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Market Discipline of Bank Risk: Theory and Evidence

BECAUSE of the many failures of banks and thrift institutions in recent years and the high cost of liquidating or reorganizing the bankrupt savings and loan associations, policymakers are now considering major changes in the way they supervise and regulate depository institutions in the United States. The Financial Institutions Reform, Recovery and Enforcement Act of 1989, which provides the funds for closing bankrupt savings and loan associations (S&Ls), calls for several government agencies to study the issues involved.[1] The federal budget document for fiscal 1991 discusses the basis for reform of deposit insurance and the advantages of various reforms.[2]

To some extent, the unusually high failure rate of depository institutions (hereafter called banks) can be attributed to developments in the economy such as declines in the prices of oil and farmland in the early 1980s. Some studies conclude that fraud and mismanagement account for many of the bank failures.[3] The general consensus, however, is that deposit insurance creates an incentive for banks to assume higher risk than they would without it. Such risk may be gauged in terms of the variance of a bank's return on assets as a percentage of its capital. The logic that underlies this consensus is that without deposit insurance, banks that choose portfolios of assets with higher variance in their rates of return, or lower ratios of capital to total assets, would have to pay higher interest rates on deposits. Deposit insurance blunts this penalty. The relatively high failure rate and losses of the deposit insurance funds reflect, to some extent, the banks' response to the incentives to assume risk created by deposit insurance. Thus, a major issue in the debates over financial reform is the future role of deposit insurance.

Some recent proposals to reform deposit insurance are designed to increase the effectiveness of market forces in reducing the risk assumed by banks. Under these proposals, bank owners and creditors would be exposed to larger losses if their banks fail. The theory is that if bank owners and creditors have greater exposure to losses, they will limit the risk assumed by their banks. In some proposals, this influence would complement the efforts of bank supervisors. In others, market discipline would replace government supervision.

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[1]Title X of the act directs the Secretary of the Treasury and the Comptroller General, in consultation with various federal government agencies and individuals from the private sector, to prepare reports on issues related to the reform of deposit insurance, including the implications of policies that would enhance the effectiveness of market discipline.

[2]Budget (1990), pp. 246-53.

[3]Graham and Horner (1988) and Office of the Comptroller of the Currency (1988).

This paper describes some of these proposals for enhancing the effectiveness of market discipline and illustrates how they would affect the banks' incentive to assume risk. The paper also examines the empirical evidence on the effectiveness of market discipline. Proposals for the reform of deposit insurance that rely on market discipline assume that market participants can differentiate among banks on the basis of risk, and that market yields on bank debt reflect that risk. The paper lists the results of several empirical studies and draws conclusions about the potential effectiveness of these proposals in reforming deposit insurance.

THE OBJECTIVES OF DEPOSIT INSURANCE

Various approaches to enhancing the effectiveness of market discipline of bank risk are presented in table 1. Choosing one approach over another depends in part on which basic objective of deposit insurance is considered to be most important.

The following are the primary objectives of deposit insurance:

1. To protect depositors with small accounts,
2. To prevent widespread runs by depositors on banks, and
3. To protect the insurance fund from losses that would bankrupt it.[4]

There are tradeoffs among these objectives. The policy that provides the greatest protection against runs by depositors is complete coverage of all deposit accounts. That policy, however, eliminates any incentive for depositors to exert their discipline over the risk assumed by their banks, leading perhaps to an increase in the insurance fund's losses.

The dollar limit on the amount in each account that is insured, currently $100,000, reflects an attempt to balance these objectives. Total coverage of accounts less than $100,000 protects small depositors. The limit on the insurance coverage per account is designed to induce the depositors with large accounts to monitor their banks and require that riskier banks pay higher interest rates on their deposits. Those with relatively large accounts are assumed to be better able to impose such market discipline. The limit on insurance coverage per account, however, tends to undermine the objective of preventing runs by depositors on the banking system.

Of course, a run by depositors on an *individual* bank does not create a serious problem for the banking system, because these depositors simply remove their cash from one bank and deposit it in another in which they have more confidence. If the bank subject to the run cannot meet its depositors' demand for currency, it will have to close. Its depositors will be paid as the assets of the failed bank are liquidated. A run on a bank can serve a useful purpose—a mechanism for closing a bank in which depositors have lost confidence.

Runs become a problem for the banking system, however, when depositors withdraw currency and, hence, reserves from banks as a group. Banking history in the United States and

Table 1

Proposals to Increase the Effectiveness of Market Discipline of Bank Risk

(1) Phase out federal deposit insurance to facilitate the development and use of private deposit insurance. Short and O'Driscoll (1983), Ely(1985), England (1985) and Smith (1988).

(2) Lower the ceiling on federal insurance coverage per account. Council of Economic Advisers (1989), pp. 203-4.

(3) Co-insurance: limit federal deposit insurance to some fraction of each account. Boyd and Rolnick (1988).

(4) Place a ceiling on federal deposit insurance per individual at all depository institutions. England (1988).

(5) All institutions must maintain subordinated debt liabilities that are some fraction of their total assets. Cooper and Fraser (1988), Keehn (1989) and Wall (1989).

(6) Early closure: close or reorganize depository institutions when their capital ratios, reflecting the market value of assets and liabilities, are low but still positive. This proposal is designed to enhance the effectiveness of market discipline by closing or reorganizing banks whose shareholders have weak incentive to limit risks. Benston and Kaufman (1988).

[4]Federal Deposit Insurance Corporation (1983), pp. viii-xiii.

the United Kingdom prior to their central banks acting as lenders of last resort indicates that runs on banking systems have occurred, although they tended to be separated by many years.[5]

Some argue that deposit insurance is not necessary to avoid the adverse social effects of banking system runs. They maintain that, as long as the central bank acts as an effective lender of last resort, the liquidity it provides would limit any damage that runs on individual banks could do.[6] An alternative view emphasizes the dangers of relying on the central bank to operate as the lender of last resort to a banking system without deposit insurance. A central bank might respond inappropriately in a financial crisis, as the Federal Reserve did in the early 1930s, leading to rapid declines in the assets of the banking system and widespread bank failures. Deposit insurance reduces the role of the central bank in maintaining stability in the operation of the banking system. Thus, the choice among the potential reforms of deposit insurance rests on views about the vulnerability of the banking system to runs and the effectiveness of a lender of last resort in dealing with runs.

