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# Deregulation and Deposit Insurance Reform

**David H. Pyle***

*Bank deregulation has increased the need for deposit insurance reform. In particular, it has enhanced the opportunities for insured institutions to exploit risk-taking incentives in the existing deposit insurance system. Many reform proposals focus on ways of pricing the risk that is not now differentially priced. A comparative statics analysis of the insurer's liability, applying options theory, suggests that improved monitoring and control of bank activities to prevent insolvency is more important.*

Lots of people are talking about deposit insurance reform because, as deposit insurance is structured and administered, it may be incompatible with a deregulated banking system.[1] Congress, while responsible for the heightened interest, does not seem to be doing anything about it. The *Garn-St Germain Act of 1982* required federal insurers to study the deposit insurance system. The agencies responded with over 500 pages of text and tables that may be only the first of a flood. At least three articles on deposit insurance have appeared since the agency reports were released (Horvitz, 1983; Peterson 1983; and Kane, 1983a), and more are forthcoming (Campbell and Glenn, 1983; Campbell and Horvitz, 1983).

Why add to this torrent of words? Chiefly, to report some new evidence on the cost of deposit guarantees that is relevant to deposit insurance reform (Section II), but also to comment on ways that bank deregulation makes reform more imperative (Section I). One hopes that adding to the evidence may help move Congress and the bank regulators toward useful action (Section III).

## Legislation in progress

There is little sign that the 98th Congress will enact deposit insurance reform. The *Financial Institutions Deregulation Act* introduced by Senator Garn for the Treasury does not address this topic.[2] Neither did Senator Garn include deposit insurance reform in his "omnibus" banking bill, the proposed *Financial Services Competitive Equity Act* introduced in November 1983. There are proposals to alleviate symptoms of the ailing insurance system: Congressman St Germain's proposal to regulate deposit brokers and the attempt in the Treasury bill to come to grips with the elusive "non-bank" bank. The *Federal Deposit Insurance Improvements Act* introduced by Senators Garn and Proxmire for the FDIC does propose some reforms, but since they were not incorporated into Senator Garn's omnibus bill, it is not clear how they will fare in Congress. Even if they had been incorporated, the premium risk adjustment

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proposed is limited to the rebate of net FDIC assessment income. This may not be enough to produce effective risk-related premiums. The FDIC bill would also establish payment priorities in liquidation proceedings, but it does not address the critical problem of controlling the liquidating value of failing institutions.[3]

In contrast to the inaction on deposit insurance reform, legislation intended to further the banking deregulation process continues to be introduced. Since deregulation is being driven by market forces that have proved hard to restrain, it is likely that we will have more bank deregulation whether or not there is Congressional action on proposed legislation. We therefore need to know whether the existing deposit insurance system is compatible with a deregulated banking system and, if reform were needed, how it should be structured.

# I. Deregulation and the Need for Deposit Insurance Reform

The debate over deposit insurance, which predates bank deregulation[4], has frequently revolved around the objection that the current system of flat-rate insurance premiums encourage risk-taking by insured institutions. Defenders of the system are not convinced that these institutions have taken significant advantage of this built-in incentive to take risk. I was recently asked why anyone should worry about the risk-taking incentives of a deposit insurance system that has remained solvent through the exigencies of the last 50 years. My answer is twofold. First, there may be reason to question its solvency. Kane (1983b) estimated the net worth of insured S&Ls and mutual savings banks at minus 100 to 175 billion dollars in December 1981. Interest rates have fallen since then so the immediate threat to the funds has decreased, but it is prudent to remember that the laws of gravity do not apply to interest rates.

Second, and more relevant, today's financial environment differs markedly from that of the last 50 years. The banking system has changed in fundamental and permanent ways, and these changes make it easier for insured institutions to act on the risk-taking incentives of deposit insurance. The pronounced interest rate volatility of the 1970s and early 1980s was an important difference in the environment, but perhaps a transitory one. The changes resulting from the deregulation of financial services that began with the *Depository Institutions Deregulation and Monetary Control Act of 1980,* however, show no signs of ending. They are, in large measure, responses to market forces that do not appear to be abating, let alone reverting.[5] Moreover, insurer insolvency *per se* is not the major reason for concern about the deposit insurance system. The more important consideration is that the failure to price deposit insurance correctly leads to allocative inefficiencies. Even if deposit insurance premiums were correct on average so that the funds were solvent, allocative inefficiencies could remain flaws in the present deposit insurance system. The rest of this section contains a discussion of some ways that deregulation has intensified the need for deposit insurance reform.

## Asset deregulation

Excessive credit risk has not been the major cause of bank failures over the past 50 years, the Penn Square debacle and the continuing LDC loan scare notwithstanding. Leverage risk, interest rate risk, and fraud have been more important. The secular increase in interest rate levels and volatility has troubled many institutions, but increased interest rate risk may not be a permanent problem and, in any case, is a manageable one since interest rate risk can be hedged. It is arguable, however, that the measurement of interest rate risk is a less serious problem for the insurers than measurement of credit risk or the detection of fraud.[6]

Is the bank risk experience of the past a harbinger of the future? Much of the thrust of asset deregulation, past and proposed, points in the other direction. Savings and loan holding companies, for example, have been authorized to engage in a broad range of activities, including real estate development, credit, life and health insurance.[7] The *Financial Institutions Deregulation Act* proposes to extend similar powers to bank holding companies. Although these new asset and product-line powers may have been intended to increase asset diversification, they also create the

potential for increased risk-taking by insured institutions.

### Deposit deregulation

Congress, through the Depository Institutions Deregulation Committee, has eliminated most deposit rate ceilings. The resulting flow of funds into the deregulated accounts has been amazing.[8] More changes, including interest on all demand deposits, are proposed. Whether this will increase liability costs at banks and thrifts in the long run is an open question. Depositors may just receive more direct interest and less implicit interest in the form of free or subsidized services. At the minimum, the response time to market rate changes will be shortened. Existing institutions must learn to manage new trade-offs between deposit rates and deposit services. They will have to do so while competing with entrants free of the physical and mental trappings suited to a more regulated era. Airline executives should be able to advise bankers on this problem.

### Brokered deposits

New entrants into the banking field, and many older firms, have discovered brokered deposits as a means to expand their deposit draw beyond their own geographically limited areas. The deposit broker obtains funds from investors throughout the country and channels them to the client depository institutions, assigning title for the deposit in separate units, up to the insurance limit of $100,000, to a number of different investors. With deposit rate deregulation, banks can offer a higher yield on brokered deposits as an enticement. Those institutions that want to engage in increased risk-taking, therefore, need not wait for local deposit growth to provide the funding.[9] Moreover, their deposit draw is no longer limited to those who know the institutions well. This situation, without question, presents a serious problem for insurers.

Another problem with brokered deposits is that the insurer, in effect, has replaced the Federal Reserve as the lender of last resort. A bank in trouble can go to the brokered deposit market instead of the discount window for liquidity. This is quite rational behavior when the insurers offer failing institutions a bargain insurance rate on the brokered deposits while the Federal Reserve wants good collateral for loans at the discount window.

Access to a national deposit market may be a new and heady thing for smaller banks, but it is old hat for large banks. They have tapped the money market for some years both by direct and brokered placement of large, mostly uninsured CDs. Given the revealed behavior of bank regulators, a large bank's lenders have been confident of their deposits' safety. With the notable exception of Penn Square National Bank, large bank failures have been resolved with no losses for uninsured depositors. This has resulted in less than full risk-pricing of deposit liabilities for banks issuing large denomination CDs. The introduction of insured deposit brokerage may well be an important concern for the deposit insurers, but so is the direct or brokered sale of "uninsured" deposits that are thus implicitly insured.

Making insured deposit brokerage more difficult does not solve the problems deposit brokerage presents. Instead, it risks cutting off an economically efficient deposit-gathering mechanism. An analogy may help make the point. When large banks began to use large computers, it was suggested that scale economies in computing would drive small banks out of business. This has not happened because a large computer does not have to be owned directly by a small bank for the bank to use competitively priced computer services; the small bank can purchase them. Similarly, by pooling the deposit offerings of a number of banks, a deposit broker uncouples size and access to national deposit markets. The flaw lies in the mispricing of deposit guarantees, whether explicit or implicit, for large banks as well as small, and not in the deposit marketing mechanism.

### Deposit deregulation and the liability mix

There is a positive aspect to deposit deregulation from the regulator's viewpoint in that it may help regulators enforce capital adequacy standards. The removal of deposit rate ceilings undermines the argument that deposits are a cheaper source of funds than other bank liabilities. Even before deposit rates were deregulated, Black, Miller, and Posner (1978) made a convincing case that capital requirements are not a costly form of bank regulation. The basic

idea is that competition among banks for deposits will drive the total return on deposits into equilibrium with the cost of other sources of funds. If the substitute liabilities were subordinated to deposits, they may pay a higher return than deposits just as in other corporations subordinated debt pays a higher return than senior debt, and equity a higher return that subordinated debt. In none of these cases is the higher required return an economic cost to the issuer as long as it is consistent with the risk borne by that class of investor. Considerations such as taxes, corporate control, and financial flexibility may influence the choice between debt and equity. If the bank is free to use both debt and equity liabilities in place of deposits, these considerations do not influence the choice between deposits and other liabilities.[10]

When deposit rate ceilings were binding, the industry was forced into non-rate competition. It is conceivable that this non-rate competition was less than perfect, and that it allowed at least some banks to raise funds at the margin at lower cost than by issuing deposits. The elimination of deposit rate ceilings has made full rate competition possible again. If marginal deposits are bargains when full rate competition is possible, it is because some bank markets are not fully competitive or because deposit insurance premiums are insufficient to cover the insurer's deposit guarantee liability. Regulatory policies regarding capital adequacy standards should not allow depository institutions to take advantage of these sources of deposit "cheapness."

## Geographic deregulation

There has been no systematic deregulation of the geographic restrictions on banking, yet we have gone a long way toward removing those restrictions. Market forces, acting through loan production offices, money market mutual funds, deposit brokers, nonbank banks, electronic banking networks, and other channels, continue to push the banking system in this direction.

Bank regulators have aided the process of geographic deregulation. Before 1978, a foreign bank could obtain charters in more than one state. A number did and were "grandfathered" when this loophole in geographic regulation was closed in the *International Banking Act of 1978*. More recently, geographic deregulation has been fostered by interstate acquisitions of troubled institutions. The explicit authorization of interstate acquisitions in the *Garn-St Germain Act of 1982* confirmed a process of extraordinary acquisition in use by the federal agencies. Notable examples include the 1981 acquisition of two out-of-state institutions by the California-based Citizens Savings (since metamorphosed into First Nationwide Savings) and the Citicorp acquisition of Fidelity Savings and Loan of San Francisco immediately before the 1982 Act was approved. Since the 1982 Act, there have been additional out-of-state acquisitions, including two more proposed thrift acquisitions (in Chicago and Miami) by Citicorp.

## Interstate franchises and insurance funds

Together, market forces and regulatory policies are breaking down the barriers to interstate banking. As these barriers fall, the value of a multi-state franchise falls too. This has an important implication for the deposit insurance funds. The major bidders for troubled institutions have often been out-of-state firms. Over the past two years or so, they have resulted in more than a dozen interstate acquisitions. The out-of-state bidders made offers that included the value of a multi-state franchise as well as the value of the troubled firm's asset portfolio. If the insurers had been unable to offer a significant relaxation of geographic barriers to these bidders, does anyone doubt that the insurance funds would be smaller today?

When we achieve full geographical deregulation, *de facto* or *de jure,* the deposit insurance agencies will not have valuable multi-state franchises to sell. They will then have to bear the full brunt of the shortfall in asset value in failed institutions.

## II. Targets for Deposit Insurance Reform

The preceding arguments suggest that bank deregulation has increased the need for deposit insurance reform. If so, how should that reform be structured? A central theme of the arguments about the effects of deregulation is that deregulation has increased the opportunity for insured institutions to respond to the risk-taking incentives in the current deposit insurance contract. The proposed reforms have correspondingly focused on bank risk and the pricing of risk, as in risk-related premiums. This view of the reform process, especially the use of risk-related premiums, has its critics, who think reform should focus more on the process by which the insurers monitor and control the net worth of insured institutions.

A framework for comparing these alternative views on deposit insurance reform can be built around the concept of the deposit insurer's liability. An insurer of a bank's deposits has a liability if that bank could become insolvent, and if, at that time, the value of the bank's assets do not sufficiently cover the deposit guarantee. Bank asset risk and the insurer's insolvency policies are therefore major determinants of this liability.

Consider the effects of bank asset risk. Since bank monitoring is costly, the insurer (or a surrogate) examines a bank at discrete intervals. If the bank's assets are risky (from the insurer's viewpoint), there will be a positive probability that the value of those assets will fall below the deposit guarantee before the next examination. The more volatile the value of a bank's assets, the more likely that this event will occur and the larger the potential shortfall could be. Recognizing this, analysts suggest that deposit insurance reform should include risk-related insurance premiums. However, the critics are not convinced. They argue that risk-related premiums would be hard to implement because measuring risk on non-traded assets is difficult.[11] Nonetheless, the failure to maintain consistency between bank asset risk and the insurance premium is a flaw in the deposit insurance system that is likely to be aggravated by bank deregulation.

Horvitz (1983) has made a thoughtful case against risk-related premiums. A main part of his argument is the distinction between the risk of bank failure and the risk of insurer loss: "The key point... is that if insured institutions are operating with positive net worth, and the insurance agency is able to monitor their condition, then the risk of loss to the agency is low, *regardless of the riskiness of individual institutions.*"[12] This argument emphasizes the important protection given lenders by their right to force insolvency proceedings. Unfortunately, bank and thrift regulators have not always exercised this right in a way that is consistent with a low risk of loss. They often did not deal promptly with failing institutions whose market net worth reached zero. There are a number of reasons for this. One is the divided responsibility among insurers and regulators.[13] A second is the the use of book value net worth standards. The failure to mark fixed-rate, long-term assets to market in a period of rising interest rates allowed numerous institutions to remain in business after their economic net worth had fallen below zero. Once many institutions were in this position, concern over the effects of having a large number fail at the same time strengthened the regulators' reluctance to enforce more realistic insolvency controls. A similar problem has developed with respect to the reliance on book value net worth in banks with a significant fraction of their assets in loans to less-developed countries.

The prospect that a bank will not be declared insolvent as soon as its *market* net worth has been found to reach zero or less is an important determinant of the insurer's current deposit guarantee liability. A net worth standard that permits negative market net worth tends to make the date of insolvency later than it would be under a zero market net worth standard. It thereby reduces the *present value* of a given *future* shortfall in asset value relative to the deposit guarantee. This effect, however, is more than offset by the increased size of the potential shortfall. The net effect of the failure to use market value net worth standards in declaring insolvency therefore is an increase in the present value of the insurer's liability.

### The Deposit Insurer's Liability

Recent research on the valuation of the deposit insurer's liability can shed some light on the relative importance of asset risk control and insolvency

control in deposit insurance reform. Merton (1977, 1978) pioneered the use of options theory to model deposit insurance. A recent extension of this model (Pyle, 1983) provides the basis for a comparative statics analysis of the insurer's liability. The model is described in the appended box.

The insurer's guarantee is modelled as a perpetuity. This assumption is not essential to obtain a closed-form solution (see Pyle, 1983), but it does allow one to obtain more useful comparative statics results than can be obtained from a single-period model. As noted earlier, if the insolvency ratio is reduced, the probability of reaching insolvency before the next audit is reduced. But, in essence, this just puts off the date of the insurer's potential loss while increasing its size. In the short run, the reduced likelihood of early insolvency has a significant effect on the value of the liability. By analyzing a perpetual guarantee, one can obtain the long-run effect (and hence, the full effect) of a given insolvency policy on the insurer's liability.

Given some simplifying assumptions, standard options theory can be used to find an equation for the present value of the insurer's liability.[15] This value depends on several variables: the interest spread (over the riskless market interest rate) on deposits, the ratio of the market value of the bank's assets to the face value of the insured deposits, the frequency of examination, the examination costs, the riskiness of the insured bank's assets and the insolvency ratio. The insolvency ratio, as the term is used here, is the ratio of the market value of assets to the face value of deposits below which a bank will be declared insolvent. This variable and the riskiness of the insured bank's assets are of specific interest in our evaluation of deposit insurance reform proposals.

The role of asset risk in determining the size of the insurer's liability is straightforward. The measure of asset risk in the model is the standard deviation of asset return per unit time. For given values of the other determinants of the liability, the larger this standard deviation is, the more likely that the value of the assets will be below any given value (less than the mean) when the next examination takes place. Since the insurer's liability depends on these lower tail outcomes, the size of that liability will increase with increases in asset risk. The magnitude of the standard deviation of asset return, or, as it is also called, the asset return volatility, depends on the types of assets held by the bank. To put this in perspective, the average asset return volatility for common stocks is on the order of 0.2 to 0.3 (20 percent to 30 percent per year), while the return volatility for long-term U.S. Treasury bonds has been estimated to be 0.05 to 0.06 (5 percent to 6 percent per year). Asset return standard deviations of .07 and .10 have been used in the numerical examples in this paper.

The bank's asset portfolio is the underlying asset on which the insurance contract is written. The asset value at which an options contract may be exercised is called the exercise price. Clearly, the exercise price is an important determinant of the current value of the option. The comparable variable in the deposit insurance model is the insolvency ratio—the asset value (at market) to deposit ratio below which a bank will be declared insolvent. The smaller is this "exercise price", the larger is the insurer's liability. For example, suppose the bank regulator uses a book value insolvency rule. A bank will be closed, merged, or reorganized if its asset book value to deposit ratio falls below some number, say 1.03. If book value overstates market value by 15 percent, the book value insolvency rule translates into a true insolvency ratio of 0.875. The insurer will claim assets worth only \$0.875 for each dollar of deposits that must be paid off. There will be some probability that the value of the bank's assets will be insufficient to cover deposit claims at the next audit for any reasonable value of the insolvency ratio. The present value of this potential shortfall is the amount of the insurer's liability. If the true insolvency ratio implied by the regulator's rule is 0.875 instead of 1.0, the magnitude of that present value will be larger.

Before reporting our results on the relative importance of asset risk and the insolvency ratio as determinants of the insurer's liability, a few additional comments on the model are in order.

The insurer's guarantee is modelled as a perpetuity. This assumption is not essential to obtain a closed-form solution (see Pyle, 1983), but it does allow one to obtain more useful comparative statics results than can be obtained from a single-period model. As noted earlier, if the insolvency

ratio is reduced, the probability of reaching insolvency before the next audit is reduced. But, in essence, this just puts off the date of the insurer's potential loss while increasing its size. In the short run, the reduced likelihood of early insolvency has a significant effect on the value of the liability. By analyzing a perpetual guarantee, one can obtain the long-run effect (and hence, the full effect) of a given insolvency policy on the insurer's liability.

The usefulness of the model is limited by the assumptions on which it is based. Two limiting assumptions are worthy of special note. First, the perpetuity assumption conflicts with the assumption that asset risk is constant. In fact, asset risk is a choice variable for the insured bank (subject to regulatory constraints) and the bank may change its risk policy during the period of the guarantee. The longer the period for which the guarantee holds, the harder it is to accept the assumption that asset risk is constant. This limitation of the model will certainly affect the measured value of the insurer's liability. Its effect on the relative importance of asset risk and the insolvency ratio in determining the size of the liability is not obvious.

