perhaps with $\alpha = \beta = 0$. So a regulatory scheme is a set of regulations R1 and possibly one or more of the following:

(R2) $p \cdot X \geq (\delta s - R)/r, \qquad \delta \geq 1$

(R3) $C = 0$

(R4) $x_j \geq \varepsilon s - R$ for all j, $\quad 1 \geq \varepsilon \geq 0$

(R5) $x_j \geq \lambda \max x$ for all j, $\quad 1 \geq \lambda \geq 0$

where max x is the maximum of the x_j's.

Although it may not seem to, regulation R2 specifies a minimum amount of bank capital. It says that the prestate value of assets,

$p \cdot X + R/r$, must be at least as great as some multiple $\delta \geq 1$ of the prestate value of the commitment to the owners of deposit and other liabilities. But for given s and r, a restriction on $p \cdot X$ is a restriction on I, which denotes bank capital.

Regulation R3 prohibits banks from issuing other liabilities (for instance, negotiable CDs). We have included it among the regulations we consider because as we understand there are government officials who are (or were) deeply concerned about the "liability management" approach to banking and would therefore put limits on bank liabilities other than, say, demand deposits and passbook accounts. To our knowledge, no bank regulator has ever advocated prohibiting banks from issuing large-denomination CDs so our regulation R3, although it serves us well enough, is perhaps a bit extreme. On occasion, though, the Federal Reserve, by its choice maximum deposit interest rates, has in effect prohibited banks from issuing some kinds of other liabilities. And the restriction on other liabilities that is our regulation R3 can be thought of as resulting from another restriction, namely $c^* < r$. That follows from the definition of c^* and equation (6).

Regulations R4 and R5 are alternative restrictions on bank portfolios. If regulation R4 applies, then for given R a bank's portfolio must be such that whatever state of the world occurs it can meet some fraction of its commitment to the owners of its deposit and other liabilities. One way of complying with that regulation is by holding the appropriate amount of constant securities. That is why we think of it as requiring a secondary reserve of near-term treasury bills. Professor Friedman has in effect proposed [1] that regulation R4 apply and with $\varepsilon = 1$.

Regulation R5 limits the differences between the various state-specific portfolio payoffs. The smallest of those payoffs must be some fraction λ of the largest. As we interpret the regulation, it prohibits banks from holding certain kinds of assets. Thus, with $\lambda > 0$ it rules out the ownership of equities; and it rules out having a portfolio that is heavily weighted with one type of risky loan.

Note that regulation R4 may apply and not be a binding restriction. For some values of ε and in particular for $\varepsilon = 0$, the x_j's are restricted not by the regulation but by inequality (2). And similarly for regulation R5, with $\lambda = 0$, portfolio choice may be effectively restricted by inequality (2), or more fundamentally by our first and second subordination rules. Finally, those rules also imply $p \cdot X \geq (s-R)/r$, so imposing regulation R2 with $\delta = 1$ does not further restrict portfolio choice.

III. THE BASIC PROFIT FUNCTION

Bank profit, denoted by Π, is for us the difference between the prestate value of the bank to its owners and the bank's capital. That is, $\Pi = p \cdot E - I$. And what we want is a relationship between Π and the choice variables X, D and C.

By assumption, the total cost of providing payments services to owners of deposit liabilities is aD, where $a > 0$. And the total cost of insurance is $\gamma(D+C)$, where $\gamma \geq 0$ is the per dollar insurance premium.[8/] The service and insurance costs are paid in the prestate period and therefore since regulation R1 always applies, the bank budget or balance sheet constraint is

$$p \cdot X + R = D + C - (a+\gamma)D - \gamma C + I.$$

Or alternatively

$$(7) \qquad I = p \cdot X - (1-a-\alpha-\gamma)D - (1-\beta-\gamma)C.$$

And by equation (4),

$$p \cdot E = \sum_1 p_j(x_j+R-s)$$

where $\sum_1$ is the summation over all nonbankruptcy states. But if j is a nonbankruptcy state, then $d^* = d_j$ and $c^* = c_j$. So

$$(8) \qquad p \cdot E = \sum_1 p_j[x_j+(\alpha-d_j)D + (\beta-c_j)C];$$

and by equations (7) and (8),

$$(9) \qquad \Pi = (1-a-\alpha-\gamma)D + (1-\beta-\gamma)C - \sum_2 p_j x_j$$

$$+ \sum_1 p_j[\alpha-d_j)D + (\beta-c_j)C]$$

where $\sum_2$ is the summation over all bankruptcy states.

We also have, though, as our variant of the "sources equals uses" identity that for j in S_2

$$(10) \qquad d_j D + c_j C = x_j + R - \sigma s + L_j$$

where $L_j \geq 0$ is the state-j payoff by the government insurer of bank liabilities to the owners of those liabilities. What the owners of deposit liabilities and other liabilities receive, $d_j D + c_j C$, is necessarily the same as what is available to be paid out to them. Nor does it matter whether there is an insurance scheme in force. In either event, equation (10) holds.

If there is no insurance scheme in force, then $L_j = 0$ for all j. And if there is a scheme in force, then $L_j = 0$ for all j in S_1 and $L_j > 0$ for all j in S_2. Thus, $\sum_2 p_j L_j = p \cdot L$, where $L = (L_1, L_2, \ldots, L_n)$. And by equation (10),

$$\sum_2 p_j x_j = -\sum_2 p_j[(\alpha - d_j)D + (\beta - c_j)C] - p \cdot L + \sigma s P_2$$

where $P_2 = \sum_2 P_j$. It follows [see equation (9)] that

$$\Pi = \psi D + [1 - \beta(r-1)/r]C - V - (p \cdot d)D - (p \cdot c)C - \sigma s P_2 \tag{11}$$

where $\psi = 1 - a - \alpha(r-1)/r$ and $V = \gamma(D+C) - p \cdot L$ is the prestate net worth of the government insuring agency. And making use of equations (5) and (6), we may therefore write

$$\Pi = [\psi - g(D)]D - [\beta(r-1)/r]C - V - \sigma s P_2. \tag{12}$$

The RHS of equation (12) is our basic profit function. Although X does not appear therein, it is an argument of the function. For $p \cdot L$ and $\sigma s P_2$ are determined in part by X. But how those terms and X are related depends on what insurance and regulatory schemes are in force. And that being so, there is an appropriate variant of our basic profit function for each of the combined insurance-regulatory schemes that we consider.