If the primary objectives of deposit insurance are to protect small depositors and to protect the insurance funds from large losses, a logical change would be to reduce the insurance coverage per account. This was proposed by the President's Council of Economic Advisers in 1989. Those who consider the possibility of banking system runs a serious threat to the stability of the banking system would oppose a large reduction in the insurance coverage on bank deposits.

THE EFFECTS OF REFORM PROPOSALS ON BANKING RISK

The reform proposals are designed to reduce the incentives for banks to assume risk. In evaluating their effectiveness, it is useful to consider three indicators of the banking system's performance that reflect this risk: the expected loss by depositors due to the bank failure, the expected loss of the Federal Deposit Insurance Corporation (FDIC), and the probability that a bank will fail. The expected loss by depositors and the FDIC are considered separately since proposals that reduce the FDIC's expected loss tend to increase the expected loss by depositors. Focusing on only one of these measures of performance misses some of the reform proposals' implications. The third measure, the probability of bank failures, is of interest because of evidence that bank failures have adverse effects on economic activity in addition to the wealth losses by depositors and owners.[7] The studies that find adverse effects of bank failures on economic activity attribute those effects to the constraints on the availability of credit created by bank failures.

The proposals' implications for the effectiveness of market discipline can best be derived by using a model of the behavior of banks and their creditors.[8]

Nature of the Model

The implications of the various reform proposals are derived by examining the effects of proposed changes in deposit insurance on the optimal choice of risk by a representative banker. Several assumptions are made to simplify the model.

Rate of Return on Assets — The only random variable in the model is the rate of return on assets of the representative bank, which has the same probability distribution under all assumptions about the nature of deposit insurance. Bank regulators are assumed to determine the probability distribution of the rate of return by restricting the types of assets the bank may hold. The only choice for the representative banker in this model is the *level* of the bank's total assets. The capital of the bank is held constant at $100 in each case. With a given level of capital and a given probability distribution of the rate of return on assets, the probability of failure (losses exceeding capital) is positively related to the total assets of the bank. Management is assumed to choose the level of

[5]Gilbert and Wood (1986) and Dwyer and Gilbert (1989).

[6]See Kaufman (1988) and Schwartz (1988).

[7]See Bernanke (1983), Calomiris, Hubbard and Stock (1986), Grossman (1989), and Gilbert and Kochin (1989).

[8]To illustrate the need for such a model, consider a basic reform of eliminating deposit insurance. That change would increase the interest expense of a bank with a given portfolio of assets, thereby tending to increase its probability of failure. The penalty of higher interest expense imposed by depositors on those banks that assume more risk would induce banks to assume less risk in their choice of assets. The net effect of eliminating deposit insurance on the probability of bank failure must be derived from a theoretical model that specifies the risk preferences of depositors and bank managers.

total assets that maximizes the expected profits of the bank.

With a given level of bank capital, the conditions under which the bank fails can be derived only with a specific probability distribution of return on assets. This paper uses the discrete probability distribution presented in table 2.[9] For each of the seven possible outcomes, the rate of return on assets is net of the operating cost of servicing the assets.

The rate of return associated with each outcome is assumed to be inversely related to the size of the bank's total assets. One reason for this assumption of an inverse relationship is that, as the bank increases its total assets, it must lend to borrowers beyond the local area in which it has some market power. Another reason is diseconomies of scale in the operating cost of servicing assets. For each outcome with a positive return on assets, therefore, the rate of return falls as total assets increase. This feature of the model yields a maximum expected profit for the bank under each assumption about deposit insurance.[10]

Bank Costs — For a given level of total assets, the bank's cost depends on the insurance coverage on its liabilities. This paper considers the four cases described below. If, as in case A, all deposits are fully insured, the bank can attract an unlimited supply of deposits by paying the risk-free rate of interest. Under each of the four assumptions about deposit insurance, the costs of servicing deposit accounts are offset by fees charged to depositors.

For a given level of total assets, the highest expense occurs in case B, with no deposit insurance. In this case, the interest rate that the bank must pay on deposits is positively related to its total assets. Depositors are assumed to be risk-neutral and to know the probability distribution of the bank's return on assets. Hence, the bank must pay the rate to depositors that makes their expected return on deposits equal to the risk-free rate.[11]

The interest rate that the bank pays depositors is above the risk-free rate if the bank fails in at least one of the seven possible outcomes. If it fails, the depositors receive the liquidation value of the bank's assets. Liquidation value in those outcomes reflects the probability distribution of the bank's return on assets. There is no additional loss to depositors resulting from the elimination of the bank as a going concern.[12] The equation for calculating the rate paid to depositors in case B is presented in table 2.

Cases C and D reflect two methods of enhancing the effectiveness of market discipline of bank risk, while retaining some form of deposit insurance. Co-insurance in case C limits deposit insurance coverage to 90 percent of each deposit account.[13] In case D, deposits are fully insured, but each bank is required to keep its

[9]The use of a discrete probability distribution, with a limited number of outcomes, makes the presentation simpler than if a continuous probability distribution was used. In using a discrete probability distribution, there is a trade-off between simplicity and continuity of the probability of failure with respect to leverage. The smaller the number of possible outcomes, the larger the jumps in the probability of failure at certain asset levels. Increasing the number of possible outcomes, however, increases the difficulty of illustrating the calculations. Thus, the probability distribution in table 2 is arbitrary.

[10]The model abstracts from possible losses by our representative bank on the deposits it holds at other banks. If a reform proposal increases the probability of losses on interbank deposits, the effects of such reform proposals on the probability of failure at our representative bank would be understated.

This point about possible loss on interbank deposits is most relevant in comparing the case with no deposit insurance to the other cases examined below. The model in this paper is not modified to reflect directly the effects of possible losses on interbank deposits.