Second, the analysis also requires that the policy regarding the true insolvency ratio be known. Since this is a choice variable for the regulators, it should be known in principle. In fact, the true insolvency ratio that will be used for a given institution is probably not known in advance. For example, if a book value insolvency ratio is used, the market value insolvency ratio is a random variable. There is no clear way to deal with this problem in the context of the model. Again it is not clear what effect, if any, this has on the comparative statics analysis of the insurer's liability.

Given these considerations, the results from the model should be approached with some caution.[16] It seems clear that violation of some of the simplifying assumptions would have a significant effect on the measured value of the insurer's liability. However, the comparison between asset risk ($\sigma$) and the insolvency ratio ($\phi$) was carried out in terms of the ratio of the "price" elasticities of these two parameters. This measure is independent of the specific insurer liability values generated by the model, but not of any biases that the simplifying assumptions may have induced in the partial derivatives of the insurer's liability valuation function.

## Asset Risk, the Insolvency Ratio, and Deposit Insurance Liability

Equation (2) in the boxed insert is the model of the insurer's liability that was used to analyze the effect of asset risk and the insolvency ratio on that liability. The partial derivatives of the liability $[p_1(\times)]$ with respect to $\sigma$ and $\phi$ were derived and used to obtain the two elasticity measures, $e_\sigma$ and $e_\phi$. These elasticities were evaluated for various values of the parameters.

Audit frequency is a random variable with a mean ($\lambda$) of one (an audit is expected to occur once per year). Audit costs of 1, 10 and 100 basis points per dollar of deposits[17] and two asset volatilities, 7 percent per year and 10 percent per year, were considered.[18]

The point elasticities for the insolvency ratio (measured at $\phi = 1$) and for asset risk (measured at $\sigma = 0.07$ and $\sigma = 0.10$) are given in columns 4 and 5 of Table 1. These elasticities measure the percentage change in the present value of the insurer's liability for a given percentage change in each of the two parameters of interest. The elasticity with respect to the insolvency ratio is negative (a smaller insolvency ratio increases the liability) and the elasticity with respect to asset risk is positive. As noted earlier, for any set of parameters, the ratio of the two elasticities is independent of the measured level of the liability so the elasticity ratio given in the last column of Table 1 may be the most useful comparison of the relative importance of the insolvency ratio and asset risk. This elasticity ratio ranges between 7.4 and 19.8. Since these are point elasticities, the comparison only holds for small deviations from the base case. As a check on this, arc (average) elasticities were calculated for finite changes of approximately 20 percent in the two parameters. For audit costs of 10 basis points, the ratio of these arc elasticities was greater than 5.0; for audit costs of 100 basis points, the ratio of arc elasticities ranged between 1.6 and 3.4; and for a 1 basis point audit cost, the ratio exceeded 13.0 for all cases considered.

The conclusion drawn from this analysis is that a given proportional deviation in the insolvency

condition from 1.0 has a significantly larger effect on the size of the insurer's liability than an equal deviation in asset risk from its base value. In other words, the failure to maintain a target insolvency ratio is significantly more important to the insurer than the failure to maintain an asset risk target when those failures are measured as equal percentage deviations from the targets. This result is not particularly surprising given our earlier observations on the mechanism by which changes in these two parameters affect the size of the insurer's liability.

## III. Conclusions

Bank deregulation implies an increased need for deposit insurance reform because it has enhanced the opportunities for insured institutions to exploit the risk-taking incentives in the existing deposit insurance system and likely reduced the ability of the deposit insurers to limit their losses by selling valuable franchises. Many current deposit insurance reform proposals focus on risk-related insurance premiums or other ways of pricing the risk that is not differentially priced under the existing deposit insurance structure. Control of asset risk is clearly important. However, our analysis of the relative importance of asset risk and the insolvency ratio implies that improved insolvency control is an even more important focal point for deposit insurance reform legislation.

**Table 1**
**Elasticity of Insurer's Liability**
$\lambda = 1$

| K(bp) | $\sigma^2$ | x | $e\phi$ | $e\sigma$ | $\frac{\lvert e\phi \rvert}{e\sigma}$ |
|---|---|---|---|---|---|
| 1 | .01 | 1.0 | −13.6 | 0.97 | 14.1 |
| 1 | .01 | 1.1 | −13.6 | 0.97 | 14.1 |
| 1 | .005 | 1.0 | −19.4 | 0.98 | 19.8 |
| 1 | .005 | 1.1 | −19.4 | 0.98 | 19.8 |
| 10 | .01 | 1.0 | −13.4 | 0.97 | 13.7 |
| 10 | .01 | 1.1 | −13.4 | 1.00 | 13.2 |
| 10 | .005 | 1.0 | −18.9 | 0.99 | 19.2 |
| 10 | .005 | 1.1 | −18.9 | 1.06 | 17.8 |
| 100 | .01 | 1.0 | −10.7 | 1.04 | 10.4 |
| 100 | .01 | 1.1 | −10.7 | 1.42 | 7.6 |
| 100 | .005 | 1.0 | −13.7 | 1.07 | 12.7 |
| 100 | .005 | 1.1 | −13.7 | 1.84 | 7.4 |

## A Model of Deposit Insurance

The model that is used in the analysis of deposit insurance reform targets is an adaptation of Merton's (1978) application of options theory to deposit insurance. Interested readers can refer to Pyle (1983) and Merton (1978) for a more detailed derivation of the model.

In the model, it is assumed that the insurer guarantees deposits and, if the insured bank is declared insolvent, that the insurer claims the bank's assets and pays off the insured depositors at face value. The insured bank holds risky assets that are financed with a combination of insured deposits and equity. Some investors (including the insurer and the insured banks) can borrow and lend in a "frictionless" capital market. Marketable assets are assumed to be priced according to the capital asset pricing model. Typical options pricing assumptions on asset value dynamics are employed.

Some assumptions that distinguish the deposit insurance model from other options pricing models of liabilities follow:

1. Some investors are assumed to face a transactions cost for lending in the exchange market. For such investors, insured deposits can yield less (up to the level of the transactions cost) than the riskless interest rate.

2. The insurer uses a random-time audit procedure for bank surveillance (Poisson-distributed audit times).

3. The insurer guarantees the bank's deposits in perpetuity, subject to the declaration of insolvency and the subsequent payoff of depositors.

4. There is an auditing cost that is paid by the insured bank at the time of audit.

Simplifying assumptions include a constant deposit growth rate (which, for convenience, is assumed to be equal to the total return on deposits) and a constant audit cost per dollar of deposits.

The derivation of the model proceeds by writing down the return on the insurer's liability over the next instant in three mutually exclusive circumstances: no audit takes place, an audit takes place and the bank is solvent, and an audit takes place and the bank is insolvent. Using standard options pricing methods, the instantaneous return function is transformed into a pair of differential equations that the in-

surer's liability must satisfy (one for the solvent and one for the insolvent bank). These differential equations are subject to four boundary conditions. The most important for our purposes are the continuity conditions linking the two segments of the liability function at the insolvency point. Letting $p_1$ be the value of the insurer's liability for a solvent bank and $p_2$, the comparable value for an insolvent bank and $\phi$, the insolvency ratio being used by the regulator, the continuity requirements are:

$$p_1(\phi) = p_2(\phi)$$

and

$$p'_1(\phi) = p'_2(\phi)$$

where the primes denote first derivatives with respect to the asset value-to-deposit ratio.

To obtain the correct value of the insurer's liability, the argument of the liability value function must be the market value of the bank's assets divided by the promised payment to depositors. If the regulator's insolvency policy leads to the closing of a bank as soon as its market net worth is observed to have reached zero, the value of $\phi$ is 1. If banks are allowed to continue operating after zero net worth is observed, $\phi$ is less than 1.

The solution of the resulting differential equation system provides a closed-form equation for the insurer's liability per dollar of deposits (see Pyle, 1983).

$$p_1(x) = \frac{(1-k)\phi + \left[\frac{\lambda+\lambda K}{\lambda+\mu}\right] k}{\delta+k} x^{-\delta}\phi^{\delta}, \; x \geq \phi \quad (1)$$

where

$\mu \equiv$ the deposit rate spread (the riskless interest rate minus total deposit return)

$\sigma^2 \equiv$ the instantaneous variance of asset return per unit time

$\delta \equiv 2\mu/\sigma^2$

$\upsilon \equiv 8\lambda/\sigma^2$

$k \equiv \frac{1}{2} \quad 1 - \delta + [(1+\delta)^2 + \gamma]^{\frac{1}{2}} \quad > 1$

$\lambda \equiv$ expected number of audits per unit time

$K \equiv$ the auditing cost per dollar of deposits

$x \equiv$ the market asset value-to-deposit ratio

$\phi \equiv$ the insolvency ratio

A few comments may help in the interpretation of Equation (1). The deposit rate spread must be non-negative in this model to prevent arbitrage by investors who have costless access to the exchange market (for example, other banks). Since $\gamma$ is strictly positive, k must be greater than 1. Furthermore, for reasonable parameter values, the value of k is determined, to all extents by the value of $\gamma$ which is a weighted ratio of the critical parameters of the two stochastic processes that the insurer faces.

In Merton (1978), it is shown that the competitive deposit rate spread ($\mu$) is equal to the expected audit cost per unit time ($\lambda K$). In effect, the depositors pay the expected costs of auditing by receiving less than the riskless rate. They are willing to do so as long as their personal cost to access the exchange market is greater than this spread. This property of competitive equilibrium carries over to the model used here. Therefore, by assuming a competitive deposit market, Equation (1) simplifies to

$$p_1(x) = \frac{(1-k)\phi + k}{\delta+k} x^{-\delta}\phi^{\delta}, \; x \geq \phi \quad (2)$$

where $\delta$ and k are now equilibrium values ($\mu = \lambda K$).

Equation (2) can be used to obtain the comparative statics properties of the insurer's liability. The elasticities of $p_1(x)$ with respect to $\phi$ and to $\sigma$ are of particular interest.

Using equation (2), The elasticity of the insurer's liability with respect to $\phi$ is

$$e_{\phi} = \frac{(1-k)\phi}{(1-k)\phi + k} + \delta \quad (3)$$

while the elasticity with respect to $\sigma$ is

$$e_{\phi} = \frac{(1-\phi)\left\{\delta - \frac{\delta(1+\delta)+\frac{1}{2}\gamma}{[(1+\delta)^2+\gamma]^{\frac{1}{2}}}\right\}}{(1-k)\phi + k} + \delta + \frac{\left\{\frac{\delta(1+\delta)+\frac{1}{2}\gamma}{[(1+\delta]^2+\gamma)^{\frac{1}{2}}}\right\}}{\delta+k} + 2\delta\left(\ln\left(\frac{x}{\phi}\right)\right) \quad (4)$$

## FOOTNOTES

1. I use the term "banking system" in a broad sense to include thrift institutions as well as commercial banks.

2. See Natter (1983b) for a legal analysis of the Treasury proposal.

3. In a recent development, the Task Group on Regulation of Financial Services has proposed some deposit insurance reforms including higher insurance premiums for banks that engage in risky activities.

4. See Mayer (1965).

5. Some of these changes, ironically, were set off by the **Interest Rate Adjustment Act of 1966.**

6. It is not coincidental that the FHLBB (1983) study of deposit insurance dwells on interest rate risk. This was the problem at S&Ls in the 1970s and early 1980s. Furthermore, a number of analysts believe they can measure interest rate risk. See Beebe (1977, 1983) for evidence on bank risk-taking behavior.

7. See Natter (1983a) p. 7-9.

8. See Zimmerman (1983).

9. The extent to which the increase in deposit brokerage is due to deposit deregulation in 1980 and 1982 or to the increase in insurance ceilings (to $100,000 per account) in 1980 or to some combination of the two is an open question.

10. This statement may not be correct if the bank is near insolvency. Then the competing interests of existing liability holders and the potential buyers of new liabilities may prove difficult to resolve.

11. The cover letter for the NCUA report states that "...risk rating is theoretically and practically inconsistent with the government's role as an 'insurer of last resort.'" The FDIC summary statement on the subject is "The 'ideal system' with premiums tied closely to risk is simply not feasible." (FDIC (1983) p. II.1). Also, see Horvitz (1983) for a discussion of the difficulties in implementing risk-related premiums. A counter to the arguments against risk-related premiums is that lenders regularly set risk premiums on corporate debt. Risk assessment in private markets is competitive. Can the risk assessment for setting deposit insurance premiums be done on a basis equivalent to competitive risk assessment? If not, the corporate destanology losses much of its power. Competitive bank risk assessment may be desirable and practicable, either through private deposit insurance or through more reliance on non-deposit liabilities or, as suggested by the Bush Task Group, by private risk appraisal. Such considerations, while both interesting and important, are beyond the scope of this paper.

12. Horvitz (1983) p. 257 (his emphasis). Unless monitoring is continuous, however, the risk of loss to the agency will depend on the riskiness of the institution.

13. See Kane (1983a) p. 277 for a discussion of the insurers' need for enhanced rights to take timely action.

14. See Beebe and Blank (1983) for a discussion of some of the problems in measuring market net worth in financial institutions.

15. See Jarrow and Rudd (1983) for a thorough treatment of modern option theory.

16. In defense of the model, it can be pointed out that the results obtained for the version of the model reported here are robust to some changes in the simplifying assumptions. See Pyle (1983).

17. Little information is available on the cost of examinations. The evidence that is available suggests that direct supervisory costs are less than 5 basis points per dollar of deposits. However, there are indirect costs for the institution being examined and, perhaps, for the supervisors as well.

18. The bank asset volatilities considered in the analysis lie between the estimated volatility of long-term governments (5 percent-6 percent per year) and the average volatility of common stocks (20 percent-30 percent)

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# Bank Regulation and Deposit Insurance: Controlling the FDIC's Losses

**Barbara A. Bennett***

*The FDIC's failure to close insolvent institutions before their market-value net worth becomes negative adds a further sizeable subsidy to risk-taking. In effect, it grants shareholders a larger (expected) claim against insured institutions than that represented by recorded net worth. More stringent enforcement of existing portfolio regulations by the FDIC, comparable to restrictive covenants in bond indentures, would eliminate a large portion of this subsidy and help minimize the agency's losses.*

Many have argued for some time that the present deposit insurance system encourages depository institutions to take more risks than are optimal for society. Under the present system, insured institutions are frequently allowed to continue raising insured deposits even after they have exhausted their net worth on a market value basis. As a result, the marginal cost of increased risk-taking from the perspective of the individual institution is lower than the cost to society as a whole. Insured institutions, therefore, tend to take on more risk than society would prefer. Moreover, the recent deregulation of deposit interest rates, the loosening of restrictions on depository institutions' lending and investment powers and the increase in deposit insurance coverage from $40,000 to $100,000 probably enhance this tendency to undertake excessive risk.

The Federal Deposit Insurance Corporation (FDIC) and others argue that this potential for increased risk to the deposit insurance fund creates a need for countervailing reforms that will give depository institutions incentives to reduce risk-taking and/or give the insurance agency new powers to manage the risk to its fund. Much has already been written about the relative merits of various reform proposals. This article takes a different approach by evaluating the FDIC's use of its *current* regulatory and supervisory powers. Based on this evaluation, it is clear that the need for reform would be less pressing today, even with deregulation, if the FDIC had made better use of its authority to control risk-taking.

In Section I, the nature of the risk to the deposit insurance fund is described. Preservation of the market value of the deposit insurance fund is set forth as the criterion for judging the FDIC's use of its current powers to control risk-taking. Section II compares the FDIC's regulatory and supervisory powers to restrictive covenants in bond indentures. Section III evaluates the FDIC's use of its enforcement powers. Section IV presents and analyzes the FDIC's options for liquidating insolvent institutions. Although the FDIC's choice of liquidation proceedings would not affect the (ex ante) risk-taking behavior of insured institutions, it would affect the losses incurred by the FDIC and the value

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of the insurance fund, which is thought to be a measure of the FDIC's ability to handle widespread failures. In Section V, the valuation of the deposit insurance fund is discussed. Finally, the paper concludes with some observations on desirable changes in the FDIC's behavior.

# I. The Risks to the Deposit Insurance Fund

Most analysts do not question whether deposit insurance in some form is necessary. Neither do they question the need for some government involvement in the provision of deposit insurance. The financial panics of the period before the creation of the FDIC and the relative stability of the financial system since then provide ample evidence, it seems, for the benefits of government-provided deposit insurance.

## Risk-taking Subsidy

The provision of deposit insurance, however, may encourage insured institutions to take on more risk than is socially optimal. Deposit insurance clearly reduces depositors' incentive to monitor the financial condition of the institutions where they place their funds. Thus, unless the insurer closes failing institutions before their net worth (on a market value basis) is exhausted, deposit insurance will give such institutions incentive to take on extraordinary risks with insured deposits, because the costs (after the institution becomes insolvent) will be borne solely by the insurer. Moreover, systematic failure to close insured institutions as they become insolvent affects the risk-taking behavior not only of those institutions on the verge of insolvency, but that of *all* insured institutions.

A tendency to close failing institutions only after their net worth becomes negative will distort the marginal cost of risk-taking by reducing the cost of increased leverage. Shareholders of an insured institution would be willing in such cases to accept greater leverage for a given level of portfolio risk and return because the *expected value* of their claims against the institution will be greater than that represented by its recorded net worth (even on a market value basis). This is because, in the event that the institution fails and is found to have negative net worth, the burden falls on the insurer rather than on the shareholders. As a result, the cost of raising additional equity will not reflect the true social cost of increased risk-taking, and insured institutions will tend to take on more risk and operate with greater leverage than they would otherwise.

## Bank Closure Rule

To eliminate this subsidy to risk-taking, all the insurer need do is guarantee that, on average, insured institutions are closed as their net worth becomes negative. Under such a rule, the expected cost of increased risk-taking would be borne entirely by the shareholders[1] of insured institutions. They, in turn, would demand a premium commensurate with those risks, including risks associated with high leverage. As a result, insured institutions would have an incentive to reduce risk-taking and leverage to socially desired levels.

This closure rule implies, of course, that the protection afforded depositors is not insurance as the term is generally understood. Instead, the government in effect provides a guarantee that an "insured" institution will always have sufficient assets (on a market value basis) to discharge its liabilities, or that institution would not be allowed to stay in business. Theoretically, under such a rule, neither the depositors nor the insurer need ever incur losses, making a deposit insurance fund unnecessary.

The task of closing insured institutions before their net worth becomes negative is not a simple one, however. Determining when insolvency occurs is subjective, particularly under book value accounting conventions. In most cases, bank failure occurs not as a result of a readily observable inability to meet maturing obligations, but as a result of the more subjective determination that the value of the bank's loan and/or investment portfolio has deteriorated sufficiently to wipe out its capital. This determination is subjective because, short of a decision to close the bank and sell off its assets, there is no way objectively to determine the market value of the bank's portfolio. The other, more

objective, liquidity standard for determining a firm's bankruptcy (a firm's inability to meet maturing obligations) is one which the courts have applied to nonbanking firms. It is generally not applicable to banks and other depository institutions because, as noted above, deposit insurance has, to a large degree, removed depositors' incentive to withdraw funds when a bank is in danger of failing.[2]

To make matters worse, the FDIC does not have the legal authority to close a bank that, by the FDIC's valuation, is insolvent. Instead, the bank's chartering authority (that is, the Comptroller of the Currency in the case of a national bank, or the appropriate state banking agency in the case of a state-chartered bank) must determine that a bank is insolvent and close it before the FDIC can take action to limit its losses. This division of responsibilities can create problems for the control of risk to the deposit insurance fund. Not having the insurance liability of the FDIC, the other regulators' concern for the viability of the banks they supervise may lead them to keep a bank open longer than is optimal (that is, long enough to be certain that capital has been exhausted, which, because of uncertainties regarding asset valuation, is usually *after* capital has actually been exhausted).