Assuming that banks are profit-maximizers, we may use equation (12) to determine competitive and monopolistic banking industry equilibria. Suppose that the industry is made up of one bank. It maximizes the RHS of equation (12) subject to any of the regulations

R2-R5 that apply. And the maximizing values of D (or p·d), C and X that satisfy equations (5) and (6) are the industry equilibrium values.

And if the banking industry is (purely) competitive? Since parameter values are the same for all banks, every bank maximizes the RHS of equation (12) subject to any of the regulations R2-R5 that apply and with p·d and p·c given. The implied first-order conditions can therefore be interpreted as determining optimal industry values. And Π, as given by equation (11) or by equation (12), can be interpreted as industry profit. We do not, however, take the number of banks as given. The competitive banking industry is characterized by unrestricted (free) entry. So there is an entry condition, $\Pi = 0$, where Π is given by equation (12). Together with certain first-order conditions, it determines the competitive industry equilibrium.

IV. THE *LAISSEZ-FAIRE* EQUILIBRIUM

We refer to the banking industry that is made up of (an unknown number of) perfectly competitive banks, each of which issues only uninsured liabilities and is subject only to regulation R1, as the *laissez-faire* banking industry. And we refer to the equilibrium of that industry, which we determine in this section, as the *laissez-faire* equilibrium. For us, that equilibrium is, so to speak, special. Somewhat arbitrarily perhaps, we take it as being optimal and therefore use it in evaluating the equilibria that obtain under various insurance-regulatory schemes.

The Optimal Portfolio

By assumption, there is no insurance scheme in force. Since $\gamma = 0$ and $L_j = 0$ for all j, it follows that V = 0 for any D and C. And by equation (12) we have that X should be chosen so as to minimize $\sigma s P_2$, which is nonnegative. That is what profit maximization requires. So $P_2 = 0$ is optimal. With none of its liabilities insured and subject only to regulation R1, the profit maximizing bank chooses a portfolio such that for it there are no bankruptcy states. Any X such that $x_j + R \geq s$ is optimal. And the bank's liabilities, although uninsured, are nevertheless safe.

Equilibrium Liability Totals

If $\beta > 0$, then $\beta(r-1)/r > 0$ and by equation (12) we have $\hat{C} = 0$, where $\hat{C}$ is the laissez-faire equilibrium value of C. If $\beta = 0$, then Π is independent of C and $\hat{C}$ may be any nonnegative value. It follows then from equations (12) and (5) that

$$(13) \qquad \Pi = (\psi - p\cdot d)f(p\cdot d)$$

where now Π is industry profit. But for a competitive banking industry, since entry is unrestricted, $\Pi = 0$. So $\widehat{p\cdot d} = \psi$ and $\hat{D} = f(\psi)$, where $\widehat{p\cdot d}$ and $\hat{D}$ are respectively the laissez-faire equilibrium values of $p\cdot d$ and D.[9/]

By the conditions imposed on the function f, the condition $1 > \psi > 0$ is necessary and sufficient for the existence of a unique and positive laissez-faire equilibrium value of D.

It can reasonably be argued, though, that the adjective laissez-faire is inappropriate if banks are subject to regulation R1 and α is positive. Be that as it may, if $\alpha = \beta = 0$, then $\hat{D} = f(1-a)$ and the existence condition, necessary and sufficient, is $1 > a > 0$. Moreover, $\hat{C}$ is then indeterminate.

A Monopoly Bank

If the banking industry is made up of one bank that issues only uninsured liabilities and is subject only to regulation R1, then the equilibrium value of $p \cdot d$, denoted by $\widetilde{p \cdot d}$, is that which maximizes the Π of equation (13). For the monopoly bank's optimal X is such that $P_2 = 0$. And as for the perfectly competitive bank, either the optimal C is zero or C can be any value. As is easily proved, if $\psi > 0$, then there exists a unique and positive $\widetilde{p \cdot d}$ such that $\tilde{D} = f(\widetilde{p \cdot d}) < f(\widehat{p \cdot d}) = \hat{D}$. Thus, on our assumptions, a monopoly bank charges "too much" for the services provided owners of deposit liabilities. That conclusion is reassuring. Had we come to another, we would have had to be suspicious of our assumptions.

A Unique General Equilibrium

We have done what we said we were going to do in this section--namely, determine the *laissez-faire* equilibrium. That equilibrium is, however, not unique. There are many optimal portfolios; and if $\beta = 0$, the equilibrium total of other liabilities may be any nonnegative number. Since it may bother some that the *laissez-faire* equilibrium is not unique, we pause to explain why there is nothing to be bothered about.

Our point is that the *laissez-faire* equilibrium being indeterminate is quite consistent with there being a unique general equilibrium. Suppose that with some optimal banking industry portfolio, some total of other liabilities and a given total of deposit liabilities, $\hat{p}$ is a market clearing price vector. (At $p = \hat{p}$, all aggregate excess demands for state-specific payoffs are zero.) Then for the same total of deposit liabilities, any other optimal portfolio and any total of other liabilities, $\hat{p}$ is a market clearing price vector.

The argument is straightforward, hardly more than a rephrasing of the familiar observation that banks are financial intermediaries. Consider the owners of bank equities and the deposit and other liabilities of the banks. As a group, they have a portfolio that is made up of the banking industry's portfolio, which they own indirectly, and another that is directly owned. That being so, their portfolio does not have to change when the banking industry's portfolio changes or when the total of other liabilities changes. And if it is assumed that for each p there is one and only one optimal distribution of state-specific payoffs, that portfolio does not change. What changes when the banking industry's portfolio changes, or when the total of other liabilities changes, is the directly owned portfolio, and in such a way as to leave the portfolio unchanged at $p = \hat{p}$. It follows that for any (optimal) banking industry portfolio and any total of other liabilities, $\hat{p}$ is a market clearing price vector.