This model also ignores losses from runs on the bank by its depositors in reaction to the failure of other banks. If deposit insurance coverage is reduced or eliminated, the failure of some banks may induce depositors to run on other banks to receive currency in exchange for their deposits. Several such episodes occurred in the United States prior to the establishment of deposit insurance in the 1930s. See Dwyer and Gilbert (1989). To incorporate the possible effects of runs, the probability distribution of the return on assets at the representative bank would have to be specified as a function of the number of bank failures.

[11]The general nature of the comparisons among the four cases would not be changed if depositors were assumed to be risk averse.

[12]The assumption that a bank's assets lose no value when they are liquidated results in an understatement of the expected loss of depositors and bank creditors in the various cases. A study by the Federal Deposit Insurance Corporation, Bovenzi and Murton (1988), reports that when the FDIC liquidates the assets of failed banks, their liquidation value averages about 70 percent of the book value of the assets of failed banks.

[13]Boyd and Rolnick (1988) suggest 90 percent coverage of deposits in their proposal for a form of co-insurance in deposit insurance.

Table 2

A Model of Bank Profits

NET REVENUE

Revenue of the bank, net of the operating cost of servicing assets, is a random variable with a discrete probability distribution. Let A be the assets of the bank. The probability distribution is as follows.

Outcome number	Net revenue	Probability
1	0.4(1 – A/10,000)A	0.01
2	0.3(1 – A/10,000)A	0.04
3	0.2(1 – A/10,000)A	0.10
4	0.1(1 – A/10,000)A	0.70
5	0.0(1 – A/10,000)A	0.10
6	–0.1(1 – A/10,000)A	0.04
7	–0.2(1 – A/10,000)A	0.01

COST

The cost of the bank is not a random variable. It is the same in each of the seven outcomes. Expected profits are calculated for four cases, each involving a different assumption about the interest expense of the bank. In those outcomes in which the bank has a loss, the maximum loss to the shareholders is their investment of $100.

Case A: All Liabilities Fully Insured
The bank pays the risk-free rate of 8 percent on deposits, which equal A – $100.

Case B: No Deposit Insurance
At each level of total assets of the bank, the interest rate on deposits is set at the level that makes the expected return to holders of uninsured deposits equal to the risk-free rate of 8 percent.

The interest rate on deposits in case B, for a given level of assets, can be derived by solving the following equation for R, the interest rate on deposits. To economize on notation, let $A^* = (1 - A/10{,}000)A$. Then,

$$
\begin{aligned}
1.08(A - 100) = \quad & 0.01(1+R)(A\text{-}100), \text{ or} \\
& 0.01(1.4A^*) \text{ if } 0.4A^* - R(A\text{-}100) < -100 \\
+ \; & 0.04(1+R)(A-100), \text{ or} \\
& 0.04(1.3A^*) \text{ if } 0.3A^* - R(A-100) < -100 \\
+ \; & 0.1(1+R)(A-100), \text{ or} \\
& 0.1(1.2A^*) \text{ if } 0.2A^* - R(A-100) < -100 \\
+ \; & 0.7(1+R)(A-100), \text{ or} \\
& 0.7(1.1A^*) \text{ if } 0.1A^* - R(A-100) < -100 \\
+ \; & 0.1(1+R)(A-100), \text{ or} \\
& 0.1(A^*) \text{ if } -R(A-100) < -100 \\
+ \; & 0.04(1+R)(A-100), \text{ or} \\
& 0.04(0.9A^*) \text{ if } -0.1A^* - R(A-100) < -100 \\
+ \; & 0.01(1+R)(A-100), \text{ or} \\
& 0.01(0.8A^*) \text{ if } -0.2A^* - R(A-100) < -100
\end{aligned}
$$

Table 2 continued

A Model of Bank Profits

Case C: Co-insurance

The calculation of the stated interest rate on deposits as in case B is modified by setting the minimum return to depositors in each outcome at 90 percent of their principal plus stated interest.

The equation for the interest rate on deposits is the same as that presented for case B, except that in each of the seven possible outcomes, the return to the depositors can be no less than: $0.9(1+R)(A - 100)$.

Case D: Subordinated Debt Requirement

The bank is required to have liabilities that are uninsured and subordinated to deposits, equal to at least 10 percent of its total assets. Deposits are fully insured. The interest rate on deposits is 8 percent. The interest rate on subordinated debt, for a given level of assets, can be derived by solving the following equation for R.

$1.08(0.1)(A) =$

$0.01(1+R)0.1A$, or

if $0.4A^* - R(0.1A) - 0.08(0.9A - 100) < -100$,

0.01 (the greater of $1.4A^* - 1.08\,(0.9A - 100)$ or zero)

$+\ 0.04(1+R)0.1A$, or

if $0.3A^* - R(0.1A) - 0.08(0.9A - 100) < -100$,

0.04 (the greater of $1.3A^* - 1.08(0.9A - 100)$ or zero)

$+\ 0.1(1+R)0.1A$, or

if $0.2A^* - R(0.1A) - 0.08(0.9A - 100) < -100$,

0.1 (the greater of $1.2A^* - 1.08(0.9A - 100)$ or zero)

$+\ 0.7(1+R)0.1A$, or

if $0.1A^* - R(0.1A) - 0.08(0.9A - 100) < -100$,

0.7 (the greater of $1.1A^* - 1.08(0.9A - 100)$ or zero)

$+\ 0.1(1+R)0.1A$, or

if $-R(0.1A) - 0.08(0.9A - 100) < -100$,

0.1 (the greater of $A^* - 1.08(0.9A - 100)$ or zero)

$+\ 0.04(1+R)0.1A$, or

if $-0.1A^* - R(0.1A) - 0.08(0.9A - 100) < -100$,

0.04 (the greater of $0.9A^* - 1.08(0.9A - 100)$ or zero)

$+\ 0.01(1+R)0.1A$, or

if $-0.2A^* - R(0.1A) - 0.08(0.9A - 100) < -100$,

0.01 (the greater of $0.8A^* - 1.08(0.9A - 100)$ or zero)

subordinated debt liabilities equal to 10 percent or more of its total assets.[14]

In cases C and D, the interest rates on bank liabilities also are set at levels that make expected returns to bank creditors equal to the risk-free rate. Equations for calculating the interest rates on bank liabilities are specified in table 2.