As a result, the timing of bank closures is likely to be biased in favor of allowing insolvent institutions to continue in operation. In fact, given the uncertainties associated with bank asset valuation, there will almost certainly be a bias toward closing insured institutions *after* their net worth becomes negative. This holds unless there are also legal guidelines permitting regulators to close institutions when net worth is still positive. Such guidelines would allow the *average* value of net worth at the time of closure to be zero, and avoid the subsidy to increased risk-taking.

One measure of the extent of this bias, and of the resulting subsidy to risk-taking, is the amount of the FDIC's net losses in connection with bank failures. Because the failure to close insolvent institutions represents, in effect, a guarantee of solvency on the part of the FDIC, the FDIC's potential liability increases in direct proportion to the amount of negative net worth in insured institutions. As a result, the FDIC's losses are also closely related to the amount by which insured institutions' net worth is allowed to become negative on a market value basis. (By the same token, if insured institutions were closed before net worth became negative, the FDIC's potential liability would be zero and the agency would not incur losses since the value of failing institutions' assets would, by definition, be sufficient to discharge depositors' and other creditors' claims.) The FDIC's net losses between 1934 and 1983 amounted to $2.4 billion, of which $2.2 billion represented losses incurred since 1980 (primarily in connection with mutual savings bank failures. See Table 1). These figures probably provide only a lower-bound estimate of the size of the subsidy to risk-taking since they reflect the negative net worth position of only the institutions that were finally closed. Nonetheless, $2.2 billion over a three-year period constitutes a sizeable subsidy.

## Bank Closure Authority

Given the magnitude of the subsidy arising from the failure to close insolvent institutions promptly, the FDIC needs the authority to close such institutions. But until such authority is granted, the FDIC needs to exert greater pressure on the chartering agencies to close insolvent institutions. Since the chartering agencies generally consult the FDIC whenever an insured institution is considered in danger of failing, the FDIC clearly has an opportunity to make its views known. The FDIC was, in fact, consulted about the majority of the bank failures to date, yet its losses amounted to $2.4 billion. Thus, one would be hard-pressed to conclude that the FDIC has sought to minimize its subsidy to risk-taking.

Two examples of the FDIC's reluctance to seek an earlier closure of insolvent institutions will suffice. In the recent failures of the United American Bank of Knoxville, Tennessee, and affiliated banks, the FDIC was aware of the condition of the banks for some time before they were declared insolvent, yet the FDIC apparently made no attempt to encourage the state-banking agency to close the banks sooner. Losses to the insurance fund from these failures are likely to run as high as $220 million. Likewise, in the case of the Franklin National Bank failure in 1974, the FDIC acquiesced in the decision to keep the bank open for a period of several months until a purchaser was found. The

FDIC's liability mounted during that time because, as the uninsured creditors took the opportunity to withdraw their funds, the bank replaced them with borrowings from the Federal Reserve, which the FDIC agreed to repay. If the agency had recorded foregone interest as a cost of this transaction, its losses would have been sizeable.

Efforts to close insolvent institutions sooner than is presently the case, however, will not eliminate the subsidy to risk-taking completely because there will always be instances in which failure is not detected immediately. For example, failure may occur between examinations. Thus, although the FDIC could reduce this subsidy substantially by pressing chartering agencies to close insolvent institutions sooner, some form of more direct control is also necessary. Two approaches (separately or in combination) are available: risk-adjusted pricing of deposit insurance and/or regulation of bank portfolios. Since the FDIC must currently charge insured institutions the same statutory assessment rate for deposit insurance regardless of riskiness, the task of reducing risk-taking falls largely on supervision and regulation. While such an approach may seem, at first glance, less efficient than pricing, private long-term debt markets use such an approach in addition to risk-pricing to control the risks that private firms might take.

The appropriate criterion for judging the effectiveness of the FDIC's supervisory and regulatory powers, then, is the extent to which those powers give the FDIC the ability to protect the market value of the deposit insurance fund. The next section evaluates the FDIC's regulatory and supervisory powers in comparison to the mechanisms private markets have developed for protecting the principal value of investors' funds.

**Table 1**
**FDIC Insurance Losses By Year**
**(dollars are in millions)**

| Year | Liquidation Status | | | | | |
|---|---|---|---|---|---|---|
| | All Cases | | Payoff Cases | | Assumption Cases | |
| | Number | Losses | Number | Losses | Number | Losses |
| 1965 | 5 | $ 3.9 | 3 | $ 3.8 | 2 | $ 0.1 |
| 1966 | 7 | 0.5 | 1 | — | 6 | 0.5 |
| 1967 | 4 | 1.0 | 4 | 1.0 | — | — |
| 1968 | 3 | 0.01 | — | — | 3 | 0.01 |
| 1969 | 9 | 0.1 | 4 | 0.1 | 5 | — |
| 1970 | 7 | 0.3 | 4 | 0.3 | 3 | 0.01 |
| 1971 | 6 | 0.2 | 5 | 0.2 | 1 | — |
| 1972 | 1 | 1.2 | 1 | 1.2 | — | — |
| 1973 | 6 | 67.6 | 3 | — | 3 | 67.6 |
| 1974 | 4 | 0.3 | — | — | 4 | 0.3 |
| 1975 | 13 | 18.7 | 3 | 0.1 | 10 | 18.6 |
| 1976 | 16 | 22.5 | 3 | 1.9 | 13 | 20.6 |
| 1977 | 6 | 1.2 | — | — | 6 | 1.2 |
| 1978 | 7 | 5.9 | 1 | 0.1 | 6 | 5.8 |
| 1979 | 10 | 7.8 | 3 | 0.7 | 7 | 7.1 |
| 1980 | 10 | 21.0 | 3 | 1.8 | 7 | 19.2 |
| 1981 | 10 | 556.7 | 2 | 1.2 | 8 | 555.5 |
| 1982 | 42 | 1,069.1 | 7 | 48.0 | 35 | 1,021.1 |
| 1983 | 48 | 584.9 | 9 | 18.3 | 39 | 566.6 |
| Total **1934-1983** | **668** | **$2,393.4** | **328** | **$96.2** | **340** | **$2,297.1** |

Source: FDIC, *Annual Report* 1982, p. 38 (Figures for 1983 were obtained from FDIC staff)

## II. Restrictive Covenants As a Paradigm for Bank Supervision

Like deposit insurance, the existence of long-term debt can influence shareholders' incentives to undertake risk. Because long-term creditors cannot simply withdraw their funds as the condition of a firm worsens, the existence of long-term debt provides an opportunity for the firm to continue operating with negative net worth on a market value basis. To prevent the shareholders from engaging in activities that are riskier than what the bondholders would prefer, long-term debt markets have sought to control shareholders' behavior not only through pricing but through restrictive covenants. Thus, a model for evaluating the powers of the FDIC is the extent to which they take on the characteristics of bond covenants.[3]

Long-term debtholders have long recognized the potential for conflict between their interests and those of the issuing firm's shareholders. To the extent that investors can anticipate the future investment opportunities and risk characteristics of a given firm, the prices of that firm's equity and debt will incorporate risk permiums commensurate with the marginal cost to society as a whole. In theory, pricing could even incorporate a premium to compensate investors for the possibility that the issuing firm would be able to operate until the entire value of the long term debt had been exhausted. (The price of the firm's equity would be higher and the price of the firm's debt would be lower than otherwise.) However, investors might then require such a high premium for holding bonds that no market for long-term debt would develop. Consequently, long-term debt contracts also contain covenants that constrain the shareholders' ability to engage in activities that would place bondholders at such a risk.[4] These covenants generally place restrictions on the issuing firm's dividend, financing and/or investment policies. Violations of such covenants give the bondholders the right to re-negotiate the terms of the indenture or even to declare the firm in default and seize collateral or accelerate the maturity of the debt, frequently forcing the firm into bankruptcy.[5]

One type of covenant common to many debt contracts places restrictions on the ability of the firm's management to reduce the value of the firm's debt coverage through stock repurchase and/or dividend policy. By specifying the percentage of the pool of current and retained earnings and new stock issues that is available for dividends, redemptions and repurchases, this type of covenant prevents the firm's owners from reducing investment (and therefore, the value of outstanding debt) to increase share values.

A second class of covenants found in long-term debt contracts covers actions by a firm's shareholders that would tend to dilute the claims of bondholders. For example, covenants of this sort may require that a firm maintain certain financial ratios such as capitalization to debt and short-term assets to short-term debt at pre-specified levels as a condition of issuing additional debt. There are also likely to be restrictions on the issuance of debt with claims senior to those of the outstanding debt.

Finally, while covenants are not generally written to constrain a firm's investment choices directly (because of prohibitive enforcement costs), many have that effect. Constraints placed on dividend and financing policy will also constrain investment policy by limiting the firm's cash flow. Moreover, restrictions on the disposition of assets and the acquisition of claims against other firms make the pursuit of a more risky investment policy more difficult.

### Regulatory Means

In the same way that restrictive covenants protect bondholders, regulations regarding, among other things, loan concentrations, insider transactions and capital adequacy standards can protect the deposit insurance fund by constraining banks' investment and financing choices. The most significant check on the actions of a bank's shareholders, of course, is the enforcement of capital adequacy standards. The FDIC has stated that it will enforce a *minimum* capital-to-total assets ratio of five percent for the banks it insures, and that the adequacy of a bank's capital structure will be evaluated in light of the riskiness of the bank's portfolio.[6] Capital includes reported equity capital, reserves (including loan loss reserves) and mandatory convertible subordinated debt—net of loans the FDIC has classified as having a high probability of default. This

policy, together with the FDIC's authority to order a bank to stop paying dividends under certain circumstances, serves to protect the insurance fund from shareholders' policies that are contrary to the FDIC's interest.

By enforcing a minimum capital standard, the FDIC is effectively placing restrictions on a bank's ability to reduce coverage (protection) for the deposit insurance fund. Bond covenants restricting a firm's dividend policy serve the same purpose. Moreover, a minimum capital standard limits the extent to which a bank can issue more deposits and thereby increase the size of the FDIC's liability without also increasing the size of the bank's capital base. Finally, the FDIC's policy on bank capital significantly constrains a bank's ability to follow risky lending and investment policies. By requiring banks to subtract from their capital base the (book) value of loans with a high probability of default, the FDIC is able to force shareholders to absorb more of the costs of risky lending policies. Likewise, by stating that it will establish higher capital standards for riskier banks, the FDIC is again requiring shareholders to absorb the costs of increased risk-taking.

Additional restrictions on banks' ability to pursue risky policies include various regulations limiting both concentrations of loans to any given borrower and transactions between a bank and its executive officers, directors or principal shareholders. Moreover, regulations regarding debt issuance and pledged assets constrain a bank's ability to dilute the claims of the insurance fund. Like bond covenants restricting a firm's ability to issue new debt with claims senior to those of existing debtholders, prohibitions against preferred debt in a bank's capital structure prevent some forms of claim dilution. Likewise, the ruling that only the uninsured deposits of public units may be secured by a pledge of assets places a check on banks' ability to undermine the FDIC's claim on their assets in case of insolvency. Finally, like many bond contracts, bank regulators require that banks have an adequate system of internal audits and that they purchase insurance to protect against certain types of risk, such as theft, fraud and employee infidelity. These requirements provide a buffer for the deposit insurance fund, particularly since many bank failures have involved fraud or insider abuses.

Clearly, then, bank regulation has much in common with restrictive bond covenants that are designed to control shareholders' tendencies to maximize their share values at the expense of the bondholders (or the deposit insurance fund). And, like bondholders, bank regulators have substantial powers to enforce these regulations. The next section evaluates the FDIC's use of these powers.

## III. Enforcement Options

Although the FDIC insures the deposits of nearly all banks in the U.S., it can take direct enforcement action only against the state-chartered nonmember banks.[7] Thus, the FDIC regulates and supervises directly only 59 percent of the more that 14,000 insured banks (and only about 23 percent of the total banking assets) in this country. While the other federal regulators have substantially the same powers over the remaining institutions, this division of authority could increase the risk to the deposit insurance fund because the other regulators might perceive risk differently from the FDIC. To reduce the risks arising from this division of powers, the FDIC is seeking legislation to give it the full range of enforcement powers over the banks it does not supervise directly.[8] However, its record as supervisor of banks over which it *does* have direct authority suggests that even if granted expanded powers, the FDIC is not likely to enforce regulations much more vigorously than the other regulators.

On the whole, the FDIC has tended to make limited use of its current enforcement powers, particularly those involving legal proceedings, despite the substantial increase in risks to the insurance fund (as measured by the substantial losses incurred by the FDIC) over the last several years. Thus, although the FDIC has the authority to thwart insured nonmember banks' expansion plans, issue cease-and-desist orders, impose civil money penalties, suspend/remove bank officers and directors and ultimately terminate the insurance of *any* insured bank, it has tended to rely mainly on informal agreements with offending institutions and on more frequent examinations of their portfolios. Of

course, these last two actions are frequently sufficient to induce an insured institution to change its behavior. Nevertheless, the FDIC's apparent reluctance to resort to more serious measures until institutions are on the verge of insolvency unnecessarily increases the risk to the insurance fund.

### Formal Agreements

As a first step in inducing a nonmember bank to change its behavior, the FDIC always attempts to obtain some agreement from the bank to rectify the situation (including a plan to increase capital). The FDIC also increases the frequency of examination to monitor the bank's efforts at changing its practices. Such actions impose the burden of a significant cost on the bank, comparable, in some ways, to an increase in the insurance premium rate. Thus, like bond covenants that give bondholders the right to force the issuing firm to renegotiate the terms of the original contract when it has violated one or more of its provisions, the FDIC's ability to increase the frequency of examinations enables the agency to "renegotiate" the terms of the deposit insurance "contract" to reflect the increase in risk assumed by the fund.

Should agreements and more frequent examinations prove ineffective, the FDIC may decide to deny a nonmember bank's application to expand its activities. The FDIC has stated that it will use its authority to deny branch and acquisition applications, for example, as a means of forcing a bank to improve a seriously impaired capital structure.[9] This power is analogous to bond covenants that prevent a firm from undertaking certain types of activities until pre-specified minimum levels of capitalization and working capital, for example, are met. However, the FDIC has been criticized for not making greater use of this authority. The agency, together with the other bank regulators, allowed bank capital ratios to decline throughout the 1970s and early 1980s—at a time when most observers would argue that the more uncertain economic climate called for higher capital ratios. This decline has been especially pronounced at the large banks, where capital fell below 5 percent of assets between 1978 and 1981 (See Table 2.) Of course, a sizeable proportion of these large banks are not supervised directly by the FDIC. However, it is not clear that the FDIC would have been significantly more stringent in regulating these banks' capital in any case. For example, in the United American Bank failure, the FDIC *did* have direct supervisory authority but nevertheless permitted the bank to continue expanding its branch network even *after* the bank had been deemed in danger of failing.[10] (As mentioned earlier, the bank and its affiliated banks failed in February 1983.)

### Legal Proceedings

The FDIC also has the ability to threaten and initiate legal proceedings (including termination of deposit insurance) against a bank. However, because of the costs (administrative hearings, for example) and delays involved in imposing these legal sanctions, the FDIC generally does not resort to them except in the most extreme cases. Until 1966, termination was the only legal proceeding the FDIC could bring against a bank, and it remains the only legal proceeding the FDIC can bring against the banks it does not supervise directly. Between 1966 and 1983, the FDIC initiated an average of only six

**Table 2**
**Captial Trends In Insured Banks**

| | Equity Capital as a Percentage of Total Assets | | |
|---|---|---|---|
| Year | All Banks | Large Banks[1] | Small Banks |
| 1960 | 8.1 | | |
| 1965 | 7.5 | | |
| 1970 | 6.6 | | |
| 1971 | 6.3 | | |
| 1972 | 6.0 | | |
| 1973 | 5.7 | | |
| 1974 | 5.6 | | |
| 1975 | 5.9 | | |
| 1976 | 6.1 | 5.3 | 7.7 |
| 1977 | 5.9 | 5.1 | 7.5 |
| 1978 | 5.8 | 4.9 | 7.7 |
| 1979 | 5.7 | 4.8 | 7.8 |
| 1980 | 5.8 | 4.8 | 8.0 |
| 1981 | 5.8 | 4.9 | 8.1 |
| 1982 | 5.8 | 5.0 | 8.1 |

1. Large banks are those with total assets in excess of $300 million.
2. Data by size of institution were not available until 1976.

Source: FDIC, *Assets and Liabilities of Commercial and Mutual Savings Banks*.

termination proceedings a year—far below the annual average of 284 banks that were considered problem institutions over that same period. Since its inception, the FDIC has initiated only 307 termination proceedings even though the number of banks operating with negative net worth has undoubtedly exceeded the number (668) that actually failed. This reluctance to resort to termination proceedings is particularly significant since termination of deposit insurance is tantamount to a declaration of insolvency. A greater willingness to terminate would help overcome the FDIC's present lack of authority to close insolvent institutions.

### Other Enforcement Measures

In 1966 the agency was granted authority to issue cease-and-desist orders. Again, however, the FDIC has tended not to use this power except in cases of *serious* multiple infractions such as insider abuses, unsafe lending practices and/or serious impairment of capital. Between 1966 and 1975, only 37 such orders were issued. Since then, the agency has made greater use of this authority, issuing an average of more than 40 a year. Nonetheless, the FDIC still tends to use cease-and-desist only after the condition of a bank has deteriorated to the point where it represents a substantial risk to the insurance fund. Since cease-and-desist powers were granted to give the FDIC a more flexible weapon than termination proceedings, the reluctance to use these powers unnecessarily hampers the FDIC's efforts to reduce bank risk-taking.

The FDIC's authority to impose civil money penalties, granted in 1978, has been used very infrequently. Only 11 were issued in 1982 and only three in the preceding years. In general, the FDIC uses this authority only after a bank has violated a cease-and-desist order, even though it has the authority to impose penalties for violations of laws limiting dealings with bank officials and/or corporate affiliates of the bank. Finally, the substantial restrictions on the exercise of the FDIC's authority to suspend or remove bank officers and directors mean that the FDIC has made limited use of this authority as well.

Thus, although the FDIC has considerable authority to take actions against a bank that poses a substantial risk to the insurance fund, such authority is used infrequently. In the end, this reluctance increases the losses borne by the FDIC and raises the value of the subsidy to bank risk-taking.

## IV. Insolvency Proceedings

Once an insolvent institution is finally closed, the means by which the FDIC disposes of that institution may affect the size of the FDIC's reported losses to some extent, but it will not affect the (ex ante) risk-taking behavior of insured institutions further (with one exception as noted below). However, because unnecessary losses impose additional costs on society by diminishing the FDIC's resources to handle future failures (the agency may be forced to raise effective assessment rates or, in the case of widespread failure, seek assistance from the Treasury or the Federal Reserve System), minimizing actual losses associated with bank failures even *after* banks fail may be as important a social goal as minimizing potential losses *before* banks fail. Therefore, this section examines the FDIC's options for disposing of insolvent institutions.

As the receiver[11], the FDIC has several options for liquidating the assets of and paying off the claims against a failed bank. First, it can pay off the bank's depositors up to the insurance maximum of $100,000. Second, it can arrange for another institution to purchase the assets and assume the liabilities—Purchase and Assumption (P&A)—of the failed bank. Third, it can arrange a financially assisted merger which is, in many respects, equivalent to a P&A. Or fourth, if it decides that closing the bank is not the best approach, it can make loans or provide other financial assistance to the bank to keep it open. The FDIC's choice among these options depends primarily on which, in each case, involves the least cost to the FDIC (on the basis of initial estimates). However, these costs are estimated on the basis of accounting costs and may not give appropriate consideration to the effects of the transaction on the market value of the fund. As a result, the FDIC's choice may at times reduce the value of the fund unnecessarily.