V. SOME ALTERNATIVE EQUILIBRIA

And now, having determined the laissez-faire equilibrium, we turn to the task of appraising alternative insurance-regulatory schemes. Is there an industry equilibrium? And if so, is it the same as the laissez-faire equilibrium? For all values of the parameters (if any) of those regulations that apply? Or only some? Or none? For each of the schemes that we consider, we ask those questions and in our fashion answer them.

A Variable Insurance Premium

The first of our insurance-regulatory schemes approximates in part that urged by Professor Meltzer [4]. Of all the regulations R1-R5, only regulation R1 applies. And bank liabilities (deposit liabilities or deposit and other liabilities, it makes no difference) are insured, but γ, the per dollar insurance premium, is variable. Each bank pays a premium such that $V = 0$ for any choice of X, D and C.

The relevant profit function is therefore precisely that of the laissez-faire banking industry; and although bank liabilities are insured, the industry equilibrium is the same as the laissez-faire equilibrium. In particular, the equilibrium X is such that there are no bankruptcy states. So in equilibrium $\gamma = p \cdot L/(D+C) = 0$ and in a very real sense bank liabilities, if free of default risk, are not insured.[10/]

But if there is a right or proper insurance premium (or better, insurance premium schedule), the fact remains that the premium charged by the FDIC is fixed, not variable. It is the same for all member banks and in particular is independent of X, D and C. That being so, we proceed now to consideration of two FDIC-type insurance-regulatory schemes. Under the first, all bank liabilities are insured at a fixed per dollar premium γ and regulations R1-R4 apply. Under the second, all bank liabilities are insured at that same premium and regulations R1-R3 and R5 apply. With either scheme in force, banks are prohibited from issuing other liabilities. But in the next section we show that certain of the conclusions of this section also hold when regulation R3 does not apply. And toward the end of this paper we comment on the simplifying assumption, used in what remains of this section and in the next, that there is perfect compliance with all regulations that apply, achieved at no cost.

When Regulations R1-R4 Apply

The immediate task is to derive the profit function that obtains when bank liabilities are insured at the fixed per dollar premium γ and regulations R1-R4 apply. It is convenient to get Π as a function of $p\cdot d$, which with deposit liabilities insured is equal to d^*/r. All we have to do [see equation (12)] is eliminate X as a determinant of the term $p\cdot L - \sigma s P_2$, which from now on we denote by Y. To do that, we find the X, as a function of $p\cdot d$, that maximizes Y. That is obviously the thing to do, for Π is increasing in Y.

On our present assumptions, $d_j D = d^* D = s$ for all j. And since $\sum_2 p_j L_j = p\cdot L$, it follows from equation (10) that

$$(14) \qquad Y = (s-R)P_2 - \sum_2 p_j x_j .$$

But if $s \leq R$, then by inequality (2), which always applies, there are no bankruptcy states. S_2 is empty and therefore $P_2 = Y = 0$.

And if $s > R$? Given S_2, Y is decreasing in x_j for all j in S_2. Thus, an optimal X is such that x_j is a minimum for all j in S_2. That is, $x_j = \min x$ for all j in S_2, where min x is the minimum of the x_j's. What min x is, though, depends on whether inequality (2) or regulation R4 is binding. It is given by

$$(15) \qquad \min x = \max (0, \sigma s - R, \varepsilon s - R).$$

But in any event, for the optimal X, $Y = (s-R-\min x)P_2$.

Evidently, if $\varepsilon = 1$, then again S_2 is empty and $Y = 0$. If $\varepsilon < 1$, though, then bankruptcy is possible. And profit maximization requires that P_2 be a maximum or that $P_2 = 1/r - \min p$, where min p is the minimum of the p_j's. So the optimal Y is

$$\hat{Y} = (s-R-\min x)(1/r-\min p).$$

Note that $\hat{Y}$ does not depend on δ, the parameter of regulation R2 which specifies the required minimum amount of bank capital. With $s > R$ and $\varepsilon < 1$, there is one nonbankruptcy state and all that δ determines is a lower bound for the x_j of that state. An increase in the minimum capital-asset ratio does not then lessen the risk of bankruptcy.

Since $d^* - \alpha$ is necessarily of the same sign as $s - R$ for all $D > 0$, we may in summary write

$$(16) \qquad \Pi = \begin{cases} (\psi-\gamma-d^*/r)D & \text{if } d^* \leq \alpha \text{ or } \varepsilon = 1 \\ \\ (\psi-\gamma-d^*/r)D + \hat{Y} & \text{if } d^* > \alpha \text{ and } \varepsilon < 1 \end{cases}$$

where again Π is industry profit. So we have the profit function that obtains under the first of our FDIC-type insurance-regulatory schemes. And it follows that $\psi > 0$ is not sufficient for the existence of a positive industry equilibrium. Suppose that $\varepsilon = 1$. By equation (16), the competitive equilibrium value of d^* is $r(\psi-\gamma)$, which need not be positive. That is by way of saying that with $\varepsilon = 1$, the insurance premium may be a prohibitive tax. Or suppose that $\varepsilon < 1$ and further, as is possible with $\psi > 0$, that

$$\lim_{d^* \to r} \quad \psi - \gamma - d^*/r + \hat{Y}/D \geq 0.$$

Then there exists no admissible d* satisfying the entry condition $\Pi = 0$. (Nor perhaps an admissible d* that maximizes Π.) An indefinitely large subsidy is possible and there may therefore be no (finite) equilibrium total of deposit liabilities.

Imagine, though, that a positive competitive equilibrium does exist. For $\gamma > 0$, that equilibrium is not the same as the *laissez-faire* equilibrium. If $\Pi = 0$ along the upper branch of the profit function, then the equilibrium total of deposit liabilities is less than the *laissez-faire* total. A positive γ is a net tax. And if $\Pi = 0$ along the lower branch, then (for any γ) there are bankruptcy states and with a rather high probability bankruptcy costs are incurred.

We may then conclude that the equilibrium that obtains under the first of our FDIC-type insurance-regulatory schemes is optimal, the same as the *laissez-faire* equilibrium, only if $\varepsilon = 1$ and $\gamma = 0$, or only if regulation makes bank liabilities safe and those liabilities are only nominally insured ($p \cdot L = \gamma = 0$).