Other reform proposals are of interest but are more difficult to incorporate into this simple model. For instance, more detail would be necessary to model the effects of changing the deposit insurance limit per account or limiting FDIC coverage for each depositor to a given amount at all insured institutions.

Case A: All Liabilities Fully Insured

The bank maximizes expected profits in this case with total assets around $1800 (see figure 1). At this level, the bank fails (losses exceed the $100 of capital) in outcomes 5, 6 and 7. Thus, the probability that the bank will fail is 15 percent, based on the probability distribution for the return on assets in table 2. The FDIC's expected loss, $14.26, is about 0.84 percent of insured deposits. The expected loss of depositors, of course, is zero.

Case B: No Deposit Insurance

Several reform proposals call for phasing out deposit insurance (see table 1). With no deposit insurance, depositors lose part of their principal plus interest if the bank fails (if losses exceed the $100 of capital). The interest rate on deposits charged by risk-neutral depositors is positively related to the bank's total assets (see figure 2).

The bank maximizes its expected profits with total assets equal to $1,000. It fails only in outcomes 6 and 7. Thus, the probability that the bank will fail is only 5 percent, compared with a 15 percent probability of failure associated with maximum profits in case A. Case B illustrates how a bank that maximizes expected profits can be induced to limit its probability of failure through market discipline imposed by its creditors.

The FDIC's expected loss in this case is zero. The expected loss of depositors with total assets equal to $1000 is $4.21, which is about one-half of one percent of deposits.

Case C: Co-insurance

Under the co-insurance option, federal deposit insurance coverage would be limited to a fraction of each deposit, with some low level of each account fully covered to protect small depositors. Those who advocate co-insurance argue that the depositors subject to fractional coverage at the margin would monitor the risk assumed by their banks and demand relatively high interest rates on deposits at the banks that assume relatively high risk.

To simplify the illustration, all deposit accounts are subject to the same percentage of insurance coverage. In those outcomes in which the bank fails, payments to depositors under the co-insurance option would be the larger of:

(1) the liquidation value of the bank's assets, or
(2) 90 percent of the principal plus interest on their deposits. The FDIC incurs a loss only if the bank fails and the liquidation value of the bank is less than 90 percent of the principal plus interest on deposits.

As in case B, the market interest rate on deposits is set at the level that makes the expected return on deposits equal to 8 percent. The difference in this case is that depositors have the option of receiving 90 percent of their principal plus interest from the FDIC if their banks fail. Figure 2 indicates that for a given level of total assets, the market interest rate on deposits is lower in case C than in case B, because in case C the losses of depositors are limited by deposit insurance.

Under the assumptions of case C, the bank maximizes expected profits with total assets of $1100. The bank must pay 8.44 percent to attract the $1000 in deposits. With assets of $1100, the probability of the bank failing is 5 percent. The FDIC's expected loss is only 0.072 percent of insured deposits, about 9 percent of

[14]Case D involves a higher percentage of subordinated debt to total assets than some of the proposals that call for subordinated debt requirements. For instance, the recent proposal of the Federal Reserve Bank of Chicago recommends that banks be required to maintain a 4 percent ratio of subordinated debt to total assets. See Keehn (1989). The 10 percent requirement in case D is chosen to indicate that the degree of market discipline that can be imposed through a co-insurance proposal can be matched with a subordinated debt proposal.