### Deposit Payoff

In a deposit payoff, the FDIC literally pays a bank's depositors the value of their claims against

the bank up to the insurance maximum. The agency may choose to make the payments directly or, as it has done in a handful of cases, pay depositors through a Deposit Insurance National Bank (DINB) which it is authorized to operate for up to two years. In either case, by paying off the depositors, the FDIC assumes the depositors' claims and becomes a general creditor of the failed bank. Then, as receiver, the FDIC sells the assets of the bank and distributes the proceeds to the bank's creditors, including the insurance fund and the uninsured depositors, according to the legal priority of the claim and in proportion to the relative size of the claim. If the value of the assets is insufficient to cover the value of the liabilities, the FDIC as well as every other creditor (with the possible exception of preferred creditors or those with secured claims) receive only a portion of the value of their claims.

However, the FDIC, as receiver, can take certain steps to reduce the size of the losses incurred by the failed bank's creditors in a deposit payoff case. To the extent that the bank has insured depositors who also have delinquent loans outstanding at the bank, the FDIC can reduce its insurance liability *and* the losses incurred by the other creditors by offsetting the (book) value of the loan against the par value of the insured deposit. If the FDIC were to pay off the full value of the deposit and sell the delinquent loan, the receivership would incur a loss equal to the difference between the book and market values of the delinquent loan. In effect, the loan offset policy transfers this loss from the general creditors of the failed bank to the borrower/depositor.

At the same time that the FDIC uses a delinquent-loan offset policy to *reduce* its liability and to protect the insurance fund, curiously, it also offers uninsured depositors a "sound"-loan offset which *increases* its liability. In essence, depositors are allowed to use the book value of their indebtedness to the failed bank as an offset against the par value of their uninsured deposit to *increase* their deposit insurance protection. A depositor with a $50,000 loan from the bank and a deposit of $140,000, for example, would find this offset policy in her interest because, by using the deposit to discharge the indebtedness, the remaining deposit would be $90,000—which is fully insured. Without the loan offset, she would receive protection for only $100,000 of her deposit and her $50,000 loan liability would remain. With a good credit rating, the borrower/depositor would presumably have no trouble refinancing her loan and, as a result of the loan offset, will have protected herself against a possible loss on the uninsured portion of the deposit.

The FDIC has chosen to offer depositors this option because it enables the agency to reduce the size of its initial cash outlay. In the example above, the FDIC would have paid $100,000 without the offset, but only $90,000 with the offset. This emphasis on cash outlay is misplaced in this case, however. The policy will likely increase the FDIC's losses because, by allowing depositors to wipe out their indebtedness to the bank, the FDIC is reducing the aggregate value of the receivership's assets by more than it is reducing the value of its claims on the receivership's assets. In the example above, the assets of the receivership were reduced by $50,000, while the FDIC's claim was reduced by only $10,000. In effect, the FDIC is allowing other general creditors (that is, uninsured depositors) to assert their claims against the bank ahead of its own claims. To the extent that the receivership incurs losses, then, the FDIC will bear a larger share of them.

The FDIC has used the deposit payoff approach in 328 of the 668 failed bank cases between 1934 and 1983. With the notable exception of Penn Square National Bank in 1982, the banks whose deposits have been paid off by the FDIC have been small— holding an average of $3.4 million in total deposits. The FDIC chose to pay off these banks because high-cost liabilities, undesirable markets and/or limitations on intra-and interstate branching, among other things, made them relatively unattractive to potential bidders. Moreover, in some of the cases, particularly that of Penn Square, the existence of large contingent claims against the bank or the suspicion of fraud made the FDIC's costs under a purchase and assumption transaction potentially quite large, causing the agency to opt for the high, but more certain, costs of a payoff.

## Purchase and Assumption

Of the remaining 340 insured bank failures between 1934 and 1983, the FDIC arranged P&As for the overwhelming majority. The P&A approach

is clearly preferred by the agency for dealing with the failure of large banks. In fact, until the failure of Penn Square, which was paid off for the special reasons already noted, any bank with even $100 million in deposits was always disposed of through a purchase and assumption or a comparable financially assisted merger. The P&A is preferred because it is less disruptive than the payoff approach and has apparent cost advantages. In a deposit payoff, the bank's business is liquidated and the going-concern value is lost. In a P&A, by contrast, the winning bidder acquires the failed bank's business and pays a premium for it, offsetting a portion of the FDIC's costs. For large banks, in particular, this premium, which reflects the acquiring bank's valuation of the "goodwill" inherent in the failed bank's branch network and customer relationships, among other things, is generally sufficient to reduce the estimated cost of the P&A below that of the payoff. Moreover, the authority given to the FDIC by the Garn-St Germain Depository Institutions Act of 1982 to arrange interstate and interindustry purchases should increase these premiums because the FDIC will be able to sell multi-state charters that are not otherwise legally permissible.

In its simplest form, the purchase and assumption transaction requires that the acquiring institution assume *all* the deposit liabilities[12] and most other nonsubordinated liabilities of the failed bank. With these liabilities, it acquires "clean" assets of equivalent value—typically, the failed bank's premises (at appraised value), the securities portfolio (marked-to-market) and the performing loans (at book value), plus cash from the FDIC (less the amount of the purchase premium) to make up the difference between the values of the liabilities assumed and the assets acquired. Finally, because the acquiring bank does not assume all the failed bank's liabilities, the FDIC agrees to idemnify it against any costs arising from claims it does not explicitly assume.

The accounting origin of the FDIC's cash outlay is either a loan (at below-market rates) by the FDIC to the receivership secured by the remaining, unacceptable assets (at book value), or an outright purchase of those assets (at book value). Then, as the FDIC liquidates the assets it has acquired, it distributes the proceeds among the remaining claimholders according to the priority of their claims and in proportion to the size of their claims. Thus, to the extent that the FDIC can either sell the nonperforming loans at some price or force delinquent borrowers to pay off their indebtedness, the FDIC will recover a portion of its cash outlay.

By preserving the going-concern value of the failed bank, the FDIC has been able to use the P&A to reduce its recorded costs. However, because the use of the P&A provides, in effect, 100 percent insurance coverage to *all* depositors (including those with deposits in excess of $100,000) and many other uninsured creditors[13], as well, this approach increases the FDIC's liability unnecessarily and probably results in an understatement of the true costs of the transaction for two reasons. First, the FDIC is removing a source of market discipline on the risk-taking proclivities of *all* insured banks. Thus, the FDIC has greatly increased its potential liability by increasing the likelihood that insured institutions will engage in excessive risk-taking. As a result, the effect of this transaction on the value of the deposit insurance fund is seriously understated.

Second, while other general creditors are made whole immediately, the FDIC is repaid only as it sells the poor quality assets that were not assumed by the acquiring institution. These assets are likely to require extraordinary expenses to be made marketable, and the FDIC's initial estimates of the cost of the P&A may not adequately take these expenses into account. Moreover, only the FDIC and subordinated creditors remain to bear these expenses. (For example, in one case, the FDIC had to invest an additional $1 million in a real estate development it had acquired before it could sell the development.[14]) Although the purchase premium may offset a portion of these expenses, in many cases, the premium is not sufficient to provide a full offset (that is, the net worth of the failed bank is still negative when its goodwill is included). Therefore, the FDIC could reduce its losses significantly by sharing these costs with uninsured depositors and other general creditors. Recent P&A transactions in which only the insured deposits of the failed bank have been assumed by the acquiring institution suggest that the FDIC may be moving in this direction.

Thus, part of the attractiveness of the P&A, from the FDIC's perspective, may result from tendencies to understate the full cost of the transaction. If the

FDIC had accounted for these transactions on a market-value basis, the P&A (as it has been administered) might not have been the preferred option in as many cases, despite the loss of going-concern value under a deposit payoff. This may be particularly true when uninsured deposits represented more than a miniscule proportion of total liabilities.

### Financially Assisted Mergers

A few of the more than 300 transactions the FDIC counts as P&As were actually financially assisted mergers (FAMs). Most of these involved large mutual savings bank failures—12 occurred between 1981 and early 1983. The FDIC counts these as P&As because, while they differ from P&As in a number of technical respects, their impact on the liability of the FDIC is comparable to that of P&As. The decision to use a merger instead of a P&A for failing mutual savings banks is based largely on the distinguishing characteristics of mutual savings banks and not on the relative costs to the FDIC of a merger and a P&A.

Unlike commercial banks, mutuals' problems are due primarily to interest rate risk. The combination of a duration mismatch between their long assets and short liabilities and the upward trend in interest rates since the mid-1970s steadily eroded the industry's reported net worth. On a market value basis, the erosion was dramatic: by 1980, the value of the industry's assets had declined so much that it was substantially insolvent.

Given this erosion in the market value of a mutual's *entire* portfolio, the practice of dividing assets into "acceptable" and "unacceptable" categories does not make sense. Instead, in its handling of failing mutuals, the FDIC undertakes to keep the institution open until it can, by providing some form of financial assistance, arrange a merger with a stronger institution. In the typical FAM (although the specifics of each transaction vary considerably), the acquiring institution accepts a large portion of the failing institution's assets (generally at book value) and most of the liabilities as well. It also obtains the goodwill of the failed institution. Then, because the market value of the acquired liabilities exceeds that of the acquired assets, the FDIC provides the acquiring institution with sufficient financial assistance to make up the difference.

This assistance can take several forms. First, the FDIC can make a cash loan to the acquiring institution at a rate below the appropriate risk-adjusted rate. The FDIC's losses in this case will be in the form of foregone interest. Second, the FDIC can purchase some of the assets of the failing bank at their book values. For example, in the FDIC's handling of the merger of Greenwich Savings Bank with Metropolitan Savings Bank, the FDIC assumed responsibility for repaying a $428 million loan from the Federal Reserve Bank of New York and received in return approximately $480 million (book value) of Greenwich's assets which were actually worth about half their book value. The FDIC's losses under this form of assistance are equal to the difference between the value of the cash outlay (or liability assumed) and the market value of the assets acquired.

On the FDIC's books, this transaction would appear as an increase in the FDIC's assets equal to the book value of the assets assumed and either an increase in liabilities equal to the liability assumed or a decrease in cash assets equal to the net cash outlay. The difference between the book and market values of the assets acquired would be recorded as a loss which reduces the FDIC's net worth (that is, the insurance fund). Thus, this approach should provide an accurate accounting of the true cost, assuming the FDIC can arrive at a close estimate of the market value of the acquired assets. As in the case of P&As, however, the same problems with estimating extraordinary expenses incurred in disposing of acquired assets arise, making the FDIC's valuation of this type of transaction suspect.

The third approach, which the FDIC has chosen in nine of the 12 recent assisted mergers, may understate significantly the true cost of handling insolvent mutuals. Under this approach, the FDIC enters into an income maintenance agreement with the acquiring institution. It agrees to pay the difference between the average cost of funds for all mutual savings banks and the yield on the acquired earning assets over some period of years. Presumably, the acquiring bank is willing to pay a higher purchase "price" in a transaction involving an income maintenance agreement than in those involving a subsidized loan or a purchase of assets because such

an agreement transfers all interest rate risk to the FDIC.

The FDIC's potential losses, however, are also much higher. In effect, the FDIC is betting that interest rates will not rise significantly—the same thing that got the mutuals into trouble in the first place. Moreover, it is likely that the FDIC is not being fully compensated for these increased risks. Unless the bidding is fully competitive (that is, the investor who would be willing to pay the highest premium for the income maintenance agreement has the opportunity to bid for the failing institution), the FDIC's preference for income maintenance agreements may not take into consideration their full economic costs. As a result, this practice understates the full impact of the transaction on the value of the insurance fund.

### Financial Assistance to On-Going Banks

In addition to its powers in receivership cases, the FDIC has authority to provide financial assistance to an institution in danger of failing to keep it from failing. Such authority has serious implications for the control of risk-taking by insured institutions. To the extent that the FDIC is perceived as being willing to use this authority, insured institutions will have even greater incentive to take on risks because the FDIC assistance enables insolvent institutions to continue in operation even longer. Fortunately, the original legislation granting the FDIC this authority in 1950 limited its use to situations in which the FDIC determined that the continued operation of the bank was essential to its community.

The FDIC has made extremely limited use (a total of five failing bank cases have ben resolved this way) of this power not only because the agency tended initially to interpret the enabling legislation narrowly, but also because a more extensive use of such powers might be viewed as a usurpation of the Federal Reserve's lender-of-last-resort function. With the passage of the Garn-St Germain Act in 1982, however, the FDIC's authority in this regard was expanded to include nearly all failing bank cases. To date, the FDIC has not made use of its expanded authority. However, should the agency ever make use of this expanded power, it must, as a condition of providing such assistance, demand covenants that enable it to exercise substantial control over the operations of the recipient.

The FDIC's willingness to impose such conditions is clear from the assistance it provided First Pennsylvania National Bank in 1980. In this case, the assistance package fell under the essentiality test implicit in the original (1950) legislation. The FDIC found that the continued existence of the bank was essential to its community because its size was such that failure might precipitate a crisis of confidence in the banking system more generally. Had First Pennsylvania, with almost $8 billion in assets, been allowed to fail, it would have been the largest bank failure in the United States. Instead, the FDIC put together a $500 million term loan package comprising $325 million from the FDIC and $175 million from a consortium of other banks. In exchange for providing an interest rate subsidy on the package, the FDIC received warrants to purchase 13 million shares of the holding company's stock at $3 per share. The terms of the agreement also enabled the FDIC to place restrictions on the bank's dividend policy and to review the bank's financial plans periodically. In effect, the FDIC became a shareholder in the bank with the right, appropriately, to participate in the potential rewards associated with the increased risk it was assuming.

At the same time that the Garn-St Germain Act increased the FDIC's authority to give financial assistance to weak institutions, it also gave the agency the authority to prop up the net worth of mutual savings banks and other qualifying institutions through a net worth certificate program. The FDIC buys the net worth certificates of participating institutions (which can be counted as regulatory net worth) in amounts equal to a percentage of their operating losses. In return, the institution receives a promissory note from the FDIC. Although this transaction seems little more than an exchange of paper, it has important implications because it enables substantially insolvent institutions to continue in operation and increases the potential size of the FDIC's liability. In return, the FDIC receives greater control over the decisions of the participants and avoids the immediate costs associated with closing the institutions that would otherwise require receivership outlays. Thus, net worth certificates make the FDIC an equityholder in the failing institution, with an overriding vote on certain issues. Whether these powers are adequate to control risk-taking, however, remains to be seen.

## V. The Deposit Insurance Fund

In the FDIC's supervision of failing institutions and in its practices for disposing of failed institutions, the agency has not always behaved as if preserving the market value of the insurance fund (or minimizing losses) were the primary objective. To a certain extent, this may be due to a myopic emphasis on accounting costs—and not on true economic costs. As a result, the reported value of the deposit insurance fund may be misleading as an indicator of the FDIC's ability both to manage risk-taking among depository institutions and to handle widespread failures.

The deposit insurance fund was valued at $13.8 billion as of December 31, 1982, and represents the book-value net worth of the FDIC (see Table 3). Additions to the fund come from two sources: insurance premium payments from all insured banks (which amount to little more than a few basis points per dollar of deposits but which generate close to half of the FDIC's revenues) and interest income on the FDIC's $13.6 billion securities portfolio. The fund is diminished primarily by liquidation expenses, including the FDIC's estimate of its ultimate losses (net of recoveries) in connection with disposing the "bad" assets of failing institutions.

As mentioned earlier, assets acquired through insolvency proceedings are generally recorded at their par values even though they are worth considerably less. At the same time, however, the FDIC reduces its current income and therefore, the deposit insurance fund, by its estimate of the losses in connection with disposing of the failed institution. Assuming that this estimate is valued properly in the accounting records, the overstatement of the value of the FDIC's assets will be offset by the decline in the FDIC's income and in the value of the insurance fund. However, there is reason to believe that these estimates may not reflect true economic costs. The FDIC's provision of indemnity agreements and income maintenance agreements are just two instances in which the FDIC may be placing a lower value on the transaction than the market does. Moreover, because the FDIC's choice between a P&A or an FAM on the one hand, and a payoff on the other, will frequently depend on its initial estimate of losses under each approach, the tendency to understate the costs of a P&A (or FAM) will tend to bias the agency's decisions in favor of the P&A (or FAM) and reduce the value of the insurance fund by more than might have been the case in a payoff. Likewise, the FDIC's provision of open-bank assistance (that is, loans and/or mutual capital certificates) in return for greater control over the operations of the affected institution amounts to an equity position in a failing institution. Such an investment is extremely difficult to value, providing another source of distortion in the reported value of the insurance fund.

## VI. Summary and Conclusions

The recent deregulation of deposit rates may have increased the risks to the deposit insurance fund by enabling depository institutions to increase their ability to attract insured deposits (by offering higher rates than competitors) and thereby stay in operation long after their net worth has been exhausted (on a market value basis). The FDIC should address this problem of increased risk by exerting greater pressure on the chartering agencies to close insolvent institutions. Moreover, the agency needs to engage in more vigorous enforcement of certain "safety and soundness" regulations—risk-adjusted capital adequacy standards, in particular. Of course, this approach may seem contrary to the spirit of financial deregulation. As we have seen, however, it has a direct counterpart in the largely unregulated private long-term debt market.

Like deposit insurance, the existence of long-term debt in a firm's capital structure gives shareholders incentive to undertake increased risk after the debt is issued. As a result, long-term debt contracts usually contain covenants to prevent increased risk-taking. These covenants generally place restrictions on the issuing firm's dividend, financing and/or investment policies. Violations of these covenants give the bondholders the right to renegotiate the terms of the indenture or even to declare the firm in default and thus force the firm into bankruptcy.

In the same way that restrictive covenants protect bondholders, regulations regarding loan concentrations, insider transactions and capital adequacy standards can protect the deposit insurance fund by constraining banks' investment and financing choices. And, like bondholders, bank regulators have substantial powers to enforce these regulations, including the authority to issue cease-and-desist orders, impose civil money penalties, remove bank officers and directors and close insolvent institutions. However, bank regulators have displayed a surprising reluctance to resort to these powers. The FDIC's losses and the subsidy to risk-taking, as a consequence, have been larger than they would have been otherwise.

Once insolvent institutions are finally closed, the choice of liquidation proceedings need not affect the risk-taking behavior of insured institutions further. That choice may, however, affect the losses incurred by the insurance fund. Because unnecessary losses impose additional costs on society, minimizing receivership losses may be as important a social goal as minimizing potential losses prior to actual failure. Because the estimated accounting costs of each of the FDIC's liquidation options may give a distorted picture of the true economic costs, they may lead the agency to choose an option that increases receivership losses unnecessarily. Moreover, certain practices associated with purchase and assumptions, financially assisted mergers and financial assistance all make the recorded value of the insurance fund a less reliable measure of the FDIC's resources.