The Second Scheme

We assume now that regulations R1-R3 and R5 apply and, as immediately above, that bank liabilities are insured at a fixed per dollar premium γ. So a feasible X satisfies regulations R2 and R5. And we have the following proposition, proved in appendix A of this paper: If there is no feasible X such that there are bankruptcy states, then any feasible X is optimal; but if there is a feasible X such that there are bankruptcy states and if $\lambda > \sigma$, then the optimal X satisfies regulation R2 with equality, is constant for all j in S_1 with x_j = max x and constant for all j in S_2 with x_j = min x = λ max x. The optimal S_2 is not necessarily empty, though; nor does it necessarily contain all states save one. Under the second of our FDIC-type insurance-regulatory schemes, there can be sereral nonbankruptcy and bankruptcy states.

We also have (again, see appendix A) that

$$\Pi \begin{cases} = (\psi-\gamma-d^*/r)D & \text{if } d^* \leq \alpha \text{ or } G(\min p) \leq 0 \\ \\ \leq \{\psi-\gamma-d^*/r + [(d^*-\alpha)^{\frac{1}{2}} - (\xi_1\lambda r)^{\frac{1}{2}}]^2/r(1-\lambda)\}D & \\ & \text{if } d^* > \alpha \text{ and } G(\min p) > 0 \end{cases}$$

where $\xi_1 = (\delta d^*-\alpha)/r$ and

$$G(\min p) = d^* - \alpha - \xi_1\lambda/[1/r-(1-\lambda) \min p].$$

It suffices for the existence of a positive industry equilibrium (i) that the upper-branch coefficient of D, evaluated at $d^* = 0$, be positive and (ii) that the lower-branch coefficient, evaluated at $d^* = r$, be negative. If $\psi > 0$, the condition is not necessarily satisfied for arbitrary values of γ and the regulatory parameters α, δ and λ. But as is easily shown, there are values of all those parameters for which it is satisfied.

The equilibrium that obtains under the second of our FDIC-type insurance-regulatory schemes is optimal only if the regulatory parameters are such that there are no bankruptcy states and $\gamma = 0$. And there are values of δ and λ that make bankruptcy impossible.11/ Since regulation R2 applies, $\max x \geq \delta s - R$. And since regulation R5 also applies,

$$x_j \geq \lambda \max x \geq \lambda (\delta s - R) \qquad \text{for all } j.$$

But if $x_j \geq s - R$ for all j, then S_2 is empty. So for all admissible δ and λ satisfying the inequality

$$\lambda \geq (s-r)/(\delta s-R)$$

S_2 is empty. In particular, if $\lambda = 1$, then for any admissible δ deposit liabilities are safe. And given any $\lambda > 0$, there is some value of δ, say δ_0, such that for $\delta \geq \delta_0$ those liabilities are safe. Thus, with regulation R5 applying and $\lambda > 0$, the threat of bankruptcy can be eliminated by requiring banks to have sufficient amounts of capital.

VI. OTHER LIABILITIES ALLOWED

And when regulation R3 does not apply? What then? Unfortunately, that question has thus far proved rather too difficult for us. It was easy enough to derive the profit functions that obtain when regulation R3 does not apply and other liabilities, like deposit liabilities, are insured. We have not yet succeeded, though, in deriving those that obtain when other liabilities are not insured. But perhaps it is so, as someone somewhere must surely have said, that an incomplete answer is better than no answer at all.

When Regulation R3 Does Not Apply

Above, we showed that with regulation R3 applying and deposit liabilities insured at the fixed per dollar premium $\gamma > 0$, the banking industry equilibrium is not optimal. But with regulation R3 not applying, it is also so that $\gamma > 0$ yields a suboptimal equilibrium. Nor does it matter whether other liabilities are insured. If the optimal (and hence the equilibrium) X is such that there is bankruptcy in some states of the world, then the equilibrium is not optimal. And if the optimal X is such that there are no bankruptcy states, then $p \cdot L = \sigma s P_2 = 0$, from which it follows [see equation (12)] that in equilibrium $d^* < r\psi = \hat{d}^*$ for any $\gamma > 0$.

How Binding a Regulation?

There is, though, an obvious question: Is regulation R3 ever binding? As we now show, it can be; $\epsilon = 0$ is not always optimal.

If regulation R3 does not apply but regulation R1 does and if all bank liabilities, deposit and other, are insured at the fixed premium γ, then $c_j = c^* = r$ for all j and

$$Y = (s-R)P_2 - \sum_{2} p_j x_j$$

where $s = d^*D + rC$. And if regulations R2 and R3 also apply, then

$$\Pi = \begin{cases} \Pi_0 & \text{if } s \leq R \text{ or } \varepsilon = 1 \\ \Pi_0 - [\beta(r-1/r+\gamma]C + \hat{Y} & \text{if } s > R \text{ and } \varepsilon < 1 \end{cases}$$

where $\Pi_0 = (\psi-\gamma-d^*/r)D$ and where

$$\hat{Y} = (s\text{-}R\text{-}\min x)(1/r\text{-}\min p)$$

and, as above,

$$\min x = \max (0, \varepsilon s\text{-}R, \sigma s\text{-}R).$$ [12/]

But then, as is readily verified, over some region of the parameter space there is no optimal C. (For any initial total of other liabilities, having more gives greater profit.) If $\varepsilon < 1$, then there must exist a value of C, say C_0, such that for $C \geq C_0$ profit is given by the lower branch of the profit function. And it is certainly possible to choose parameters suśh that the lower-branch coefficient of C is positive.[13/]

Moreover, if all liabilities are insured at a fixed premium and regulations R1, R2 and R5 apply, then again there may be no optimal C.[14/] And thus with deposit and other liabilities insured at a fixed premium, a regulation in the spirit of our regulation R3, one that specifies an upper limit for other liabilities, may be necessary to keep the banking industry and the insuring agency's liability finite.

<u>With Uninsured Other Liabilities</u>

Even if other liabilities are uninsured, C = 0 is not necessarily optimal. That is to say, regulation R3 may be binding (and by limiting $p \cdot L$, may protect the insuring agency). It can be shown by example that there are parameter values such that with regulation R3 not applying and other liabilities uninsured, the profit maximizing bank will have some positive amount of such liabilities on its books.[15/] And its portfolio will be such that in some states of the world it is bankrupt.[16/] Simply keeping other liabilities uninsured does not then eliminate the threat of bankruptcy.