Figure 1
Expected Profits

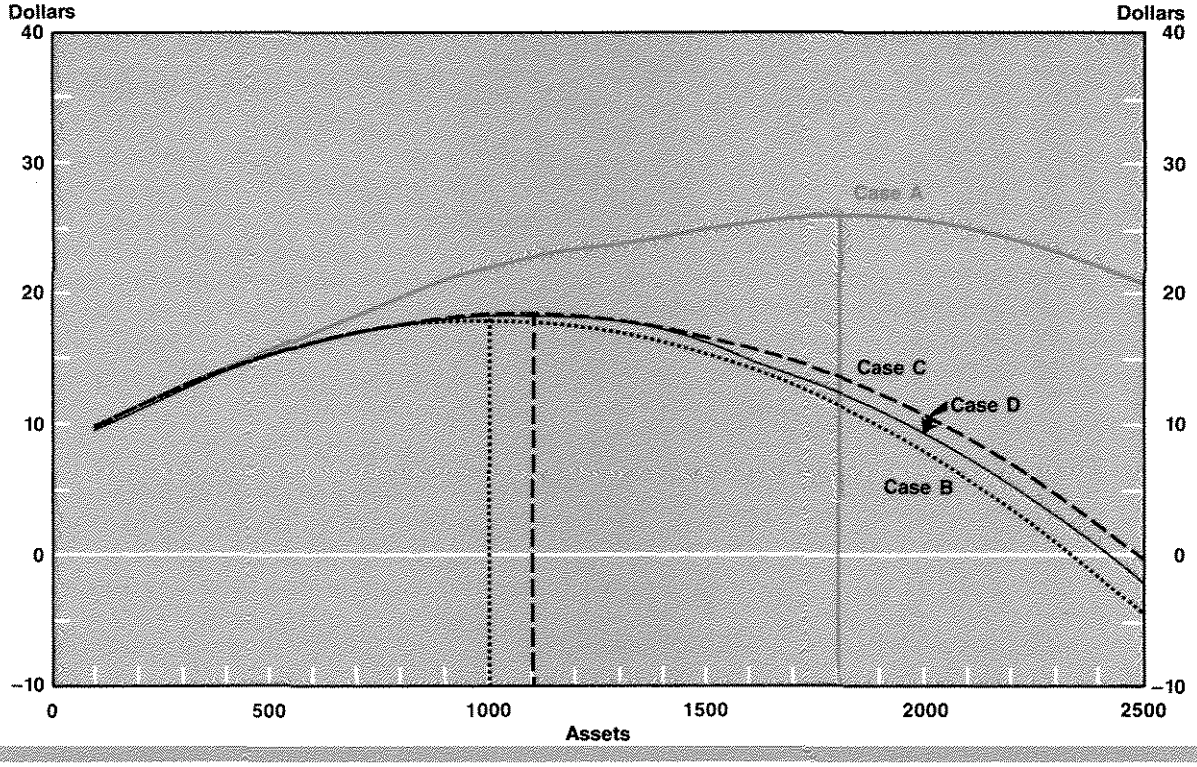
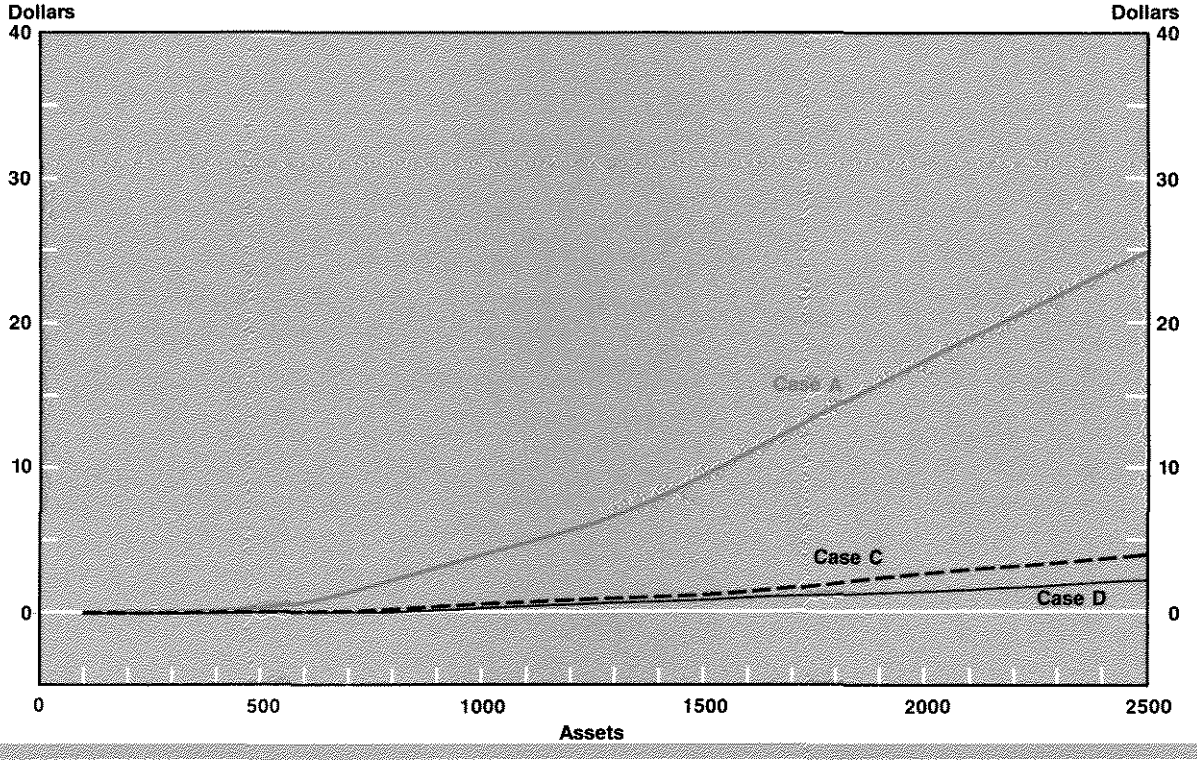


Figure 2
Expected Loss to FDIC



the loss rate for case A, with total assets at $1800. The expected loss to depositors is $5.09, which is about one-half of one percent of total deposits.

From the FDIC's perspective, there are two advantages of co-insurance (case C) over full deposit insurance (case A). First, the bank chooses a level of assets associated with a lower probability of failure. Second, for a given level of total assets of the bank, the FDIC's expected loss is lower under case C.[15]

Case D: Subordinated Debt Requirement

Some proposals for deposit insurance reform would require banks to issue subordinated debt liabilities that are not federally insured. The term "subordinated" refers to the status of creditors of a firm in bankruptcy. If a failed bank is liquidated, those who hold subordinated debt would receive payments only if all depositors are paid in full.

In case D, all deposits are fully insured by the FDIC. The bank, however, must have uninsured liabilities, which are subordinated to deposits, that equal at least 10 percent of its total assets. The bank would choose to keep subordinated debt liabilities at the 10 percent minimum since, except at relatively low levels of total assets, the interest rate on subordinated debt exceeds the risk-free rate paid on insured deposits.

As in cases B and C, those who invest in subordinated debt are assumed to be risk-neutral and know the probability distribution of the net return on assets. Figure 3 presents the interest rate on subordinated debt as a function of the total assets of the bank.[16] For most levels of total assets, the interest rates on subordinated debt is higher than the rates on deposits in the cases analyzed earlier because the expected loss is higher for those holding subordinated debt. If the bank's losses exceed the $100 investment of the shareholders, holders of the subordinated debt receive some payment only if the liquidation value of the bank exceeds total deposits.

The bank maximizes expected profits with total assets equal to $1100. At that level, the bank must pay 12.12 percent on its subordinated debt liabilities. The FDIC incurs losses only if the loss of the bank exceeds the $100 capital of the shareholders plus the subordinated debt. The bank has a 5 percent probability of failure, and the expected loss of the FDIC with total assets equal to $1100 is 0.06 percent of insured deposits. Depositor losses are zero.

Comparison of Cases B, C and D

A comparison of risk in the operation of the banking system under various assumptions depends on one's assumption about the probability of runs on the banking system. If this probability is assumed to be zero, the elimination of deposit insurance (case B) induces banks to assume minimum risk. The FDIC's expected loss is zero in this case, and the bank is induced by market forces to choose the lowest level of total assets. One advantage of the subordinated debt requirement over the other options is that, while the bank is induced to choose a level of total assets below that in case A, the subordinated debt is not subject to runs. Thus, the comparison of risk between cases A and D does not depend on assumptions about runs on the banking system.