## Table 3
## Assets, Liabilities and the Deposit Insurance Fund of the Federal Deposit Insurance Corporation
**As of December 31, 1982**
**(thousands of dollars)**

| Assets | | |
|---|---|---|
| Cash | | $ 1,335 |
| U.S. Treasury securities: | | |
| bills | | 4,440,238 |
| notes and bonds | | 9,119,243 |
| | Total | 13,559,481 |
| Assistance to insured banks: | | |
| short-term notes receivable | | 82,933 |
| long-term notes receivable | | 654,643 |
| net worth certificates | | 174,529 |
| special assistance | | 7,816 |
| *less:* allowance for losses | | (3,227) |
| | Total | 916,694 |
| Equity in assets acquired from insured banks: | | |
| depositors' claims paid | | 320,216 |
| depositors' claims unpaid | | 9,547 |
| loans and assets purchased | | 609,148 |
| assets purchased outright | | 401,563 |
| *less:* allowance for losses | | (628,405) |
| | Total | 712,069 |
| Other assets | | 43,946 |
| Total assets | | $15,233,525 |

| Liabilities and the Insurance Fund | | |
|---|---|---|
| Accounts Payable and Accrued Liabilities | | $ 162,331 |
| Notes Payable: | | |
| short-term | | 201,205 |
| long-term | | 185,753 |
| | Total | 386,958 |
| Liabilities incurred in bank failures: | | |
| FRB & FHLB indebtedness | | 147,666 |
| Notes payable | | 476,484 |
| Income maintenance agreements | | 276,595 |
| Depositors' claims unpaid | | 9,547 |
| | Total | 910,292 |
| Estimated losses from ligitation (including indemnity agreements) | | 3,000 |
| Total liabilities | | 1,462,581 |
| Deposit Insurance Fund | | 13,770,994 |
| Total | | $15,233,525 |

## FOOTNOTES

1. This assumes that there are no externalities associated with the risks taken by one institution. In fact, there are likely to be such externalities, otherwise deposit insurance could probably be provided without government involvement. To account for these externalities, all the insurer need do is close insured institutions when their net worth declines to some positive amount, for example, 5 percent of assets.

2. See Tim Campbell and David Glenn, "Deposit Insurance in a Deregulated Environment," **Journal of Finance**, May 1984, for a discussion of alternative bankruptcy mechanisms.

3. I am indebted to David Pyle for suggesting long-term debt as a possible paradigm for deposit insurance. His comments on this subject have been most helpful.

4. Whether the use of bond covenants to control the shareholder/bondholder conflict increases the value of the firm relative to other means of controlling that conflict is a source of debate in finance literature.

5. This section draws on material presented by Clifford W. Smith, Jr. and Jerold B. Warner in "On Financial Contracting: An Analysis of Bond Covenants," **Journal of Financial Economics**, 7(1979), p. 117-161, which discusses the use of bond covenants to control the stockholder/bondholder conflict.

6. Federal Deposit Insurance Corporation, "Statements of Policy," **Laws, Regulations, Related Acts**, Volume 1, p. 5223.

7. Those banks having a national charter are supervised by the Comptroller of the Currency. State-chartered member banks are jointly supervised by the appropriate state banking authority and the Federal Reserve System.

8. Currently, when the FDIC's interpretation of the riskiness of a particular practice differs from that of the bank's primary regulator, the FDIC can resort only to a termination of insurance proceeding. See **FDIC: The First Fifty Years**, Federal Deposit Insurance Corporation, Washington, D.C., 1984, p. 124.

9. FDIC, Statement of Policy, p. 5223.

10. "Federal Supervision and Failure of United American Bank in Knoxville, Tenn., and Affiliated Banks," **Twenty-Third Report, by the Committee on Government Operations**, November 18, 1983; 98th Congress, 1st Session.

11. The Comptroller must appoint the FDIC receiver for national banks. Although state banking regulators are not required to appoint the FDIC receiver for state-chartered banks, they almost always do.

12. Although a loan offset policy is not generally applicable to P&A transactions, the FDIC does occasionally offset problem loans of the bank's directors against those individuals' deposits. This policy protects the interests of the receivership in cases where fraud and insider abuses are suspected.

13. **Deposit Insurance in a Changing Environment**, Federal Deposit Insurance Corporation, April 15, 1983.

14. **FDIC: The First Fifty Years**, p. 104.

# A View On Deposit Insurance Coverage

**Frederick T. Furlong***

*The FDIC is experimenting with a "modified payout" plan for dealing with bank failures. By eliminating what has been an implicit insurance guarantee on large deposits, the plan re-establishes the traditional separation of insured and uninsured deposits on the basis of account size. The modified payout approach to deposit insurance protects the "small depositor" but does not contribute to the stability of the banking system. The latter role of deposit insurance dictates that deposits should be insured on the basis of account maturity, with liquid deposits receiving insurance.*

*(This article was written before the FDIC announced that it would cover all deposits at the troubled Continental Illinois Bank and Trust Co. in the Spring of this year. The Continental case points up the problem connected with leaving large-denomination liquid deposits uninsured, and raises doubts about the viability of the modified payout plan as it was originally designed.)*

The relationship between the Federal Deposit Insurance Corporation and depositors could be undergoing a substantive change. Since the 1930s, deposit insurance has helped to stabilize the banking industry by assuring depositors that their funds were safe. Recently, however, the FDIC has implemented a plan to increase the riskiness of large-denomination deposits as a means of protecting the insurance fund.

Putting holders of large-denomination deposits at risk may not seem like a significant alteration to the deposit insurance system. After all, since the inception of federal deposit insurance, insured and uninsured deposits have been segregated on the basis of account size. Over the years, the insurance limit has been increased from $2,500 in 1933 to the current level of $100,000[1], but the distinction has nevertheless been maintained, at least on paper. In practice, with some exceptions (the most notable being the failure of Penn Square Bank in 1982), holders of "uninsured" deposits have not incurred losses from bank failures.

This *de facto* insurance of large-denomination accounts primarily has been a by-product of the procedures used by the FDIC to handle many problem banks, and has not stemmed from the view that the "proper" role of deposit insurance encompasses all deposits. To the contrary, the FDIC sees the *de facto* coverage of all deposits as a problem in the administration of deposit insurance.[2] Accordingly, it has decided to adopt a new approach that will increase the probability of losses to holders of large accounts.[3]

The FDIC's plan can be viewed as affirming the validity of separating insured and uninsured deposits by account size. This paper's purpose is to examine critically both the FDIC's plan and the appropriateness of using account size to determine which deposits are insured. In particular, the paper evaluates whether a plan to increase the riskiness of large-denomination deposits (and not other deposits) is consistent with the basic function of deposit insurance.

The paper concludes that imposing greater risk on "large depositors" is consistent only with the "small-depositor" protection rationale for deposit insurance. Increasing the riskiness of all large-denomination deposits is not compatible with the objective of achieving stability in the banking sys-

*Economist, Federal Reserve Bank of San Francisco. My thanks to the editorial committee, Jack Beebe and Michael Keeley for helpful comments.

tem through deposit insurance. Indeed, since the bulk of large-denomination deposits is held in short-term accounts, raising the level of risk on those deposits could make the banking system more unstable by increasing the probability of "bank runs."[4] The paper suggests that *if* the main purpose of deposit insurance is to enhance the stability of the banking system, then it may be more appropriate to base insurance coverage mainly on terms of maturity, with short-term deposits receiving the insurance coverage.

## I. The FDIC Plan

Until recently, the *de facto* coverage of so-called "uninsured" deposits has resulted from the way that the FDIC has chosen to deal with many bank failures.[5] The FDIC's propensity to use purchases and assumptions, rather than deposit payouts and asset liquidations, has stemmed mainly from practical considerations. For example, purchases and assumptions have been judged to be less costly to the insurance fund than direct payouts. Covering even large deposits when using purchases and assumptions primarily reflects the FDIC's view that to have done otherwise would have been too disruptive to financial markets, since it can take some time for depositors and the FDIC to recover their claims when assets are liquidated.

In this context, the coverage of large-denomination deposits *per se* has been an incidental, not essential, function of deposit insurance. If possible, the FDIC would prefer to subject large-deposit holders to risk, lest they have no reason to be concerned with the financial condition of banks. Large depositors would otherwise not devote resources to monitor banks or constrain risk-taking by demanding interest-rate premiums that reflect the risk exposure of banks. Such a situation enhances the incentives for banks to engage in risky activities, if the banks also were left unchecked by the FDIC.

The potential for increased risk-taking when deposit insurance is provided is essentially the moral hazard problem faced by all insurers. In principle at least, the FDIC could attempt to reduce the problem by manipulating insurance premiums. In practice, the current fixed-rate premium does not curtail risk-taking on the margin, and it is unlikely that an effective structure of risk-related premiums will be adopted.[6] Consequently, the FDIC, in conjunction with other bank-regulatory agencies, probably will continue to rely on supervision and regulation as the main tools to restrain banks from engaging in excessively risky enterprises. However, the FDIC has taken the position that deregulation and increased competitiveness in banking have made the use of these latter tools complex and costly.[7] So, in the case of large-denomination accounts at least, the FDIC has decided to solve the moral hazard problem by eliminating what has been an implicit insurance guarantee.

To remove the implicit insurance guarantee for large depositors, the FDIC is experimenting with what might be called a modified payout approach for dealing with bank failures. Under the new approach, holders of large-denomination deposits will receive immediately *pro rata* shares of what the FDIC thinks it can recover from the liquidation of a failed bank's assets.[8] This means that holders of large-denomination deposits will not have their funds tied up in bankruptcy proceedings.[9] Consequently, the modified payout approach avoids what the FDIC views as one of the major sources of disruption to financial markets associated with the traditional mechanism for payouts.

Under the FDIC's experimental plan, insured deposits will continue to be handled in two ways. In situations where the FDIC cannot find another institution willing to assume the insured deposits, the FDIC will merely pay off the insured depositors. When the FDIC can find a willing bidder, the insured deposits and a comparably valued set of assets will be assumed by the other institution. The latter situation essentially represents a combined payout/purchase and assumption arrangement.[10]

The impact of the new FDIC policy will be to increase the uncertainty among "uninsured" depositors as to whether they will share in the losses of a failed bank. With a greater probability of financial loss, holders of large-denomination deposits will have an incentive to monitor banks more closely, and the cost of uninsured funds will reflect the risk

exposure of depository institutions. In this way, uninsured depositors acting in their own interest will theoretically serve as a check on the risk-taking of depository institutions.

The FDIC's call for reliance on market forces is quite appealing. The current move toward deregulation in financial markets and other industries is based on the sound premise that allowing greater latitude for market forces to operate can result in gains in efficiency for the economy. However, one must recognize that the apparent gains promised by the FDIC plan merely stem from undoing adverse side effects introduced by the provision of deposit insurance. Nothing extra can be gained; there simply will be uninsured deposits. The questions remain: Why do we have deposit insurance in the first place? And, is using account size to determine insurance status consistent with that function? These issues are addressed in the next two sections.

## II. Role of Deposit Insurance

It is probably safe to assert that the function of deposit insurance is to protect depositors. However, to identify the categories of deposits that should be insured, it is first necessary to determine why depositors need to be protected. Two objectives generally are ascribed to deposit insurance. The first is that deposit insurance should protect depositors of modest means from incurring losses due to bank failures; the second is that it should protect the economy in general from the consequences of instability in the banking system.

### Small-Depositor Protection

The first objective, of course, is the "small-depositor" rationale for federal deposit insurance. This justification for deposit insurance is at the root of the policy that determines insurance status on the basis of deposit account size. While there are a number of facets to the small-depositor argument, an important distinguishing feature is that deposit insurance is intended to protect depositors from the private cost of bank risk. Small depositors, for example, have been considered savers of limited means, who are, in comparison to large depositors, at a disadvantage in discerning (that is, at a sufficiently low cost relative to the benefits) the riskiness of depository institutions. In addition to being less effective in determining the risk of individual institutions, small depositors are presumed to be more susceptible to risk exposure because they are less able to diversify their financial holdings.

Under the small-depositor justification, the function of federal deposit insurance is to bear the risk for the insured depositors. Moreover, it is the role of the insurance agencies to assume the responsibility of constraining risk-taking by banks. Federal insurers take on this responsibility instead of the private market alone because they are assumed to be better able to acquire information on banks and to constrain their risk-taking than small depositors. Leaving large depositors uninsured, of course, implies that large depositors are at least as good, if not better, than the federal agencies at determining the riskiness of banks, and in pricing the private risk accordingly.

While the small-depositor rationale provides a basis for having small-denomination deposits insured and large-deposit accounts uninsured, it does not explain why deposits should be treated differently from other assets. The difficulties of small depositors likely are the same as the ones facing savers with small interests in mutual funds, or only a few thousand dollars invested in tax-exempt bonds issued by, say, the Washington Public Power Supply System. It might be argued that it is "desirable" as a matter of public policy to provide a safe savings vehicle for small savers. However, even if this were the case, it is not necessary to have deposits serve as the risk-free asset. Indeed, savers today can invest in liquid nondeposit securities that are free of default risk by purchasing shares in money market mutual funds that hold only Treasury securities. Moreover, mutual funds and brokered deposits can allow even small savers an opportunity to realize the benefits of diversification.

Overall, perhaps unlike the 1930s, financial markets today appear to supply ample opportunities for safe investments outside the system of depository institutions. If protecting small savers were the

reason for maintaining insurance, federal deposit insurance probably could be abandoned, or the maximum coverage reduced to some nominal level.

## Economic Stability

The second objective attributed to deposit insurance, protection of the economy in general from the impact of disruptions in the banking industry, *perhaps* provides a better reason for having deposit insurance. In this context, deposit insurance contributes to the overall stability of the economy by eliminating the adverse effects of bank runs. The special concern over runs on deposit-creating institutions appears to be fostered by two presumptions. First, the function of depository institutions makes them more susceptible to runs than other types of firms. Second, the costs of bank runs are high and extend to the economy in general, not being limited to those incurred by the banking system.

One reason that the economic costs associated with bank runs could be particularly widespread and pronounced is that depository institutions are integral parts of the nation's payments mechanism and comprise channels through which monetary policy operates. In this regard, a collapse of the banking system could lead to a large and unexpected contraction in the money supply, which, with a lag, would result in a severe and pervasive reduction in economic activity. To the extent that the significant economic costs of bank runs are related to the contraction in the money stock, it might be argued that deposit insurance should only protect deposits included in some measure of money. This does not mean that it would be sufficient to insure only money, however defined. The main protection offered the money supply through deposit insurance does not consist of the actual payments made to depositors when an individual bank fails. The main contribution of deposit insurance to monetary stability is the prevention of the bank runs in the first place. That is, the monetary benefit of the insurance funds is not that they provide liquidity for banks in the event of a financial crisis, but that they avert the need for such liquidity.[11]

It should be noted here that even if the deposit insurance were primarily intended to stabilize the money stock by paying off depositors of failed banks, it may not be practicable to cover only some narrowly defined set of deposits, say, those included in M1. Given the potential for shifts between insured and uninsured deposits and the consequent distortions to the money supply, it could be necessary to insure a broad set of liquid deposits.

The impact of the monetary contraction during the depression of the 1930s, of course, has been recognized for some time, and the monetary consequences of bank runs have stood as a primary defense of deposit insurance. However, some recent studies argue that the adverse consequences of bank runs go beyond those associated with money and the money creation process. For example, Bernanke[12] and Diamond and Dybvig[13] point out that the breakdown of the intermediation process resulting from bank runs imposes real economic costs.[14] Bernanke maintains that the malfunctioning of the system of intermediation during the 1930s was an important contribution to the severity of the depression. In cases where concern over banks runs is motivated by banks' function as purveyors of credit, deposit insurance again should aim to protect the banking system by preventing runs and not merely to pay off depositors at failed banks.

Linking the justification for federal deposit insurance to the presence of economy-wide costs of bank runs raises some question about the logic of having federal deposit insurance and the FDIC's plan to increase the riskiness of large-denomination deposits. According to the rationale of improving economic stability, deposit insurance is not needed because of depositors' inability to protect themselves, but it is warranted on the grounds that depositors protecting themselves is not sufficient to guarantee stability in the banking system. This rationale does not deny that providing deposit insurance creates the potential for even greater risk-taking by depository institutions because depositors have little or no reason to be concerned about the financial condition of individual institutions. However, the most that can be expected from leaving large deposits uninsured is that banks will be forced to take into account the cost of their risk-taking to the extent that it affects the uninsured depositors. This means that, while putting depositors at risk may undo the moral hazard problem introduced by deposit insurance, it does not ensure that the total cost to society of bank risk-taking and bank runs will be considered. If

support for deposit insurance is based on the market's failure to address the problem of bank runs fully, then it would seem somewhat contradictory to look to the market to help alleviate the problems created by deposit insurance.

To the extent that bank runs and the resulting cost to society explain the need for deposit insurance, then deposit insurance should be extended on the basis of solving these problems. In this regard, leaving larger-denomination deposits uninsured makes sense if doing so has little or no bearing on the problem of bank runs. However, as will be discussed in the next section, justifying deposit insurance on the grounds that it is necessay to ensure financial stability does not appear to call for the separation of insured and uninsured deposits on the basis of account size. In fact, if anything, this role of deposit insurance suggests that the first criterion for determining insurance status should be account maturity, with short-term accounts being insured regardless of denomination.

## III. Deposit Coverage

The economic-stability rationale for having deposit insurance dictates that the first role of deposit insurance should be to prevent runs on banks. Consequently, the key to determining which deposits are to be insured should lie in the goal of reducing the susceptibility of banks to runs. On this point, Kareken[15] suggests that depository institutions are subject to runs because deposits are fixed-dollar claims against depositories that hold risky assets.[16] With risky portfolios, depository institutions can incur losses that exceed net worth, while with a fixed-dollar claim, a depositor can avoid sharing in those losses by withdrawing funds before other depositors. This distinguishes deposits from the shares of many money market mutual funds. In the case of mutual funds using mark-to-market accounting, fluctuations in the value of assets are reflected daily in the value of the money funds' shares. A shareholder automatically participates in the losses as well as gains on a *pro rata* basis, and cannot shift losses to other shareholders by redeeming shares.[17]

Without deposit insurance, all depositors have incentives to participate in runs on banks. The presence of large volumes of deposits essentially available on demand—checking accounts, savings accounts, and money market deposit accounts—and short-term time deposits makes the problem of bank runs particularly acute. The holders of these deposits can react quickly to a real or a perceived deterioration in the financial condition of banks. This is as true, if not more so, for depositors with large-denomination liquid accounts as it is for depositors with small liquid balances. Holders of longer-term deposits could "run" in the sense that they would not roll their accounts over at maturity. But such a process would be drawn out over a period of time that would allow depositors and regulators an opportunity to assess the condition of individual institutions more accurately.

With regard to longer term deposits, it might be argued that the premature withdrawal provisions on time accounts also enable holders of such deposits to make a run on banks. Under current regulations, however, banks are not obliged to honor requests for early withdrawals, except in cases involving the death or mental incapacitation of depositors, although they may allow withdrawals from time-deposits prior to maturity.[18]

While the combination of risky assets and par-value short-term deposits makes banks susceptible to runs, the fact that banks hold illiquid assets funded by liquid deposits compounds the problem. The mismatch of asset and liability durations contributes to the vulnerability of the banking system in two ways. First, to the extent that most institutions are exposed to interest-rate risk, fluctuations in asset values relative to liabilities will be correlated across depository institutions. A sharp rise in interest rates would result in widespread capital losses among depository institutions, and these losses could precipitate a general run on banks as depositors try to avoid sharing in the losses. Second, asset and liability mismatches also can contribute to the problem of bank runs when institutions are unable to meet the demand for withdrawals through maturing assets. The "forced" liquidation of longer-term assets may

result in further losses.[19] This could be particularly true of certain assets such as consumer loans for which there is not a well-established secondary market.