If other liabilities are uninsured, there may, though, be an alternative to imposing regulation R3: namely, making the claim of the owners of other liabilities subordinate to the claims of the owners of deposit liabilities and thereby in bankruptcy states to the claim of the insuring agency. If that claim is subordinate, then for certain parameter values $C = 0$ is optimal and $p \cdot L$ is what it would be with regulation R3 applying. That is proved in appendix B.

VII. AN EMERGENCY LENDING RATE

On May 9, 1974 the Federal Reserve Bank of New York began its "rescue" of Franklin National Bank with a discount-window loan of $125 million. But Franklin was not an easily satisfied customer. In a very few weeks the New York Bank's loan increased to more than $1 billion. And through the summer it averaged something like $1.5 billion. (On October 8, 1974, the day Franklin was declared insolvent by the Comptroller of the Currency, its indebtedness was $1.72 billion.) It is therefore not surprising that outsiders, among them Senator Proxmire and Professor Friedman [3], should have interested themselves in what was going on and ended up by publicly charging the System with giving away taxpayers' money. The System, evidently stung by its critics, responded by revising its Regulation A (Extension of Credit by Federal Reserve Banks), thereby making it possible for Reserve Banks to charge a penalty rate on emergency loans to member banks--on relatively large loans, that is, of relatively long duration made in exceptional circumstances.[17/] And on September 26, the day after the revised regulations went into effect, the New York Bank, mindful that the Federal funds rate had been averaging about 11 percent, increased the rate of its discount-window loan to Franklin from roughly 8.5 percent to 10 percent.

And there may have been some in the System who thought that with a penalty rate on emergency loans, other banks would be dissuaded from taking risks comparable to those taken by Franklin. That, though, is not so. Charging a penalty rate, however much greater than the base (Section 13) discount rate it may be, does not dissuade banks from holding very risky portfolios. The optimal portfolio is independent of the rate charged on emergency discount-window loans.

Why lend to a bank in real difficulty, to a bank that in the judgment of private lenders has already gone bust? There would seem to be two possible objectives: to save it; or to keep its doors open just long enough for some or all owners of uninsured liabilities to be paid off. And since Franklin National was allowed to fail, we take it that the System's objective is to in effect insure large-denomination CDs.[18/]

Nor is that necessarily an unworthy objective. No one who believes that an epidemic of bank failures would be costly should find fault with the System for having lent to Franklin. Had it defaulted on its large-denomination CDs, there surely would have been a run on many other banks. System emergency lending is properly thought of as a supplement to the FDIC insurance scheme. And indeed a necessary supplement, since all or nearly all bank liabilities must be insured if an insurance scheme is to eliminate the risk of a bank panic.

But that is by the way. The proposition to be established is, as we said, that the optimal portfolio is independent of the rate charged on emergency loans. When a bank gets an emergency loan, the value of the bank to its owners does not increase. Independent of what rate is charged, that is so. In effect, the System pays off the uninsured creditors.[19/] It pays nothing, though, to the owners of the bank. Nor does the value of the bank to its owners decrease. Independent of the rate charged on the emergency loan, that too is so. Only if a bank has already gone bust does it take an emergency loan from the System. Were it not bankrupt, it would need no help in paying off creditors. But there is limited liability. Owners do not ante up more or less, depending on the rate at which the emergency loan was granted.

In truth, the System makes emergency loans not to banks but to the FDIC. In the brief period between bankruptcy and the official declaration of insolvency, a bank may be nominally responsible for its emergency loan. It is, however, the FDIC that gets the loan. It pays the interest. The owners of the bank do not.

So $p \cdot E$ is independent of the rate charged on emergency loans. And therefore X is too. If some portfolio X maximizes $p \cdot E$ at a given emergency lending rate, it maximizes $p \cdot E$ at any rate.

We do not say, though, that the System should not have revised its Regulation A. If the objective in making emergency loans were to rescue banks that have already failed, then revising the regulation would have been a waste of time. To save a bank, it is necessary to make it a subsidy loan, a loan at less than the safe rate of interest. So why worry about what rate is charged? Charging a higher rate means only that the maturity and/or the amount of the loan must be increased.

But again, the System's objective in making emergency loans is apparently only to make uninsured liabilities safe. And that being so, it should have revised its regulation. It is important that the FDIC be charged the proper rate--the safe rate, whatever it may be at the moment the emergency loan is made. Charging a lower rate amounts, as others have alleged, to having taxpayers subsidize bank creditors.

And we do not say that it is of no consequence whether there is an emergency lending program. Having such a program amounts, as we observed above, to insuring uninsured liabilities. And it may make a considerable difference whether other liabilities are insured. What makes no difference, at least for prestate portfolio choices, is the rate charged on emergency loans.

VIII. IN CONCLUSION

We do not in this final section restate our various conclusions, but instead comment briefly on one of our assumptions and then argue against making the central bank responsible for insuring some or all bank liabilities.

Compliance a Problem

In section II we introduced a rather extreme assumption: the distributions of state-specific returns associated with all the various securities are known to all. More particularly, everyone knows what portfolio the several banks own. And without anyone having spent so much as a penny. We could have assumed, though, that there is a cost to finding out about bank portfolios and that the cost of being certain about those portfolios is actually paid by the private sector. Had we made that assumption, we would have come to conclusions essentially the same as those established in sections V - VII.

If it is assumed that the private sector pays something to find out what portfolios banks own, then it must also be assumed that compliance with regulations is achieved at a cost. Some maybe would argue that information about bank portfolios is produced at decreasing average cost and that therefore bank examination is a natural responsibility of government. Perhaps, although it is not clear to us why a private firm might not then collect and disseminate information about banks. Is a government agency to be trusted more than a private firm? It would have been easier ten years ago than it is now to argue that. To our minds, the most plausible assumption is that the costs of private and government examination of banks are the same. And on that assumption, the optimal fixed insurance premium is not zero, but rather such that premium income covers the cost of enforcing regulations. If that premium is charged and banks are sufficiently restricted by regulation, then the equilibrium that obtains is the same as the *laissez-faire* equilibrium.