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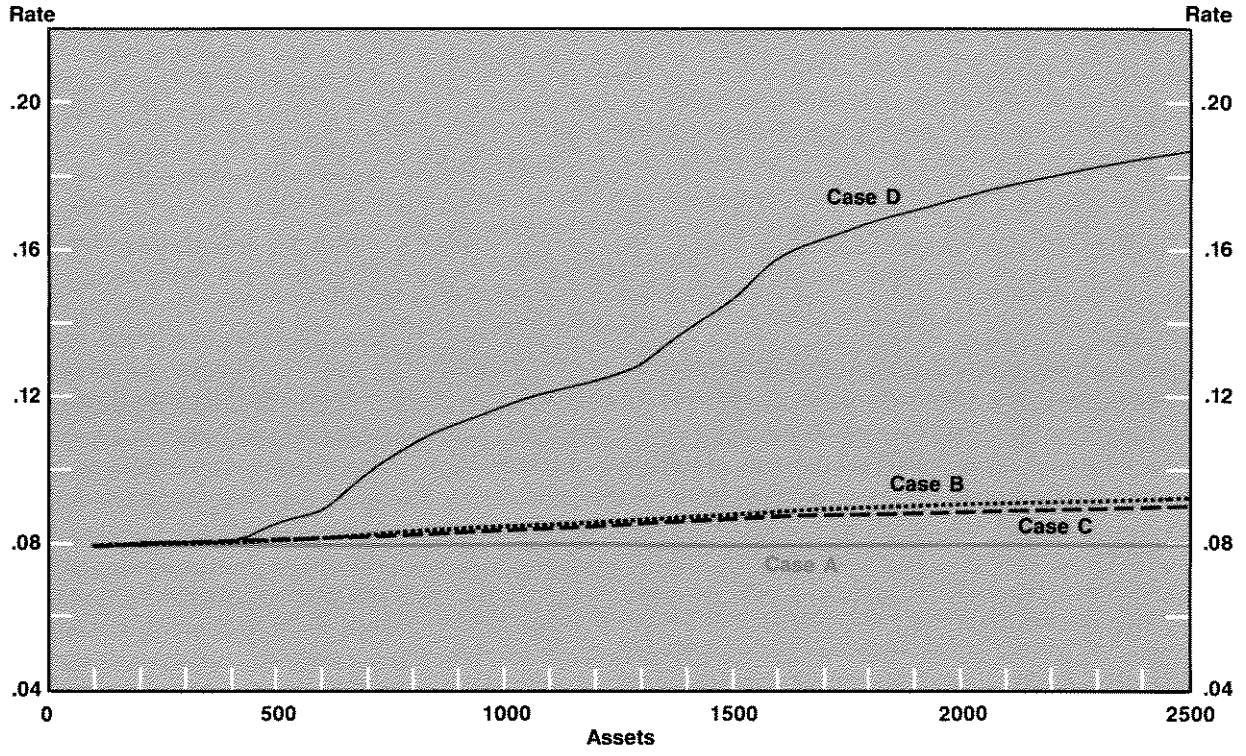
[15]Co-insurance, however, has one disadvantage. A change from full coverage of insured deposits to co-insurance creates an incentive for depositors to run on banks in response to information (or rumors) about problems at banks. Even with the FDIC insuring 90 percent of the principal and interest of deposit accounts, depositors have an incentive to avoid the 10 percent loss by withdrawing their deposits from a failing bank. Thus, in comparing cases A and C, co-insurance reduces the significance of deposit insurance in preventing runs on the banking system, placing greater responsibility on the role of the Federal Reserve in stabilizing the banking system in a financial crisis, as it functions as the lender of last resort. If there is some doubt that the Federal Reserve will execute its role as lender of last resort, co-insurance may be less advantageous than full insurance of deposits.

[16]The humped pattern of the interest rate on subordinated debt for case D in figure 3 reflects the particular discrete probability distribution of returns on the assets used in this paper. With a continuous probability distribution, or a discrete distribution with more possible outcomes, the plot of the interest rate as a function of total assets would have a less humped pattern.

The fact that the interest rate on subordinated debt is higher at higher levels of total assets of the bank might indicate a way in which the management of the bank could take advantage of those who invest in subordinated debt. The bank could issue some subordinated debt at a low level of total assets, at a relatively low interest rate, and then increase total assets and issue more subordinated debt at a higher rate. Investors in subordinated debt can protect themselves from such actions by insisting on covenants in the subordinated debt agreements that limit additional debt. If management of the bank violates such a covenant, the holders of the subordinated debt could go to court to make their debt instruments payable on demand. Restrictions on the issuance of additional debt are common in bond covenants. See Smith and Warner (1979).

Figure 3
Market Interest Rate on Bank Liabilities



The co-insurance option is not superior under any combination of assumptions. If the possibility of runs on the banking system can be ruled out, there is a subordinated debt requirement that induces the same degree of market discipline of banking risk as co-insurance.

EMPIRICAL STUDIES OF MARKET DISCIPLINE OF THE RISK ASSUMED BY BANKS

Market forces will be effective in constraining the risk assumed by banks only if investors can assess the relative degrees of risk assumed by individual banks, and then set differential prices on the stock and debt instruments issued by banks that reflect their information about risk. The results of the studies described in table 3 are relevant in evaluating the effectiveness of market discipline. These studies estimate the influence of measures of risk assumed by banks on the stock prices of banks and on the market interest rates on uninsured deposits and the subordinated debt of banks.[17] These studies do not test the hypothesis that banks adjust their risk in response to signals from the markets for bank stocks and debt.[18]

The Market for Bank Equity

All but one of these studies report evidence that is consistent with the hypothesis that stock prices are inversely related to the risk assumed

[17]The studies described in this section include only those based on data for individual banking organizations. Some studies cited in the literature estimate indices of returns on share prices or interest rates on bank liabilities for groups of banks as functions of aggregate data on banking risk. Such results are not relevant in determining whether participants in the equity and debt markets can distinguish among the banking organizations, which would be necessary if market discipline of bank risk were to be effective.