On this last point, it has been argued that the Federal Reserve as the lender of last resort could ease the adjustment for banks. Through the discount window, depository institutions do not have to liquidate assets, but can merely commit them as collateral on loans from the Federal Reserve. This does not mean that the "proper" administration of the discount window would eliminate the usefulness of some form of deposit insurance. The Federal Reserve, in providing general liquidity, does not automatically do away with the reasons banks are susceptible to runs—deposits remain fixed-dollar claims and depository institutions' portfolios remain risky. Depositors could still have the incentive to "run" to avoid sharing in the losses of depository institutions. To the extent that there are advantages to preventing bank runs, rather than merely attempting to meet the increased demand for liquidity when runs occur, the commitment by the central bank to provide liquidity has to be coupled with assurances to holders of short-term deposits that their funds can be withdrawn at par value.

The above discussion suggests that the apparent conflict between plans to increase depositor risk and plans to stabilize the banking system can be resolved if the distinction between insured and uninsured deposits is made on the basis of account maturity. Short-term deposits, which can precipitate runs on banks that in turn impose costs on the economy, should be insured. Without convincing arguments for why the probability of runs, and thus the expected costs to society, would decline significantly as the size of accounts rises, it would seem that the insurance of short-term deposits should include both large-denomination and small-denomination accounts. Long-term deposits, which do not contribute to runs, conceivably could be left uninsured to give holders of these deposits an incentive to monitor the activities of depository institutions.

This recommendation, of course, raises the problem of specifying what constitutes a short-term and a long-term. The purpose of this paper is not to provide a definitive solution to this problem because, in the end, the selection of any one maturity has to be arbitrary at the margin, although no more arbitrary than the choice of a cutoff *size* for deposit insurance.

However, as a general matter, the deposit maturity chosen should allow an adequate period of time for evaluating the financial condition of banks. Along these lines, the appropriate maturity for determining insurance status could be tied to the frequency of bank examinations. Among the federal bank regulatory agencies, examination policies call for most "healthy" banks (CAMEL ratings of 1 and 2) to be reviewed to some degree at least every 12 months,[20] although for some state-member banks the suggested minimum is once every 18 months. Banks found to have more than moderate financial problems (CAMEL ratings of 4 or 5) are reviewed twice a year or more. Given the current examination policies, it might be reasonable as a starting point to think about a one-year maturity, or perhaps slightly longer, as more or less the upper-end for the cutoff between insured and uninsured deposits.[21] If a one-year maturity were used to determine which deposits would be insured, the bulk of the large-denomination accounts would initially be covered. Data on large commerical bank holdings of negotiable CDs indicate that the average remaining maturity on these accounts was about 3-1/2 months as of November 1983, with 85 percent of the CDs maturing in less than one year.

Extending deposit insurance on the basis of account maturity, of course, could affect the maturity structure of deposits. For example, if deposit insurance were provided at a subsidized rate that held up the yields on short-term accounts compared to those on longer-term accounts, relatively more funds would flow to the liquid insured accounts. This could exacerbate the problem of mismatched asset and liability durations at many institutions. Thus, using maturity as the foremost criterion for determining insurance status would not make the insurance agencies' job any easier. The insurance agencies still would have to be concerned about the problems of regulating bank portfolios and properly pricing deposit insurance. Nevertheless, insurance coverage that focuses first on account maturity is consistent with the use of deposit insurance to prevent bank runs.

# IV. Conclusion

Traditionally, the insurance status of deposits has been determined by account size. As a practical matter, however, the size limitation has not been binding because the FDIC has chosen to handle many bank failures through purchases and assumptions. To re-establish the separation of insured and uninsured deposits according to the size of accounts, the FDIC has begun to use a modified payout approach in some bank failures. Large-denomination deposit holders now can expect to incur losses when banks fail. The objective of the FDIC's plan is to shift to the market more of the burden of monitoring risk-taking by banks.

In essence, the FDIC's new approach delegates to large depositors at least part of the responsibility for "pricing" bank risk. The benefit of this approach is that it reduces the moral hazard problem connected with the provision of deposit insurance. However, it only ensures that the cost of bank risk as it affects *uninsured* depositors will be taken into account. This is not a drawback if deposit insurance only is intended to protect small depositors. That justification for insurance is based on the assumptions that it is the losses to depositors from bank failure that are important and that large depositors are effective in determining and pricing the cost of bank risk. In other words, there is no reason to insure large depositors because they can protect themselves.

FDIC's plan does present a problem for the stability rationale for deposit insurance. This justification for deposit insurance maintains that depositors protecting themselves is not enough. The foundation for the economic stability argument is that private market arrangements cannot be expected to solve the problem of bank runs and that bank runs lead to economy-wide losses. Putting large depositors at risk does not address the bank run issue and could well exacerbate the problem.

The economic-stability rationale for deposit insurance does not point to a separation of insured and uninsured deposits based on account size. This paper points out that the reasons banks are more susceptible to runs than other firms is that bank portfolios consist of a large volume of par-value *short-term* deposits and risky illiquid assets. Thus, the economic stability argument suggests that insurance status should be related first to deposit maturity, not account size. Short-term deposits should be insured, and these short-term deposits would include accounts in large denominations.

FOOTNOTES

1. Increases in insurance coverage generally have been intended to allow for increases in the level of prices. However, the most recent increase to $100,000 in 1980 was prompted in part by concern over disintermediation at depository institutions.

2. Federal Deposit Insurance Corporation, **FDIC: The First Fifty Years**, 1984, p. iv.

3. As part of the FDIC plan to increase the riskiness of large-denomination deposits, uninsured depositors incurred losses in connection with the failure of two commercial banks in March, 1984.

4. The term "bank runs" is intended to refer to runs on all types of depository institutions.

5. For a discussion of the procedures used by the FDIC in purchases and assumptions; see B. Bennett, "Bank Regulation and Deposit Insurance: Controlling FDIC's Losses," in this **Economic Review**.

6. Federal legislation has been introduced that would give the Federal Deposit Insurance Corporation authority to use a system of risk-based insurance premium rebates. Under the proposed system, banks in lower risk classes would receive larger rebates on insurance premiums paid during a year than those in higher risk classes. Such a change in the administration of federal deposit insurance would provide some check on risk-taking by banks, but the impact likely would be modest since the differences in rebates among the risk categories still would be quite small.

7. FDIC (1984), ibid, p. iv.

8. This plan is discussed in Federal Deposit Insurance Corporation, **Deposit Insurance in a Changing Environment**, 1983, pp. III-4 to III-6.

9. In the event that collections from liquidating assets are greater than expected, uninsured depositors (and other creditors) will receive additional payments. However, if the amount realized from the liquidation of assets is less than originally estimated by the FDIC, the insurance fund will absorb the loss.

10. In its report to the Congress—FDIC (1983), ibid, p. III-5—the FDIC mentions the possibility that the partial "advances" to uninsured depositors also could be accomplished through an assumption arrangement. That is, in-

stead of making a direct payment to uninsured depositors, the deposit liabilities equal to the FDIC's estimate of the **pro rata** share for the uninsured depositors could be assumed by another institution.

11. This point is made in Friedman, Milton, **A Program for Monetary Stability**, New York: Fordam University Press, 1960, pp. 20-21.

12. Bernanke, Ben S., "Nonmonetary Effects of the Financial Crisis in the Propagation of the Great Depression," **The American Economic Review**, June 1983, pp. 257-276.

13. Diamond, Douglas W., and Philip Dybvig, "Bank Runs, Deposit Insurance, and Liquidity;" **Journal of Political Economy**, June 1983, pp. 401-419.

14. It could be argued that depository institutions also impose costs on each other to the extent that the failure of one bank can cause another bank to fail. If there were no other ramifications of bank failures, the costs would be borne only by bank shareholders, depositors and other creditors.

15. Kareken, John H., "The First Step in Bank Deregulation: What About the FDIC?," **The American Economic Review**, May 1983, pp. 198-203.

16. Bryant, John, "A Model of Reserves, Bank Runs, and Deposit Insurance," **Journal of Banking and Finance**, December 1980, p. 335-344, also attributes the vulnerability of banks to runs to their holdings of risky assets. Bryant states, "to generate a model of useful deposit insurance, it is first necessary to generate deposit liabilities backed by risky assets. Once one has done so, the possibility of some form of bank runs immediately follows." (p. 335).

17. A number of money market mutual funds amortize changes in the value of an existing asset over the life of the instrument. For these funds, a shareholder can avoid at least some previously incurred losses by redeeming shares before other shareholders.

18. For a discussion of early withdrawal penalties on time deposits, see Furlong, Frederick T. and Gary C. Zimmerman, "Deregulation and Withdrawal Penalties," **Weekly Letter**, Federal Reserve Bank of San Francisco, December 9, 1983.

19. Diamond and Dybvig, ibid, use the illiquidity of bank assets as the rationale for banks being susceptible to runs. In their model banks incur losses because of the high cost of liquidating assets to meet deposit withdrawals.

20. In the case of "healthy" banks (CAMEL ratings of 1 or 2), for the FDIC, over a 36-month period one examination must be a comprehensive examination and less extensive reviews can be performed in each 12-month period during which the formal examination is not conducted.

21. In principle, the insurance status should be determined on the basis of remaining maturity, but in practice it may be necessary to use original account maturities.

# Pricing Mortgages: An Options Approach

**Randall J. Pozdena and Ben Iben***

*Options theory has provided a framework for valuing financial instruments with contingent claims features. This paper uses a simple numerical options pricing technique to price adjustable and fixed rate mortgages containing prepayment options. The simulations performed illustrate the sensitivity of mortgage prices to mortgage features. They also underscore the risk-return tradeoff made by a lender who chooses to emphasize the origination of adjustable rate mortgages.*

Lenders in the residential mortgage market were among those caught unprepared by the high and volatile interest-rate environment of the 1970s. The fixed rate, long-term mortgage that was then dominant limited the ability of financial institutions to adapt to high and rising interest rates. Most institutions that specialized in mortgage lending confronted deteriorating net worth and cash flow positions as the value of their mortgage portfolios declined while the costs of their deposit liabilities rose.

The industry's response was to re-examine their marketing of the conventional fixed rate mortgage and to introduce new instruments, such as the adjustable rate mortgage (ARM), that passed some interest-rate risk to the borrower. Unfortunately, there were few guides to help mortgage lenders "price," that is, set initial contract rates, on these new instruments.

The purpose of this paper is to illustrate how the options pricing model developed in the theory of finance can be applied to the problem of pricing mortgage instruments. Although the technique is quite general, we illustrate it with two relatively simple examples—a conventional fixed rate mortgage with a prepayment option and a special type of adjustable rate mortgage. These two applications demonstrate the usefulness of the options pricing model, and illustrate how mortgage contract rates are determined both by the specific provisions of the contract and the underlying assumptions about further interest rate movements.

The model reproduces fairly accurately those mortgage rates observed in the secondary mortgage market, and demonstrates how those rates would be affected by different contract provisions for prepayment penalties and for "caps" on how much interest rates can be varied on adjustable rate mortgages. It also is capable of explaining observed spreads between rates on GNMA pass-through securities and other riskless rates. Finally, the model provides estimates of the value to mortgage lenders of the interest rate risk protection offered by adjustable rate mortgages. These estimates suggest that current techniques for pricing adjustable rate mortgages may result in overpricing these instruments.

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# I. Basic Mortgage Instruments

The mortgage instruments examined here are a conventional fixed rate mortgage (FRM) and an ajustable rate mortgage (ARM). On the FRM, the contract rate is fixed for the life of the loan (we will be using 30 years), and the payment is simply that which will amortize the face value of the loan over its life. The typical fixed-rate mortgage contains a number of additional features. One of the most common, and the one we will concentrate on, is the option the borrower has to pre-pay the remaining principal of the loan before the end of its life. This option often carries a penalty if exercised early in the mortgage's life.

In its purest form, the ARM is a loan on which the contract interest rate is continuously varied. The periodic payment at any time is a payment that will fully amortize the remaining balance of the loan at the contract rate over the remaining life of the mortgage. In essence, it is a sequence of very short-term loans of varying contract rates. Because the interest rate on the pure ARM is continuously adjusted, it should always sell at par— that is, at a price equal to the remaining principal. This is the attraction of the ARM to institutions desiring to avoid the effects of interest rate movements on the net worth of their portfolio.

In reality, most ARMs are "impure." That is, the contract rate typically is adjusted only at intervals, and the size of the individual or total adjustments may be "capped." Later on, we shall discuss how these features can be incorporated into the pricing exercise.

# II. The Options Pricing Model

Our pricing simulations rely on the observation that a mortgage may be viewed simply as a coupon-type bond with certain options attached to it. This equivalence allows us to use the bond option pricing model discussed in a previous *Economic Review*[1] to analyze the valuation of mortgages. It is useful to summarize briefly the essential steps in the model. The accompanying Box provides a numerical illustration of these steps, and a detailed description of the process is provided in the Appendix.

In essence, options pricing models rely on the observation that if a portfolio of options and the underlying security on which they are based can be constructed to yield the riskless rate of return, it is possible to infer the price of the option from the value of the underlying security and the riskless interest rate.[2] The actual mechanism for doing so involves three steps.

First, the possible future outcomes for interest rates must be specified. Options have a value only in a world in which there is uncertainty about future interest rates, that is, a world in which there is more than one possible outcome for them. The pricing simulation approach taken here begins with the assumption that the short-term, riskless interest rate is drawn from a log normal probability distribution. This diffusion process for interest rates can be approximated by a binomial representation and produces a "tree" of interest rate possibilities over time like the one depicted in the Box.

The nature of interest rate movements is controlled by the parameters of the underlying binomial distribution, the mean and the standard deviation. In the context of an interest rate process, the last two can be interpreted, respectively, as the annual rate of geometric drift (M) and the annual standard deviation or "uncertainty" of interest rates (S).

The second step is to recognize that, given the interest rate tree, it is possible to price a debt security like a bond by using these interest rates to calculate its present, or discounted, value. The process is relatively complicated when there is more than one future price for the bond, and this future price goes into the calculation of the bond's present value. Investors in this situation are assumed to calculate the present value of the bond by averaging the different future outcomes for its price. In our simulations, the calculations are made much easier by assuming a binominal distribution for the evolution of interest rates, which means that for each period there are only two possible future values for the bond.

If investors are risk-neutral, they are indifferent about the *dispersion* of possible future bond prices and use only their expected value (the average calculated using their probabilities as the weights) in calculating today's price. If investors are risk-averse, they will prefer an investment with a smaller dispersion of future outcomes over one with a larger dispersion, given that both have the same expected value. As the Appendix shows, risk aversion can be taken into account by introducing a risk aversion parameter, L, into the formula for calculating the present value of the bond. In this particular formulation, L can be shown to represent the "price of risk" as articulated by Dothan.[3]

The final step is to calculate the price of the option on the debt instrument. An option on the underlying instrument is simply a right to purchase or sell the underlying instrument at any time during the life of the option at a specified price, called the exercise price. If the option is a right to purchase, it is termed a "call" option; if it is a right to sell, it is temed a "put." The price of an option depends upon one of two things. First, it may be equal to the proceeds of exercising the option, which is the difference between the value of the underlying instrument and the option's exercise price. However, an option may have a greater value if it is held and exercised later. In that case, its price is determined by the value rather than the current exercise price.

The notion that permits us to estimate the value of an option before it is exercised is the notion of a riskless hedge. In particular, Black showed that by constructing a portfolio (consisting of options and their underlying instruments) that yields the riskless interest rate, the implicit value or price of the option can be inferred.[4] The actual computation is elaborated in the Appendix.

The sequence of steps outlined in this Section yields a mechanism for pricing a debt instrument and an option on that instrument in an uncertain interest rate world. All that is necessary to implement this model for the purpose of pricing mortgages is to recognize that a mortgage is a debt instrument and that many of its features can be viewed as options on a simple mortgage instrument.[5]

## Estimating the Model Parameters

The model just described has three main parameters: the expected interest drift rate (M), interest rate uncertainty (S) and the risk aversion parameter (L), all of which must be estimated. The method adopted here to determine the relevant values of M, S, and L is to search over alternative values of these parameters and to compare the model's simulations of the yield on a simple, riskless debt instrument without options with that actually observed in the real world. The set of parameters that best replicates the actual series of yields is used in our subsequent analysis. More specifically, we use the set of parameters that minimize the sum of squared differences between the actual and simulated yields.

This procedure was employed using observations on ten-year U.S. Treasury Notes from 1982 and 1983. The model was used iteratively to find the coupon that generated a par valued instrument for each interest rate tree; the implicit yield to maturity was computed and compared to actual yields. Theoretical and empirical considerations allowed us to simplify the estimation process by setting M, the drift parameter, equal to zero.[6] The resulting estimates for the risk aversion parameter (L), and the uncertainty parameter (S), were .05 and .20 respectively.

The small but positive risk aversion parameter implies that the marketplace is characterized by risk aversion rather than a risk-neutral or risk-taking relationship between utility and wealth. This parameter obviously interacts with the uncertainty parameter in the computations, but it is informative to break them out separately since the former is a basic parameter of behavior, and as such is more likely to be stable over time than the uncertainty parameter, which is likely to be heavily influenced by ambient interest rate variability.

In any case, it is inappropriate to assign excessive meaning to the specific magnitudes of the parameter estimates. Both the simplifications inherent in the model and the estimation procedure suggest that they are at best useful as guidelines of market-wide parameters that may have been relevant to financial market behavior in 1982 and 1983. However, efforts were made to test the sensitivity of our simulated results to alternative values of these parameters. Also, we compare the model's simulations of yields on an actively-traded mortgage instrument with the instrument's actual yields as another way of checking the model's assumptions.

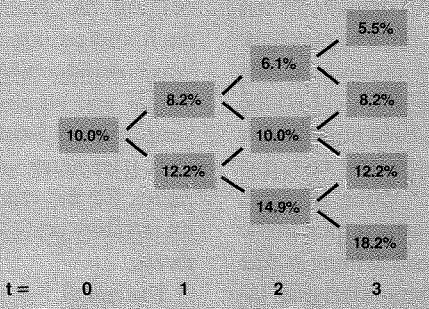
# Pricing An Option

## 1. Future Interest Rate Movements

As the text describes, interest rates are a random variable. The investor, however, knows the probability distribution that generates interest rates; he can predict possible outcomes of future interest rates. For example, he knows that in the next period (t=1), interest rates either fall to 8.2 percent or rise to 12.2 percent, each with a probability of half. Similarly, in the following period (t=2) there is an equal probability that rates will either fall or rise. Thus, between t=0 and t=2 interest rates could follow one of four possible paths: rise in both periods, fall in both, rise then fall, or fall then rise. These outcomes are shown in the interest rate "tree" of Figure A, which also shows the possible outcomes in period 3, the period in which the bond matures.

**Figure A**

**Interest Rate Tree**



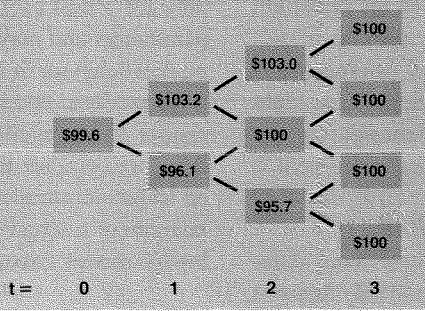

## 2. Pricing the Bond

The investor next needs to calculate the different prices the bond could possibly sell for in each period. The bond has a face value of $100, which is paid when the bond matures in period 3. In addition, a coupon of $10.00 is paid in periods, 1, 2 and 3. The only time when there is no uncertainty about the price of a bond is the last period, t=3. Here the bond is worth $110—its last coupon of $10 plus redemption value of $100—no matter what interest rates turn out to be.