Perhaps, however, what should be assumed is that there is a production function subject to which information about bank portfolios is produced and that every individual decides for himself how much to spend on information. And it maybe should be assumed that complete and certain knowledge is quite out of the question. What sum would be required to guarantee against fraud? Even if it is assumed that complete and certain knowledge can be purchased, lenders may not choose to spend what is required. So the liabilities of a *laissez-faire* banking industry may be only nearly safe. We are doubtful about that as a good defense of insuring bank liabilities. But we could easily be wrong and would leave to others the task of working out the implications of an information assumption that is more realistic than the one we used.

Bank Examination

But now, having commented briefly on our information assumption, we cannot forego saying a little something about bank examinations. If bank liabilities are uninsured, then everyone is his own bank examiner. If bank liabilities are insured, though, then the government as insurer is a creditor of banks and must therefore enforce those regulations that apply and limit its liability. And that as we understand is the purpose of bank examinations, to make sure that regulations are being obeyed.

What is troubling is the suggestion that bank examiners ought to concentrate on banks that have been doing poorly, on banks that, say, have experienced losses and/or whose market values have decreased. To be sure, examiners have to look into the affairs of such banks. Not doing so could cost the government plenty, for the owners of a bank that has already gone bust have an incentive to hide that fact from the insuring agency. They have everything to gain and nothing to lose from taking greater risks than they had been. But if bank examiners have to look into the affairs of banks that have been doing poorly, they should not ignore those that have been doing well. Think of an insurance company that has guaranteed a manufacturer against fire loss, but under a contract that calls for the installation of fire-prevention devices of certain quality. Would that company take good profits as evidence enough that the manufacturer had installed those devices? It would be more justified in interpreting the good profits as evidence that its customer had conveniently forgot. And a bank may have an impressive bottom line precisely because it has not been obeying regulations.

The Central Bank as Insurer

Unlike we two, some may find it easy to defend having government insure bank liabilities. For those who do, we have now provided a justification for bank regulation (and examination). If bank liabilities are insured at a variable premium, then only bank examination is required. Regulation is not. If, however, bank liabilities are insured at a fixed premium, as in the U.S., then regulation is required. Experience suggests that the alternative may well be having the central bank guarantee bank liabilities (or what comes to the same thing, the solvency of the insuring agency). And not by doing what the Federal Reserve did after Franklin National had been declared bankrupt by private lenders, but by altering its monetary policy.[20]

Early on, we introduced the variable θ, saying that it could be interpreted in a variety of ways: as an interest rate; or as an exchange rate; or as a vector of interest and/or exchange rates and perhaps other economic variables as well. And we said that θ is determined by God. We know, though, that central banks are not above playing God and it may be that the central bank can determine θ, or that by its choice of policy it largely determines the probability distribution of θ. That amounts to saying that the central bank can make bank liabilities safe (or nearly so). If there is in effect only one state of the world, then the probability of numerous bank failures is zero.

We believe it is arguable that the central bank can determine θ. Can it peg an interest rate or a yield curve? One or several exchange rates? In some representations of the world, it cannot. Or not for long. We would certainly agree, though, that in the past some central banks have behaved as if they could set interest and/or exchange rates. And what they believe, right or wrong, is what matters. For it is surely true that the policy rule that makes bank liabilities safe is not necessarily the optimal stabilization rule. Pegging an interest rate or the Treasury yield curve may not give the most desirable price-level path. The historical record would seem to suggest that making bank liabilities safe and, say, keeping the price-level constant are conflicting objectives.

It cannot be maintained that since the United States has its FDIC, there is no need to worry about the Federal Reserve being diverted. It was after all diverted in early 1966 and again, if briefly, at the time of the collapse of Penn Central. Had money demand followed its predicted path, it likely would have been in 1975-76. As was suggested above, the world has passed the FDIC by; there are now substantial amounts of bank liabilities that are not insured. And if all bank liabilities were insured by the FDIC, the System would have to be concerned about its solvency.

We do not say that the central bank should regulate banks, that it should decide what regulations there ought to be and be responsible for checking up on banks. It maybe should be, since it would have incentive enough to do well. But then the insuring agency would too. It is perhaps less important, though, which agency of government does the regulating than that there be sufficiently severe regulations in force.

APPENDIX A

Suppose that all bank liabilities are insured at a fixed per dollar premium and either that regulations R1-R3 and R5 apply or that regulations R1, R2 and R5 apply. Then any feasible X is optimal if there is no feasible X such that $Y > 0$. But if there does exist a feasible X such that $Y > 0$ and if $\lambda > \sigma$, then the optimal X (i) satisfies regulation R2 with equality, (ii) is constant for all j in S_1 with $x_j = \max x$ and (iii) is constant for all j in S_2 with $x_j = \min x = \lambda \max x$. That is what we alleged above and in this appendix we provide a proof of the proposition (or rather the second part, for the proof of the first part is trivial). And after having done that, we derive an upper bound for the profit function that obtains when bank liabilities are insured at a fixed premium and regulations R1-R3 and R5 apply.

If regulations R1, R2 and R5 apply and if $\lambda > \sigma$, then whether or not regulation R3 applies

$$Y = (s-R-\lambda \max x)P_2 - \sum_2 p_j z_j$$

where $z_j = x_j - \lambda \max x$, $j = 1,2,\ldots,n$. And here it is convenient to write regulation R2 as follows:

$$p \cdot X \geq \Omega \equiv \xi_1 D + \xi_2 C$$

where $\xi_1 = (\delta d^* - \alpha)/r$ and $\xi_2 = (\delta c^* - \beta)/r$. As is easily verified, $Y > 0$ implies $\Omega > 0$.

By hypothesis, there exists an X, say $\overline{X} = (\overline{x}_1,\overline{x}_2,\ldots,\overline{x}_n)$, such that $Y > 0$. For $\overline{X}$, the sets of nonbankruptcy and bankruptcy states are respectively $\overline{S}_1$ and $\overline{S}_2$; and further, $\sum_i p_j = \overline{P}_i$, i=1,2. So we may write

$$\overline{Y} = (s-R-\lambda \max \overline{x}^*)P_2 - \sum_2 p_j\overline{z}_j$$

where $\overline{z}_j = \overline{x}_j - \lambda \max \overline{x}$.