[18]Gendreau and Humphrey (1980) claim to have developed a model in which there is feedback from adverse signals in the bank equity market to bank leverage. It is difficult to see a feedback relationship between the stock price and leverage in this study, since the relationships among stock prices, leverage and other variables are estimated using contemporaneous observations. Estimating a feedback relationship from market signals to variables under the control of bank management would require dynamic relationships.

Table 3

Implications of Empirical Studies for the Effectiveness of Market Discipline of Bank Risk

Authors	Relationships estimated	Results	Results consistent with the effectiveness of market discipline
		MARKET FOR BANK EQUITY	
Beighley, Boyd and Jacobs (1975)	Share prices of bank stocks estimated as a function of (1) capital ratios, (2) earnings and growth of earnings, (3) asset size, and (4) loss rates.	Holding constant the influence of earnings banks with higher capital ratios and lower loss rates tend to have higher share prices.	Yes
Pettway (1976)	Betas for individual banks (a measure of risk derived from stock prices) estimated as a function of the capital ratios of individual banks.	The coefficient on the capital ratio is negative for one year but insignificant for other years. The negative coefficient on the capital ratio indicates that investors consider banks with higher capital ratios to be less risky.	Yes
Pettway (1980)	For several large banks that failed, returns to shareholders are simulated for several years prior to their failure. Simulations are based on returns from holding stocks of large banks that did not fail.	On average, returns on the stocks of banks that failed declined relative to simulated returns two years before failure.	Yes
Brewer and Lee (1986)	Betas for individual banks are estimated as functions of ratios from balance sheets and income statements used by bank supervisors to reflect risk.	Some of the measures chosen to reflect risk have positive, significant regression coefficients.	Yes
Cornell and Shapiro (1986)	Returns to shareholders of 43 large banks are estimated as functions of the composition of their assets and liabilities in the years 1982-83.	The percentage that Latin American loans was of total assets had a significant, negative impact on returns in 1982. Energy loans had a negative impact in 1982-83. Loans purchased from Penn Square Bank had a negative impact on returns in the month in which that bank failed.	Yes
Shome, Smith and Heggestad (1986)	Prices of bank stocks are estimated as a function of its earnings and capital ratios.	The coefficient on the capital ratio is positive and significant for some years, insignificant for other years.	Yes
Smirlock and Kaufold (1987)	Changes in stock prices of large banks at the time of the announcement by Mexico in 1982 of its moratorium on debt payments as a function of the ratio of Mexican debt to equity capital at individual banks.	Coefficient on the ratio of Mexican debt to equity capital is negative and significant. Banks were not required to disclose their Mexican debt at the time of the 1982 moratorium.	Yes

Table 3 continued

Implications of Empirical Studies for the Effectiveness of Market Discipline of Bank Risk

Authors	Relationships estimated	Results	Results consistent with the effectiveness of market discipline
	MARKET FOR BANK EQUITY continued		
James (1989) and Cargill (1989)	Returns on holding the stock of BHCs estimated as a function of the change in the market value of the BHCs' loans to less-developed countries and dummy variables for individual banks and individual time periods.	The change in the market value of loans to less-developed countries has a positive, significant coefficient which is not significantly different from unity.	Yes
Randall (1989)	This is a case study of 40 BHCs that reported relatively large losses in the 1980s. For each BHC, a time period is designated when it began assuming relatively high risk and a time period when problems became public knowledge. Stock prices are compared to market averages before and after the problems became public knowledge.	Stocks prices of the BHCs that reported relatively large losses declined relative to market average stock prices only after the problems became public knowledge, not during the periods which the banks began assuming relatively high risk.	No
	MARKET FOR UNINSURED DEPOSITS		
	The interest rate on large denomination certificates of deposit is the dependent variable in each study.		
Crane (1976)	Identifies the determinants of the CD rate using factor analysis.	The factor that reflects profit rates and capital ratios is not a significant variable in explaining the CD rate.	No
Herzig-Marx and Weaver (1979)	Estimates CD rates as a function of variables used by bank supervisors to reflect risk.	Of bank risk variables, only the liquidity measure has a significant coefficient. Capital and loss ratios have insignificant coefficients.	No
Baer and Brewer (1986)	CD rate estimated as a function of variables used by bank supervisors to reflect risk, and separately, as functions of level and variability of the prices of bank stocks.	Coefficients on risk measures used by bank supervisors are not significant. Measures of the level and variability of stock prices help explain CD rates.	No
James (1987)	The average interest rates paid by 58 large banks on their large denomination deposits are estimated as functions of leverage, loan loss provision divided by total loans and the variance of stock returns.	Each of these measures of risk have positive, significant coefficients.	Yes
Hannan and Hanweck (1988)	CD rate is estimated as a function of (1) the variability of the ratio of income to assets, (2) the capital ratio and (3) bank assets.	These three variables have significant coefficients. CD rates tend to be higher at banks with more variable income and lower capital ratios, holding constant the influence of total assets.	Yes

Table 3 continued

Implications of Empirical Studies for the Effectiveness of Market Discipline of Bank Risk

Authors	Relationships estimated	Results	Results consistent with the effectiveness of market discipline
	MARKET FOR UNINSURED DEPOSITS continued		
James (1989)	Interest cost on large CDs estimated as a function of risk measures: domestic loans/capital, foreign loans/capital and the loan loss provision/total loans.	Interest cost positively related to the ratio of domestic loans to capital and the loan loss provision. The negative relation between interest cost and the ratio of foreign loans to capital is interpreted as evidence of an implicit government guarantee of foreign loans.	Yes
	MARKET FOR SUBORDINATED DEBT: In each study the measure of the interest rate on the subordinated debt of banks is the rate on the subordinated debt minus the rate on long-term U.S. Treasury securities, called the rate premium.		
Pettway (1976)	The rate premium is estimated as a function of the capital ratio of banks and other independent variables.	The coefficient on the capital ratio is not significant.	No
Beighley (1977)	The rate premium is estimated as a function of several measures of risk, including a loss ratio and a leverage ratio.	The coefficients on the loss and leverage ratios are positive and significant.	Yes
Fraser and McCormack (1978)	The rate premium is estimated as a function of the capital ratio and the variability of profits divided by total assets.	Neither independent variable has a significant coefficient.	No
Herzig-Marx (1979)	The rate premium is estimated as a function of several measures of risk assumed by banks.	None of the risk measures have significant coefficients.	No
Avery, Belton and Goldberg (1988)	The rate premium is estimated as a function of risk measures derived from balance sheets and income statements and of the asset size of banks.	Coefficients on the risk measures derived from balance sheets and income statements are not significant.	No
Gorton and Santomero (1988)	Use data in Avery, Belton and Goldberg (1988) to derive a measure of the variance of assets of banks implied by a contingent claims valuation model. The measure of the variance of assets is estimated as a function of the risk measures derived from balance sheets and income statements.	Some of the risk measures derived from the balance sheets and income statements have significant coefficients.	Yes