In the next-to-last period (t=2), however, there are three possible outcomes, depending on what interest rates turn out to be. The price of the bond is calculated as the present (discounted) value of its future payments. Thus, in period 2, the future payments are the $110 to be paid in period 3. Using each of the three possible interest rate outcomes in period 2—6.7, 10.0 and 14.9 percent—to discount the $110, yields the three bond prices shown in Figure B.

**Figure B**

**Bond Price Tree**

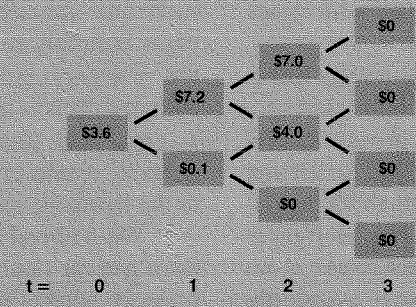


(In periods t=0 and t=1, things are a little more complicated because for each interest rate, there are *two* possible future values for the bond. In this example, investors are assumed to be risk-neutral, so that they *average* the discounted future values of the bond using as weights the probability attached to each to calculate its current price.)

## 3. Pricing the Option

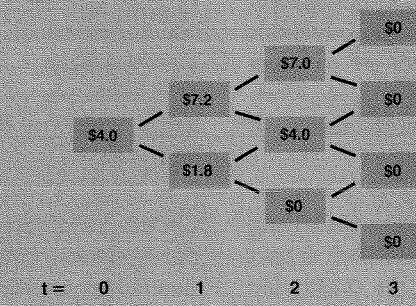
Recall that the option has an exercise price of $96, that is, the holder of the option has the right to buy the bond at a price of $96. Figure C shows the profit from exercising the option for each of the possible outcomes of bond prices. For example, if the bond sold for $100 in period 2, exercising the option then would yield a profit of $4.00 because the option holder could buy the bond for $96 and then sell it in the market for $100.

**Figure C**
**Exercise Value Tree**




Clearly, the option would never sell for less than this exercise value, as it is called. It could sell for more, however, because it may pay to hold the option and exercise it later. For example, in period 1, the exercise value is only ten cents if interest rates turn out to be 12.2 percent. If, instead, the option is held and exercised in the next period (t=2), there are two possible outcomes (see Figure D)—an exercise profit of either $4.00 or zero. Averaging these two possible outcomes and discounting them back to t=1 yields a value of $1.80. The option therefore will sell for $1.80 rather than ten cents in this case.

**Figure D**
**Exercise Value Tree, If Option Held**



## III. Valuing the Fixed Rate Mortgage

We will first illustrate the pricing of a conventional fixed rate mortgage with a pre-payment option. Such an instrument can be viewed as a constant coupon bond with a call provision, and valued accordingly using the numerical bond and option pricing model. We assume that the pre-payment option can be exercised for a price equal to the remaining balance of the loan plus any pre-payment penalties.

We want first to see if the model can replicate observed pricing behavior in the market for fixed rate mortgages. There is no good source of data on origination rates on conventional mortgages. Therefore, we must employ data from the secondary mortgage market to test the model. One useful secondary mortgage market instrument is the Government National Mortgage Association Mortgage Pass-through Security (GNMA-PS).

The GNMA-PS, is a bond-like instrument that is guaranteed by the GNMA and which is based on a group of mortgages originated by private lenders largely under Federal Housing Administration (FHA) and Veterans Administration (VA) regulations. These are thirty-year, fixed rate mortgages with a prepayment option for which there is no penalty. The pass-through security essentially passes through to the owner of that "bond" the periodic interest and principal payments made by the mortgagees. The pass-through securities offer a number of advantages from our standpoint as a source of actual observations on the behavior of the mortgage market. First, the underlying mortgages are all of a similar type. Second, the GNMA-PS can be bought and sold like a conventional bond. In addition, the principal and interest payments are guaranteed by GNMA, making the instrument essentially free from default risk. This combination of features gives us a series of actual market valuations of a consistent set of mortgages with pre-payment options. The market's valuation of FHA-type mortgages should be reflected in the behavior of GNMA-PS yields.

To simulate the GNMA pass-through yields, we must first use the model to value the underlying mortgages. Each GNMA security states the contract mortgage rate that is in force on the underlying mortgages. Using this contract rate and the assumption of a thirty-year mortgage life, the periodic mortgage payment (that is, the interest and principal repayment), can be calculated using a simple mortgage amortization formula. From the viewpoint of the bond and option pricing model, this payment is the bond "coupon." The prepayment option, which is inherent in these mortgages, may be exercised without penalty. Thus, the exercise price of this call option at any time during the life of the mortgage is simply the remaining mortgage balance.

This information makes it possible to simulate both the current price of the underlying mortgage and the price of the prepayment option for any given set of interest rate diffusion assumptions, given the current short term interest rate. The net value of a mortgage with a prepayment option in the marketplace is simply the difference between the price of the mortgage and the price of the option that it contains. This is because, as far as the marketplace is concerned, the mortgage borrower receives a valuable option at the time that he obligates himself to the mortgage payments.

We will call the difference between the bond price and the option price the net price. This is the price at whith the GNMA-PS should sell if the model and the interest rate assumptions are appropriate. In fact, of course, mortgage "prices" are usually quoted for convenience as implicit yields rather than as prices. Quoted GNMA-PS yields are derived on the assumption that the net price applies to an instrument with a 12-year life, that is, the mortgages are assumed to be prepaid in 12 years.

Given the net price of the mortgage and its contractual periodic principal and interest payments, we can calculate the implicit yield of a 12-year GNMA-PS. The yield is simply the discount rate which, when applied to the principal payment made in the terminal period and the stream of coupon payments, yields a discounted present value equal to the simulated net price of the mortgage.

In Chart 1, we present simulated and actual GNMA yields produced by the bond and option pricing model over a period of 14 months. The simulations use the actual 30-day T-bill rate as the

starting point for each simulated interest rate tree and the interest rate diffusion parameters and the risk aversion parameter estimated earlier.[7] The actual and forecast yields are quite similar, despite the fact that there was considerable variation in short-term interest rates over the period of simulation—1982 to early 1983. Clearly, many purely statistical models could perform this replication as well as or better than our model. The advantage of our model is that it permits simulation of hypothetical instruments, which a purely statistical model might not. The performance of the model, in replicating yields on an actual instrument is encouraging and provides some empirical basis for believing that the simulations that follow may synthesize what would occur in the real world.[8]

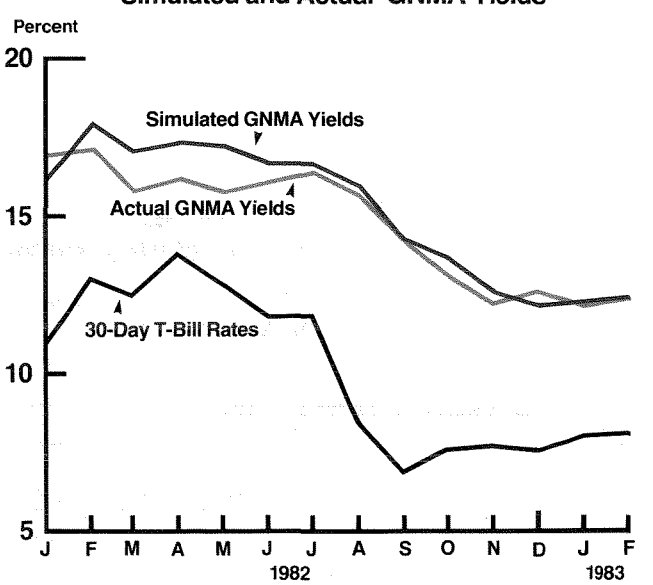
## Further Explorations

Unlike the FHA mortgages examined in the last section, most FRMs contain a penalty for prepayment of the mortgage principal. A typical prepayment penalty applies only for the first five years of a mortgage and is usually stipulated to be six months' interest at the mortgage contract rate or less, but under current regulations, the lender is free to set the penalty conditions at will.[9] In this section, we examine the sensitivity of FRM yields to variations in the prepayment penalty conditions. We also examine how sensitive FRM yields are to the underlying interest rate and risk aversion parameters of the model.

Since we are simulating a hypothetical mortgage, the steps in this simulation are somewhat different from those in the GNMA-PS case. For example, unlike the GNMA case, the mortgage contract rate is not an administered rate but, rather, will itself be determined as part of the simulation. For the given interest rate diffusion assumptions, the contract mortgage rate that yields the par value of the mortgage without an option is computed first. The price of a pre-payment option on this "mortgage" is then computed and subtracted from the pure (par value) mortgage value to get the net price. Once again, however, mortgage "prices" are usually stated as contract rates, not prices. Thus, we need to build the value of the option into the mortgage contract rate. To do this, the mortgage contract rate is increased by an arbitrary, small amount in the option computation until the net price calculation equals original mortgage par value. We are thus able to determine the contract rate spread between a mortgage without a prepayment option and one with the stipulated

**Chart 1**

**30-Day T-Bill Rates and Simulated and Actual GNMA Yields**



option and penalty.[10]

Simulations of this type were carried out over a wide range of model parameters and for three mortgage penalty configurations: a penalty of zero, a penalty equal to six months interest for the first five years, (typical of conventional penalties) and a penalty equal to six months interest applicable to the full 30-year life of the mortgage. The results of these simulations along with that of the simple mortgage without a prepayment option, are presented in Chart 2.

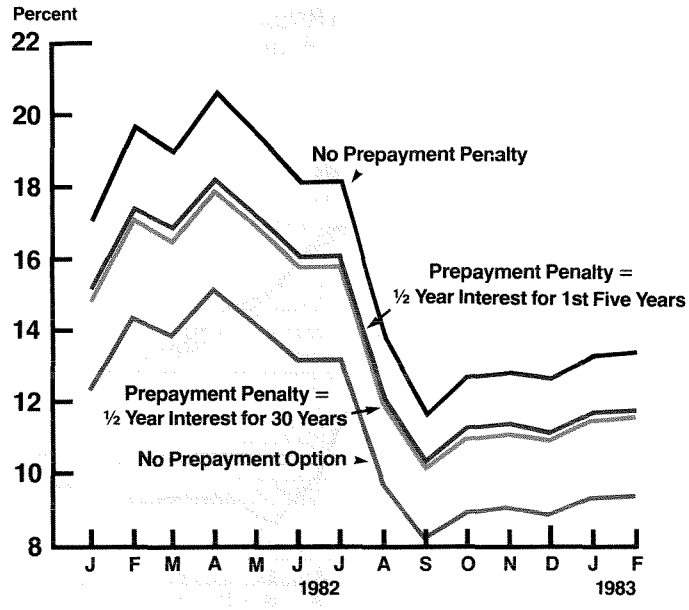
The Chart illustrates clearly the importance of appropriate pricing of the prepayment option. For example, with the "market" estimates for risk aversion and interest rate uncertainty, the market yield differential between a mortgage without any prepayment option and one with an option but no prepayment penalty, is nearly 400 basis points (Chart 2). Charging the conventional penalty reduces this spread to less than 250 basis points, and charging a penalty equal to six months' interest for the lifetime of the instrument decreases it a further 25 basis points.

Chart 3A illustrates the sensitivity of the appropriate mortgage yield to the anticipated level of interest rate uncertainty. With no interest rate uncertainty, the option—which provides the borrower with protection against uncertainty—has no value and penalty variations are, of course, meaningless. As interest rate uncertainty increases, the value of the prepayment option increases and should be manifested in higher market yields.

The results depicted in Chart 3B are perhaps of more interest to the modeler than the maker of pricing policy. They test the sensitivity of our simulated results to the parameter that describes the assumed level of risk aversion that prevails in the economy. The sensitivity of the model to this parameter indicates the hazards of incorrect parameterization of the model. Our own investigations, discussed earlier, suggest that L should be approximately .05, if the model is to approximate closely the Treasury Note yields actually observed during the 1982 estimation period. The importance of this parameter to the simulations, however, suggests that more refined procedures for estimating L may be desirable.[11]

**Chart 2**

**Simulated Fixed Rate Mortgage (FRM) Contract Rates**



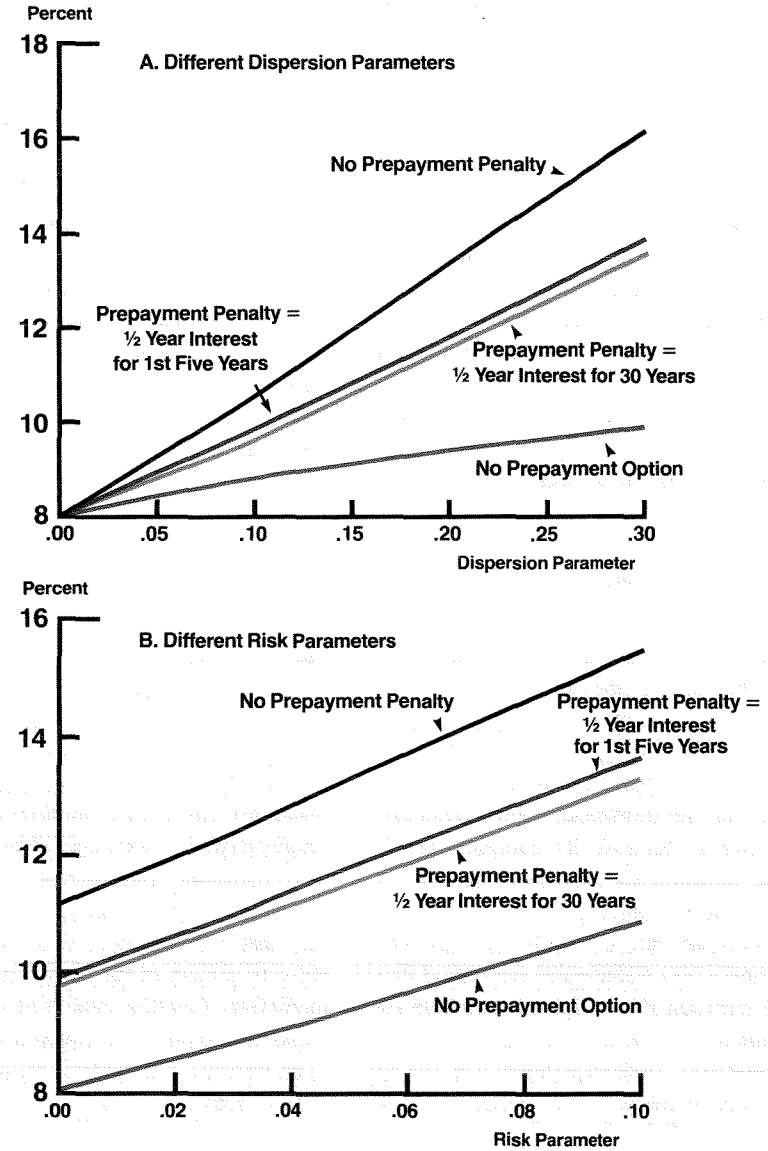
## Some Qualifications

There are, of course, many qualifications to these findings that should not be overlooked by the reader. First, because we ignored the inherent option available to the borrower to default on the mortgage, the mortgage yields reported in Charts 2, 3A and 3B are very likely understated. However, the process of modelling the conditions under which a default option will be exercised by the borrower are complex and beyond the scope of this paper. In addition, lender losses from default are extremely small in practice suggesting that the existing explicit and implicit cost to the borrower or default make that option seldom worth exercising, and therefore very likely of low value.

Second, the mortgage instrument modelled above only allows for "economic" prepayment of a mortgage. That is, we implicitly assume that the

**Chart 3**

**Simulated Fixed Rate Mortgage (FRM) Contract Rates**



prepayment option is exercised only when it makes sense because of the relative market value of the mortgage and the exercise price of the option. We do not allow for "exogenous" motives for prepayment such as death, changes in taste about the underlying real estate, job transfers, and so on. These factors may be important in the real world and affect equilibrium market mortgage yields. In essence, we assume there is no value associated with the sale of the underlying real estate prior to the maturity of the loan. Thus, if the mortgage contains a "due on sale" clause, which is essentially an option owned by the lender, our model has essentially assumed that the value of this option is zero. If in fact, exogenous forces do precipitate sale of the underlying real estate, then the "due on sale" option would have a value greater than zero and our simulations would overstate the market yield. (An option with positive value owned by the lender would be incorporated into a lower mortgage contract rate.) This is a shortcoming of the simulations, but at the present time there is insufficient data to model the "premature sale" phenomenon. Moreover, the ability of the model to simulate GNMA-PS yields offers some justification for ignoring this shortcoming of the model.

Third, the model ignores transactions costs. This criticism affects both the bond and option pricing model itself, and the mortgage simulations presented earlier. Most such costs are likely to be relatively minor and therefore unlikely to affect the results of the simulation substantially. Other "transactions costs" such as the points typically paid by the borrower at the time the mortgage is originated, are not really transactions costs but rather a different way of pricing a mortgage. We have assumed that the lender and the borrower are indifferent between the pricing of a mortgage feature via yield premia and by "up front" money in the form of points. Thus, all of our simulations assume no payment of points. In fact, of course, tax and cash flow considerations may make it more attractive for a lender to receive payments in the "up front" form. These considerations are too cumbersome to be usefully modelled here and, again, are unlikely to affect the simulated results in a substantial way.

Finally, our simulations abstract from any general equilibrium consequences of mortgage market behavior on interest rates in general. The model takes as given the initial and anticipated future short-term riskless interest rate and assumes that there is no important feedback from the mortgage market to this rate structure. Such an assumption seems reasonable in the limited context of our efforts here.

## IV. Fixed Rate Versus Adjustable Rate Mortgage Pricing

Because many mortgage lending institutions are using the adjustable rate mortgage to insulate their portfolio from the interest rate risk inherent in fixed rate instruments, it would be interesting to compare the simulated fixed rate mortgage results with those that apply to an adjustable rate instrument. For a "pure" adjustable rate mortgage, such a comparison is quite simple: because its contract rate is assumed to be adjusted continuously and with a ceiling or floor, the instrument always sells at par and its initial contract rate is simply the then-prevailing short rate. Chart 4 illustrates the spread that would prevail between the initial contract rate on such an instrument and the contract rate on a conventional 30-year fixed-rate mortgage with typical prepayment terms (namely, a prepayment penalty equal to 6 months' interest if prepayment is made in the first 5 years).

The large spread between the two contract rate graphs shown in Chart 4 demonstrates that the advantages of insulation from interest-rate risk offered by the adjustable-rate mortgage are only obtained through significant reduction in the rate of return obtained on the mortgage. (Since the expected drift of short-term interest rates over the thirty-year period is 0, the difference is due entirely to interest rate risk.) In essence, this finding illustrates the value to society of the traditional interest rate intermediation function that had been performed by banks and other financial institutions. Conversion of an institution's portfolio to adjustable rate instruments (both on the assets and liabilities side of the

balance sheet) is tantamount to abandoning the interest rate intermediation function. What the simulation suggests is that the expected earnings of such risk-insulated institutions will be much lower than those that continue to offer interest rate intermediation service.

A second observation to be made from Chart 4 concerns a practical aspect of ARM pricing. In our simulations, there are no transactions costs, operating costs, or other costs of administering a mortgage lending business. Thus, it should be kept in mind that the simulations presented, even if fortuitously correct in other aspects, underestimate the actual market yield that would be observed. Rather than use an arbitrary figure to account for these omissions, we simply underscore this inherent assumption of our model.