Now, consider the portfolio $\hat{X}$ defined by

$$\hat{x}_j = \begin{cases} \Omega/(\overline{P}_1+\lambda\overline{P}_2) \text{ for } j \text{ in } \overline{S}_1 \\ \\ \lambda\Omega/(\overline{P}_1+\lambda\overline{P}_2) \text{ for } j \text{ in } \overline{S}_2. \end{cases}$$

Since there does exist an X, namely $\overline{X}$, such that $Y > 0$, it must be that $s > R$ and therefore that $\Omega > 0$. So $\hat{X}$ is feasible. Further, as we now show, $\overline{S}_i = \hat{S}_i$, i=1,2, where $\hat{S}_1$ and $\hat{S}_2$ are respectively the sets of nonbankruptcy and bankruptcy states when $X = \hat{X}$.

From equation (1) of the text, $\overline{P}_1 + \lambda\overline{P}_2 \leq 1/r$. Hence $\hat{x}_j \geq r\Omega$ for all j in $\overline{S}_1$. So by the definition of Ω, $\overline{S}_1 \subseteq \hat{S}_1$. And if $\lambda = 0$, then $\overline{S}_2 \subseteq \hat{S}_2$. So we have only to consider the case $\lambda > 0$. By the feasibility of $\overline{X}$,

$$\text{(A1)} \qquad \lambda\sum_1 p_j\overline{x}_j + \lambda\sum_2 p_j\overline{x}_j \geq \lambda\Omega.$$

But since $\overline{Y} > 0$, $\overline{x}_j < r\Omega$ for some j. And since $\overline{x}_j \geq \lambda \max x$ for all j, $\lambda \max \overline{x} < r\Omega$. So $\lambda\overline{x}_j < r\Omega$ for all j and in particular for all j in $\overline{S}_1$. Moreover, $\lambda\overline{x}_j < \lambda r\Omega$ for all j in $\overline{S}_2$ and therefore by equation (A1)

$$r\Omega > \lambda\Omega/(\overline{P}_1+\lambda\overline{P}_2).$$

It follows that if j is in $\overline{S}_2$, then $\hat{x}_j < r\Omega$ and j is in $\hat{S}_2$. Thus, $\lambda \geq 0$ implies $\overline{S}_2 \subseteq \hat{S}_2$.

So we have that $\overline{S}_i = \hat{S}_i$, i=1,2. And since $\hat{z}_j = 0$ for all j in $\overline{S}_2 = \hat{S}_2$, it follows from the definition of p·L that

$$\hat{Y} - \overline{Y} = \lambda[\max \overline{x}-\Omega/(\overline{P}_1+\lambda\overline{P}_2)]\overline{P}_2 + \sum_2 p_j\overline{z}_j.$$

The feasibility of $\overline{X}$ implies that both terms on the RHS are non-negative. Thus, $\hat{Y} \geq \overline{Y}$ and $\overline{X}$ is optimal only if it satisfies the conditions (i) - (iii) of the proposition.

If regulation R3 applies, along with regulations R1, R2 and R5, then for the optimal X

$$Y = [(d^*-\alpha)-\lambda\xi_1/\xi]P_2D \equiv G(P_2)P_2D$$

where $\xi = 1/r - (1-\lambda)P_2$. Clearly, $Y > 0$ only if $G(P_2) > 0$. But $G(P_2)$ is decreasing in P_2. So $Y > 0$ only if $G(\min p) > 0$. If $G(\min p) \leq 0$, then $Y = 0$ for all feasible X and any feasible X is optimal.

For $G(\min p) > 0$, the function $G(y)y$ defined on the interval $[0,1/r]$ is differentiable, concave, increasing at $y = 0$ and decreasing at $y = 1/r$. Thus, an upper bound for $G(P_2)P_2$ is $G(y_0)y_0$, where

$$y_0 = 1/r - [\lambda\xi_1/r(d^*-\alpha)]/(1-\lambda)$$

is the solution of the equation $\partial[G(y)y]\partial y = 0$. And the profit function that obtains when bank liabilities are insured and regulations R1-R3 and R5 apply is bounded as indicated in the text.

APPENDIX B

Suppose that regulation R3 does not apply and further that the claims of the owners of other liabilities are subordinate to those of the owners of deposit liabilities (but not to those of other creditors, if such there be). And let

$$X(C) = (x_1(C), x_2(C), \ldots, x_n(C))$$

be any feasible portfolio.[21/] Then, since deposit liabilities are insured

$$L_j(C) = d^*D - x_j(C) - R(C) - \sigma s(C) > 0$$

for all j in S_2. And consequently

$$Y(C) = \sum_2 p_j[d^*D - x_j(C) - R(C)].$$

Now, let S_2 be partitioned into two sets, S_2' and S_2'', either or both of which may be empty. For all j in S_2'

$$d^*D \geq x_j(C) + R(C)$$

and for all j in S_2''

$$d^*D < x_j(C) + R(C).$$

It follows that

$$Y(C) \leq \sum_{S_2'} p_j[d^*D - x_j(C) - R(C)].$$

But $R(C) \geq R(0)$. And since X(C) is feasible, there must exist a feasible portfolio X(0) such that $x_j(C) \geq x_j(0)$ for all j in S_2'.[22/]

And consequently $Y(C) \leq Y(0) \leq \hat{Y}(0)$, where $\hat{Y}(0)$ is the optimal value of $Y(0)$, the value implied by $\hat{X}(0)$, the portfolio that is optimal for $C = 0$.

It follows [see equation (12) of the text] that zero is an optimal value for C. Moreover, for certain choices of parameters, zero is the unique optimal value (and therefore making the claims of the owners of other liabilities subordinate substitutes for imposing regulation R3). It is if $\beta > 0$ or if $\gamma > 0$. Or if min x is strictly increasing in C. Then $Y(C) < \hat{Y}(0)$ and zero is the unique optimal value.