by banks, holding constant other determinants of stock prices. The one study that concludes that stock prices do not reflect the risk assumed by banks, by Randall (1989), examines movements in the stock prices of bank holding companies that reported relatively large losses in the 1980s. Randall concludes that these stock prices fell relative to the stock prices at other banks after their problems became common knowledge; however, they did not decline during the periods when the banks were assuming the relatively high risk that led to losses. Randall concludes that the stock market does not discipline the risk assumed by banks, since the relative declines in bank stock prices did not precede public information on the consequences of risk assumed by these banks.

Randall's study, however, has several weaknesses. It is a case study, not a statistical study of the determinants of stock prices. The dating of points at which problems became common knowledge is arbitrary; the choice of such dates, however, determines the results. About half of the cases involve banks in the Southwest. We would not expect relative declines in the stock prices of these banks before the large decline in oil prices. We cannot expect the participants in the market for bank stocks to have greater foresight in predicting the decline in the price of oil than the participants in the market for oil.

Two studies are particularly interesting in terms of investors' ability to differentiate among banks on the basis of risk. Pettway (1980) compares stock prices of large banks that failed with simulated stock prices that were based on data from banks of comparable size that did not fail. Returns to stockholders of the failed banks declined relative to their simulated returns about two years before the banks failed. Relative returns of the failed banks also declined before the bank supervisors put them on the problem bank list. Smirlock and Kaufold (1987) find that, when Mexico announced the moratorium on its debt payments in 1982, the declines in the stock prices were proportional to the Mexican debt held by banks relative to the book value of their equity capital. At the time of the moratorium, banks were not required to disclose their loans to other nations. Nevertheless, investors appeared to have sufficient information, without such requirements, to make the appropriate adjustments to the prices of bank stocks.

The Markets for Uninsured Deposits and Subordinated Debt

The findings about the relationship between risk and interest rates on uninsured deposits and on subordinated debt are more mixed. Three of the six studies of bank CD rates report no evidence that higher CD rates are paid by banks that assume more risk. Four of the six studies of the determinants of rates on the subordinated debt of banks find no significant effects of risk measures on interest rates.

Implications for the Effectiveness of Market Discipline

In evaluating these results, it is important to note that, under the procedures followed by federal bank regulators in recent years, risk has a more certain implication for bank profits than for the returns to the holders of uninsured deposits or subordinated debt. Losses on bank assets reduce profits, and if losses force a bank to fail, the bank shareholders are likely to receive nothing after the liquidation or sale of the bank.

Uninsured depositors and holders of subordinated debt, in contrast, receive less than the principal plus contracted interest *only* if a bank fails. In most cases, the failed bank is merged with another bank, and the surviving banks assume all liabilities of the failed banks, including those in the form of uninsured deposits and subordinated debt. Most of the cases in which uninsured depositors and holders of subordinated debt absorb some losses involve banks smaller than those included in the studies described in this paper.[19] These observations are consistent with the conclusion that interest rates on bank liabilities would be more sensitive

[19]This contrast can be illustrated using some recent studies and bank failure cases. Avery, Belton and Goldberg (1988) use observations for the 100 largest BHCs, which had total assets above $3 billion in 1985 and 1986. The total assets of the banks in the sample used by Hannan and Hanweck (1988) average $4 billion. In 1985 and 1986, 69 failed banks did not have their liabilities assumed by surviving banks. Of these 69 failed banks, 66 had total assets less than $100 million, while the remaining three had total assets less than $200 million. The failure of some large banking organizations in the Southwest, in which the BHC's bondholders absorbed losses, occurred after the periods covered by these studies.

to the risk assumed by banks if bank creditors lost at least part of their principal plus interest in each bank failure.

The empirical results cannot be used to indicate the degree of risk that banks would assume if bank supervisors eliminated various forms of supervision and regulation, relying instead on market forces to limit bank risk. To illustrate such a change in policies, suppose bank supervisors eliminate capital requirements and restrictions on the types of assets that banks may acquire, substituting a requirement that banks issue subordinated debt. The empirical results do not tell us whether the probability of bank failures would increase or decrease under such a change in policies. The only useful information from the empirical studies is that investors in bank stocks, who have the strongest incentives to be sensitive to the risk assumed by banks, are able to differentiate among banks on the basis of risk.

CONCLUSIONS

This theoretical exercise illustrates how market forces could limit the incentives for banks to assume risk. The incentives for banks to assume relatively high risk are reduced if the insurance coverage of bank creditors drops from full to partial coverage. One of the important differences among the various approaches to promoting market discipline of banking risk involves the vulnerability of banks to runs. Banks are more vulnerable to runs if depositors are at risk than if the risks are borne by those holding long-term bank debt that is subordinated to deposits.

Empirical studies of the effectiveness of market discipline report mixed results. The most consistent result is that the stock prices of individual banks reflect the risk assumed by banks. Market discipline of such risk would tend to be more effective if bank creditors were forced to absorb losses in a more consistent fashion in bank failure cases.

The empirical studies do not indicate the degree of risk that banks would assume if deposit insurance were reformed to enhance the effectiveness of market discipline. Thus, the empirical studies do not permit us to determine whether the probability of bank failures would rise or fall if the current forms of bank regulation were eliminated in favor of market discipline by bank shareholders and creditors.

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