## Impure ARMs

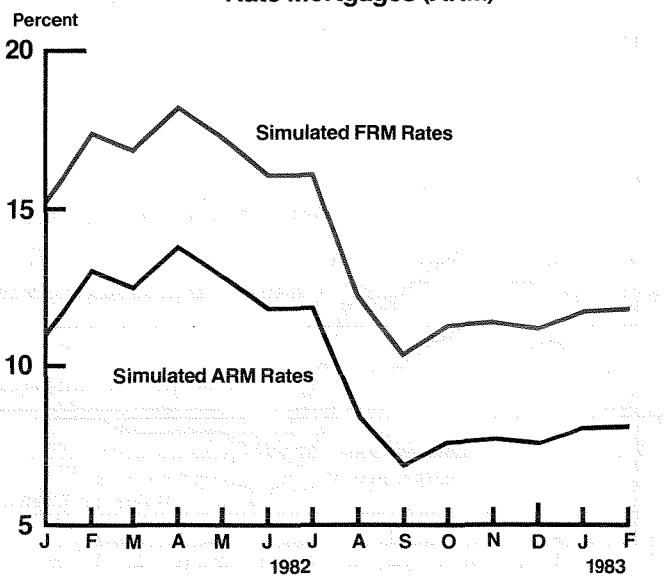
An obvious liability of the adjustable rate mortgage simulations presented above is that they do not incorporate features typical of such mortgages in the real world. In particular, most real world adjustable rate mortgage contracts do not permit continuous and unbounded adjustment of the contract rate. Rather, the rate is usually adjusted only at intervals (say, every six months) and the upward range of adjustments is often "capped" so that the rate may rise only some maximum amount over the life of the instrument. This cap is often expressed as a certain number of percentage points above the initial contract rate.[12]

Qualitatively, such features would appear to make the ARM more nearly a fixed rate mortgage. Thus, such "impure" ARMs would tend to have a contract rate somewhere between the pure ARM rate and the rate on a fixed rate mortgage.

Simulating precisely the impact of such features on ARM contract rates is not a trivial exercise, but it can be addressed in concept by the bond and option pricing model employed here. To illustrate how such simulations might be carried out, we focused on a simplified "capped" adjustable rate mortgage. We ignore the complication of infrequent rate adjustment and continue to assume that rates can be adjusted in every period of the simulation. We assume, as in the fixed rate mortgage simulations, that there is a prepayment option but that the

**Chart 4**

**Simulated Contract Rates for Standard Fixed Rate Mortgages (FRM) and Pure Adjustable Rate Mortgages (ARM)**



penalty, as is common practice, is zero. In addition, we assume that if there is a "due on sale" clause, the value of this option is zero. (That is, the exercise of the prepayment option is always an "economic" consideration rather than one based on exogenous real estate trading motives.)

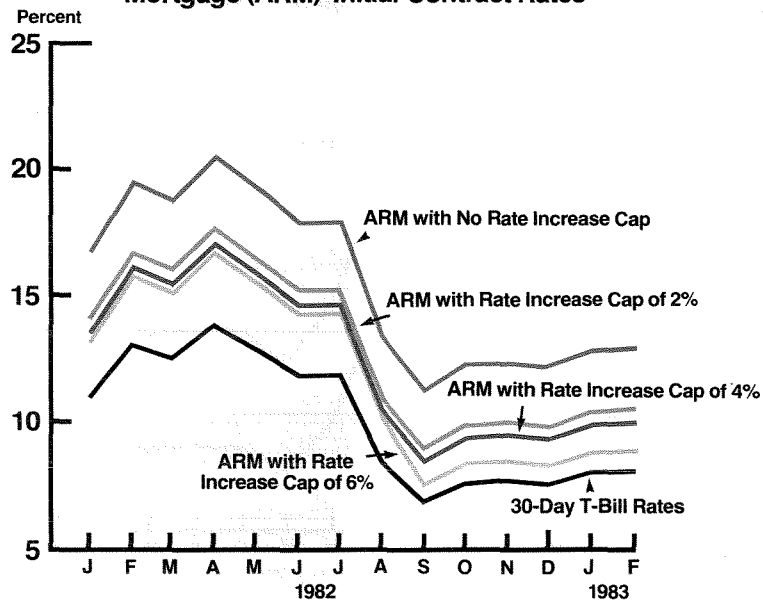
The modelling of variable rate mortgages is made easier computationally if a special variant of this instrument is employed in lieu of the "pure" instrument described earlier. In particular, we described an adjustable rate mortgage earlier as an instrument which continuously recomputed the periodic payment using a short-term rate as the contract rate, the remaining life of the mortgage, and the remaining principal at each period. A similar but computationally less cumbersome variant is a loan whose periodic payment is based on a simple interest rather than amortization rate computation; specifically, we model a loan which would probably best be called a "floating rate" loan rather than a conventional adjustable rate loan. That is, we assume that the principal amount of the loan is paid off in equal periodic increments but that interest is paid each period at the current (short) rate on the remaining principal. This loan is quite similar to that employed in commercial lending, and should serve to demonstrate the basic elements of the pricing of fluctuating rate instruments.[13]

Except for the payment adjustment convention described above, such an instrument resembles once again a coupon-type bond, and the basic bond and option pricing approach described earlier can be employed. It should be noted, however, that the contract rate cited in the results reported below is the initial contract rate necessary to give the instrument par value; this rate is adjusted up or down over the life of the mortgage in direct proportion to the changes in short market rates, with a maximum value equal to the "cap" rate when applicable.[14]

The results of simulations of these instruments with several cap alternatives are presented in Chart 5. They lead to a number of interesting observations. First, variation in the cap provision of the variable rate mortgage has a significant effect on the simulated initial contract rate of the variable rate instrument. As expected, the less binding the mortgage rate cap, the lower the effective contract rate of the mortgage. Conceptually, as was pointed out above, a pure, uncapped ARM would have an initial contract rate equal to the prevailing short-term in-

**Chart 5**

**30-Day T-Bill Rates and Simulated Adjustable Rate Mortgage (ARM) Initial Contract Rates**



terest rate. It is interesting to note that the spreads between the contract rates are smallest when the prevailing short-term interest rates are high, and greatest when short-term rates are low. This is a result of the use of additive interest rate caps which allow for greater relative movements in the value of low-rate mortgages than in the value of high-rate mortgages. Thus, in some sense, a six percent cap on a six percent mortgage is "less binding" than a six percent cap on a twelve percent mortgage. This suggests that "mark-up" rules of thumb in pricing variable rate mortgages with various caps probably should not be employed by mortgage lenders. (Note, in addition, that these simulations assume that all the other parameters of the simulation except the short-term interest rate are unchanged.)

Second, the spread between the simulated contract rate and the prevailing short rate—even for caps as low as 2 percent—is within several hundred basis points of the short-term interest rate. These results are at variance with what is—albeit anecdotally—observed in the real world. Lenders appear to assume that even essentially "uncapped" (that is with caps of 6 percent and greater) variable rate mortgage loans should be priced at several hundred basis points above short rates. These results indicate that the simplistic ARM pricing mechanisms that have been observed in the market have resulted in "over-pricing" of ARMs.[15] Because of the simplifications employed in the model, it is easy to make too much of this observation. However, it may help to explain why ARMs were not widely accepted in the marketplace when initially offered in their "pure" form.

This analysis also illustrates an important point about the use of ARMs by lenders who hope to limit the consequences of interest rate risk. Because they offer the borrower no protection against interest rate changes, the lender is in essence performing no interest rate intermediation function and the market "price" of variable rate instruments contains no implicit compensation for this role. In the real world, any compensation above the short-term interest rate offered by variable rate mortgages will be compensation for other functions performed by the lender, such as denomination intermediation and assumption of default risk. Neither of these functions is implicitly or explicitly captured in our model, but they are certainly minor relative to the role of interest rate intermediation. The results thus illustrate an important lesson about a lender seeking protection from interest rate risk through origination of variable rate instruments: there is very little income potential to such activity.

### Some Further Qualifications

A few additional qualifications are in order because of the simplifications inherent in the simulated instruments. We assume, for example, that the variable rate mortgages' contract rate can be adjusted continuously. In the real world, the lender can also elect to limit both the frequency and the amount of individual contract rate adjustments. In general, such features will tend to raise the appropriate contract yield above that presented in Chart 5. On the other hand, many real world variable rate mortgages contain a limitation on the rate of downward adjustment of interest rate as well. The effect of such a provision will be to lower the appropriate initial contract yield of a variable rate mortgage. Although it is perfectly feasible to incorporate such features in the simulations, we have chosen not to do so for simplicity of presentation and our preference to focus on the major features of these instruments.

A second qualification concerns the particular type of adjustable rate instrument employed in our simulations. It should be recalled that the instrument modelled here does not really re-amortize the remaining mortgage principal as the contract rate is adjusted; the principal repayment schedule remains the same, with only the interest component of the payment changing as the "contract" rate changes over time. From some experimental simulations, it was determined that the computational advantages of this assumption far outweigh any imprecision that was introduced. Nonetheless, it should be kept in mind that the ARM instrument modelled in this paper approximates the instruments employed in the real world. However, we believe that the approximations are good, at least for the parameter range presented in Chart 5.

Just as in the case of the FRMs, the simulated results are quite sensitive to the risk and dispersion parameters. In general, the larger the assumed level of risk aversion or the level of future interest rate uncertainty held by the marketplace, the greater is

the yield on the individual instruments and the greater the spread between their contract rates. Increased interest rate uncertainty has a smaller effect proportionately on the fixed rate instrument and the capped adjustable rate instrument. This result is to be expected because of the relative immunity from changes in value that are enjoyed by variable rate instruments when interest rates change.

## V. Summary and Conclusions

This paper has applied a simple, numerical bond and option pricing technique to the problem of pricing mortgage instruments. The model was applied to the problem of pricing fixed rate mortgages with prepayment options and to both "capped" and "uncapped" variable rate mortgages. As a crude test of the basic robustness of the model, it was used to simulate the yields on GNMA pass-through certificates and performed quite well.

The results of our investigation have a number of analytical and policy implications. First, the results suggest that the model used here can be a helpful guide to determining appropriate mortgage pricing policy for many typical instruments. For example, a lender could use these techniques to explore the effects that changes in mortgage features will have on average mortgage yields. In such a case, the modeller would obtain and employ market estimates of the parameters of the model. The model also gives its user the flexibility of comparing simulations using the market's perception of interest-rate variability with simulations incorporating the user's own assessment. In this way, the user can evaluate the wisdom and consequences of pricing the instruments at the "market" rate.

Second, the model underscores the importance of considering contingent claims features of debt instruments when examining their behavior in the marketplace. The fact that the yields on GNMAs, for example, are typically higher than other risk-free instruments has sometimes been ascribed to differences in the liquidity of GNMAs versus Treasury instruments. The model simulation suggests, however, that the spread between GNMA and Treasury instruments is explained by the value of the prepayment option implicity in the mortgages that underlie the certificates. (In fact, if our simulations are accurate, this is the major explanation for the difference in the yields of these two classes of instruments.)

A third, more tentative finding of the simulations is that the early problems encountered in marketing adjustable rate mortgages may have been due to their "overpricing" relative to existing short-term market rates of interest. There is some evidence that lenders price even quite "pure" variable rate mortgages by simply adding a few hundred basis points to the short-term rate. Our simulations suggest that such compensation cannot be justified on the basis of interest rate risk considerations. (Alternatively, of course, fixed-rate mortgages may have been "underpriced," but this implication is inconsistent with the model's close replication of the yields of these instruments in the secondary market.) These observations must obviously be regarded as tentative since our simulations employ a number of simplifying assumptions. It is useful to note, however, that the "pure" adjustable rate mortgage has thus far failed to obtain a major presence in the marketplace; what recent growth has taken place in the popularity of ARMs has coincided with more binding caps on these mortgages, making them more nearly fixed rate instruments. It is conceivable that these developments represent the marketplace's (inadvertent) evolution toward a proper pricing strategy for these instruments.

A final and related point concerns the use of adjustable rate instruments in lenders' portfolios as a means of avoiding interest rate risk. Our simulations indicate the magnitude of the trade-off between higher portfolio yields and the interest rate risk inherent in these portfolios. Although adjustable rate mortgages offer the lenders protection against interest rate risk, they do so at considerable sacrifice of expected yield. Financial institutions must decide for themselves whether their function is simply one of denomination intermediation and default risk assumption, or whether they wish to provide interest rate intermediation services in the residential mortgage market.

# Appendix: Details of the Bond and Option Pricing Model

As stated in the text, short-term real interest rates are assumed to be drawn from a log normal distribution approximated by a binomial period. Starting from the current short-term riskless rate, the alternative paths of future short-term riskless rates are determined by combinations of up-jump and down-jump ratios. That is, the interest rate in period T can take one of the following values:

$$R_t^u = UR_{t-1}$$
$$R_t^d = DR_{t-1}$$

where

U = Jump-up (rise in interest rates)
D = Jump-down (fall in interest rates)

We assume that the ratios of the two possible interest rate movements are constant. This makes the relation between interest rates over time multiplicative and enables us to use an interest rate tree for which every period t has t elements instead of one with $2^t$ elements.

Given these alternative interest rate paths, bond prices at any instant are defined as

$$B(t) = [.5(1+L) \times B(t+1)^U + .5(1-L) \times B(t+1)^D + C]/(1+R_t)^{1/N}$$

where

L = risk aversion parameter
$B(t+1)^U$ = Price of bond in period t + 1 if interest rates rise
$B(t+1)^D$ = Price of bond in period t + 1 if interest rates fall
C = per period coupon payment
R = prevailing interet rate
N = Number of periods per year

Thus, the greater the market's risk aversion, (that is, the greater is L) the more weight is given to the up-jump state, and for a given coupon the lower the bond price.

The proceeds from exercising a call option on such a "bond" in period t are equal to B(t) − E(t), where E(t) = the exercise price of the option in period T.

The proceeds for a put option can be expressed as E(t) − B(t).

In both cases the option is assumed to be of the American type, that is it is able to be exercised at any time during its life. The price (OP) of an option at any point in time is therefore the maximum of the proceeds from exercise or its value if held for future exercise (FV). More precisely,

$$OP(t) = \text{Max}[E(t) - B(t), FV(t)]$$

From the notion of a riskless hedge, it can be shown that the value of holding the option for future exercise is equal to:

$$FV(t) = (.5 \times OP(t+1)^U + .5 \times OP(t+1)^D)/(1+R_t)^{1/N} \quad (1)$$

where $OP(t+1)^U$ = the option price in period t + 1 if interest rates rise
$OP(t+1)^D$ = the option price in period t + 1 if interest rates fall

since the price of the option is known with certainty only at the end of its life (that is, its price is zero at that time) solving for the current price of the option involves working "backwards" in time using the above relationships. The authors have written FORTRAN programs that perform this general numerical computation procedure.

The procedure described above is entirely general and may be applied to any financial instrument that can be described as a finite series of "coupon" payments, however irregular. In addition, the exercise price and exercise conditions may be varied at will permitting quite complex instruments to be valued in a simple manner.

Most of our applications in this paper were directed at valuing mortgage type (that is, self-amortizing) instruments. We employ standard formulae for computing the periodic payments for a self-amortizing instrument and for computing its remaining principal balance. The periodic payment is assumed to be

$$C = (PR \times CR)/1-(1+CR)^{-NPT}$$

and the remaining balance (RB) in period t can be computed from the formula

$$RB(t) = PR \times (1 + CR)^{t-1} (1 - D)$$

where

PR = Principal

CR = Contract Rate

D = $\frac{1-(1+CR)^{-(t-1)}}{[1-(1+CR)^{-NPT}]}$

NPT = Total number of periods in the life of the investment

The relationships and procedures presented in this Appendix represent the basic computations employed in the various simulations presented in this paper. As this paper suggests, however, the computational details are influenced by the type of instrument simulated and the objectives of the simulation exercise. In some cases, only the bond pricing computations are necessary. In others, both the bond pricing and option pricing procedures are employed.

## FOOTNOTES

1. Randall J. Pozdena and Ben Iben, "Pricing Debt Instruments: The Options Approach," Federal Reserve Bank of San Francisco **Economic Review** Summer 1983. pp. 19-30.

2. See Richard Rendleman and Brit Bartter, "The Pricing of Options on Debt Securities," **Journal of Financial and Quantitative Analysis**, March 1980, pp. 11-24.

3. See Brennan and Schwartz, "Bond Pricing and Market Efficiency," **Financial Analysts Journal**, September-October 1982, p. 49-56.

4. The original Black and Scholes paper is, Fisher Black and Myron Scholes, "The Pricing of Options and Corporate Liabilities," **Journal of Political Economy**, May 1972, pp. 637-654.

5. For a review of options terminology, see Pozdena and Iben, **ibid**. p. 20.

6. In our earlier work, we estimated interest rate drift and uncertainty parameters using a simple time series estimation technique on actual short-term interest rates. That investigation yielded an estimate of interest rate drift for the period studies here of approximately zero. In addition, if interest rate movements are viewed as being generated by a mean reverting process, there may be theoretical justification for assuming that the annual rate of interest rate drift is zero over a long horizon. Finally, as a practical matter, our experience with the model suggests that the qualitative findings of our simulations would not be significantly affected by the use of a non-zero drift parameter and the presentation of the results would be made significantly more cumbersome if a third parameter dimension were incorporated.

7. The data on actual GNMA yields was obtained from various issues of the **Weekly Bond Report**, Solomon Brothers, New York.

8. It should be noted, however, that there is one sense in which this simulation overstates the performance of the options model. One of the pieces of information used in creating the simulated GNMA yields is the contract rate on the mortgages that underlie the pass-through certificate. Although this rate is an administered rate, it is adjusted periodically as conditions in the mortgage market in general change. Thus, it is not a purely arbitrary figure, but rather, contains some market information. Since this coupon stream is incorporated into our valuation, our estimated yields are probably somewhat better than they otherwise would be.

9. At the time of this writing, the Federal Home Loan Bank Board has removed regulations affecting prepayment penalty clauses in mortgage contracts. Mortgages made by state chartered institutions may not be similarly deregulated at this time.

10. This procedure of "capitalizing" the value of the option onto the contract rate of the mortgage in an iterative procedure and, although convergent, is carried out in our computation a limited number of times. Therefore, our estimates are themselves approximations and contain small approximation errors.

11. Our estimation procedure was a semi-manual one. A more sophisticated approach would incorporate the simulation model directly in a three variable optimization program.

12. In practice, "caps" often apply to movements in rates in both directions. The contract rate on a mortgage with an initial rate of 10% and a cap of 4% is thus restricted to the range of rates between 6% and 14%. We do not incorporate the downside rate limitation feature in our simulations here. The implications of this simplification are discussed below.

13. Many commercial loans are so-called "floating rate" loans. In general, these are "bullet" type loans which obligate the borrower to payments of interest during the life of the loan with repayment of principal at the end of the loan's life. Often, however, there are either explicit provisions or incentives for earlier repayment of a portion of the principal value of these loans. In this sense, the type of loan specified here is a variant of such a floating rate loan. We are simply more explicit about the principal repayment schedule, linking it to the repayment schedule that would apply on a fixed rate self-amortizing instrument.

14. The actual simulation procedure is quite cumbersome and can only be outlined briefly here. Essentially, the aim of the simulation is to discover an initial contract rate for the ARM which par values the instrument, recognizing that the mortgages contains a prepayment option which must be "capitalized" into the contract's yield. In the initial period of its life, the adjustable rate mortgage has payments that are precisely those that would obtain on a thirty year, fixed rate mortgage with similar prepayment option features.

15. A forthcoming survey of mortgage loan features conducted by the Federal Home Loan Bank of San Francisco supports these observations.

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