FOOTNOTES

1. We should perhaps have written regulation R1 as follows: $R \geq \alpha D + \beta C$. With $r > 1$, though, the profit maximizing bank satisfies that version of the regulation with equality. The restriction $\alpha \geq \beta$, if in a way arbitrary, is also realistic.

2. Note that D and C are prestate dollar totals. But R is both a prestate dollar total and for all j the state-j payoff obtained by holding R prestate dollars in cash. That is, an amount of cash R, viewed as a security, is represented by the vector (R,R,...,R). In our nomenclature, the amount of cash R is a constant security, but with a per dollar payoff of unity.

3. Since the d_j's and c_j's are known, the promises are in a very real sense empty. The promised payoffs are, though, convenient fictions. Having introduced them, we can define bankruptcy in the conventional way.

4. Those definitions and the definition of bankruptcy, given below, imply that there is at least one nonbankruptcy state. It seems reasonable, though, that there should be at least one.

5. Those who are familiar with the modern corporate finance literature will appreciate the importance of the assumption of an unavoidable cost of bankruptcy. With no such cost, the debt-equity ratio is indeterminate. The well-known Modigliani-Miller theorem [5,6] is valid. With such a cost, though, there is a

determinate ratio. And for us the assumption is critical. It gives us the most important result of section IV: that absent deposit insurance and regulation, there are no bankruptcy states. But if it is assumed that there is no bankruptcy cost, then there is an indeterminate number of such states.

6. It may seem strange, a bank having a portfolio such that in some state(s) it pays off other creditors. And indeed if banks were, for example, limited to holding ordinary bonds and loans, then restricting portfolio payoffs to be nonnegative would be natural. But an unregulated bank may have an uncovered foreign exchange position or be short equities. So negative payoffs cannot be dismissed as an absurdity.

7. And with deposit and other liabilities insured, $c_j = c^*$ for all j. If j is a bankruptcy state, what the insurer gets is $x_j + R - \sigma s$, all that is left after the bankruptcy cost has been paid. As will have become apparent, when we say, for example, that deposit liabilities are insured, we mean that all such liabilities are insured. There is no partial coverage.

8. As is realistic, we assume that the total cost of insurance is $\gamma(D+C)$ even if only deposit liabilities are insured. If no liabilities are insured, then $\gamma = 0$. If deposit liabilities or deposit and other liabilities are insured, then $\gamma \geq 0$.

9. If $\hat{d}_j$, $\hat{c}_j$, $\hat{d}^*$ and $\hat{c}^*$ are respectively the _laissez-faire_ equilibrium values of d_j, c_j, d^* and c^*, then by equations (3) $\hat{d}_j = \hat{d}^*$ and $\hat{c}_j = \hat{c}^*$ for all j. Further, since $p \cdot \hat{d} = \sum p_j \hat{d}_j = \psi$, $\hat{d}^* = r\psi$; and by equation (6), $\hat{c}^* = r$.

10. There is, though, the obvious and for us rather troublesome question: Why insure bank liabilities? We can only argue that the Seventy-third Congress made a mistake. But of course it may not have. If $\sigma = 0$, then any X satisfying inequality (2) is optimal and there may be bankruptcy states. And if absent insurance the promised payoffs d^* and c^* do not depend on X, then there will be bankruptcy states. If, however, insuring bank liabilities is justified, then maybe regulating banks is too. For is there no social cost incurred when many banks fail? If so, then it is quite wrong to urge, as some have, that bank liabilities be insured, perhaps at a variable premium, and that banks be unrestricted in their portfolio choices.

11. And values of α. But we keep α fixed at its _laissez-faire_ value, whatever that may be.

12. The argument is exactly that of section V, pp. .

13. It is not necessary that $R = 0$. But suppose that $\alpha = \beta = 0$, that $\gamma = 0$ and that $\varepsilon > \sigma$. Then if $d^*D > 0$, $s > R$ for all $C \geq 0$ and the coëfficient of C is $(1-\varepsilon)(1/r - \min p) > 0$.

14. In appendix A we show that with regulations R1, R2 and R5 applying and all bank liabilities insured at a fixed premium, the optimal X is independent of C and more specifically is as given on p.   above. It follows that for $s > R$, Π increases linearly in C.

15. The trick is to find a feasible X with $C > 0$ that gives a profit greater than that given by the optimal X with $C = 0$.

16. If regulation R3 does not apply and other liabilities are not insured, then $s = d^*D + c^*C$, where $c^* \geq r$. And by equation (12), $p \cdot L = 0$ implies that $C = 0$ is optimal.

17. The revised regulation reads in part [section 201.1(e)] as follows:

> "Federal Reserve credit is also available for protracted assistance where there are exceptional circumstances or practices involving only a particular member bank. A special rate apart from other rates charged for lending to member banks under other provisions of this Part (of the regulation) may be established by Federal Reserve Banks subject to review and determination by the Board of Governors and applied to such credit. The special rate may apply to member banks borrowing for prolonged periods...and in significant amounts... In no case should the special loan rate exceed the rate established for loans to nonmembers..."

18. Consider the following passage from an address by Arthur F. Burns, Chairman of the Board of Governors of the Federal Reserve System, to the 1974 convention of the American Bankers Association ("Maintaining the Soundness of Our Banking System," October 21, 1974):

> "In the past year, we have had the two largest bank failures in the nation's history. This fact has been widely noticed, as it deserves to be. But is is equally important to recognize that these failures did not cause any loss to depositors...

> One crucial element of our banking strength is Federal insurance of deposits. Another major source of banking strength is the Federal Reserve System's ability and willingness to come promptly to the assistance of banks facing a temporary (sic!) liquidity squeeze..."

19. But only on behalf of the FDIC. We assume, as happened in the Franklin National case, that when the bank is declared insolvent the FDIC takes over its loan from the System, if perhaps at a rate different from that it was paying.

20. Having the central bank do what the System did amounts to having a government agency insure all bank liabilities.

21. With our subordination rules and regulations, the x_j's of any feasible portfolio are bounded from below. And the greatest lower bound, denoted here by min x, is nondecreasing in C. For some parameter choices, it is strictly increasing.

22. That must be; for as was observed above, min x is nondecreasing in C.

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