FRBSF Weekly Letter

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Regulating Bank Capital

Over the past several years, greater emphasis has been placed on increasing bank capital through regulation. For example, the three federal bank regulatory agencies have raised capital requirements for banks and bank holding companies and established more uniform standards. Most recently, the federal bank regulatory agencies have put forth proposals for risk-based capital requirements to be coordinated with the Bank of England.

These regulatory measures, in part, reflect concern over the rising risk exposure of the deposit insurance system. With the sharp rise in bank failures in recent years, the Federal Deposit Insurance Corporation's (FDIC's) expenses, which ranged from about $50 million to $200 million per year in the 1970s, rose to about $2 billion per year in 1985 and 1986. More stringent capital regulation in response to these developments is based on the presumption that higher bank capital (equity) relative to assets can insulate the deposit insurance fund from fluctuations in bank earnings. With more capital relative to assets (lower leverage) and a given riskiness of assets, a bank would be less likely to fail; even if it were to fail, the failure would impose smaller losses on the deposit insurance fund.

The move to more stringent capital standards in banking, however, has met with considerable controversy as well as some skepticism. The popular view seems to be that higher capital requirements will cause banks to invest in riskier assets in an attempt to maintain a given rate of return on equity. Such a response by banks could subvert the goals of capital regulation since riskier assets would be associated with a greater likelihood of bank failure and a larger liability for the deposit insurance fund, all other things equal.

The central issue in bank capital regulation, then, is whether banks would respond to higher regulatory capital requirements by choosing riskier assets to offset or even more than offset the desired effects of higher capital.

In this *Letter*, we address this issue and find that, in contrast to the popular view, more stringent capital standards alone would not give a bank more of an incentive to increase the riskiness of its assets. Instead, the incentive to increase asset risk falls as a bank's capital increases. This finding implies that, as long as regulatory and supervisory efforts to limit asset risk (such as bank examinations) are not relaxed, increasing a bank's capital will lower the bank's chance of failure and reduce the expected liability of the deposit insurance system.

Heads I win . . .

Bank risk depends on the bank's capital position (leverage) and the riskiness of its assets. Under the deposit insurance system in the U.S., a bank's insurance premium rate is fixed and therefore unrelated to risk. Moreover, as long as insured depositors are confident about the viability of the deposit insurance system, they will be willing to lend to a bank at an interest rate that does not vary with the bank's risk since their funds are insured. As a result, a bank can benefit at the expense of the deposit insurance system by increasing its leverage and/or asset risk.

The situation is essentially one of "Heads I win; tails you lose." When a bank is lucky and its assets have high realized returns, the bank can increase its earnings by leveraging risky assets. However, when the same bank is unlucky and fails because the realized asset returns are insufficient to meet obligations to depositors and debtholders, the bank can shift losses that exceed its capital to the deposit insurance system.

Under these circumstances, the bank owners' losses would be limited to their investment in the bank when the bank fails regardless of the extent of their promised liabilities to depositors and other debtholders, whereas all the gains from risk-taking would go to the owners when the bank does not fail. Thus, a bank acting in the best interest of its stockholders to maximize the value of their stock has an incentive to risk failure.

Deposit insurance as an option

The connection between the value of the deposit guarantee and risk was developed formally by

economist Robert Merton. Merton has shown how the value of the deposit insurance guarantee can be related to leverage and asset risk using an options-pricing formula developed by economists Fisher Black and Myron Scholes for the valuation of stock options.

A put option for a particular stock, for example, is a contract that gives the purchaser the right, but not the obligation, to sell a certain number of shares of the stock to the seller of the option at a predetermined exercise price. The purchaser of the option would exercise the option only if the market price of the stock were lower than the option's exercise price. The options-pricing formula developed by Black and Scholes is a mathematical way of calculating how much a particular stock option is worth (that is, the option's price). The value of a put option is negatively related to the current price of the stock, and positively related to the variation in the stock's rate of return (that is, its risk), the exercise price, and the time to maturity of the agreement.

In Merton's adaptation of the stock option formula to deposit insurance, the bank is viewed as "purchasing" an option from the deposit insurance system to sell ("put") its assets to the system at a price equal to the value of the bank's insured deposits, which, for simplicity, we assume represent all bank liabilities. The bank would exercise this option only when its assets are worth less than its liabilities — that is, when it is insolvent. The value of the deposit guarantee to the bank is negatively related to the value of the bank's assets, and positively related to the variation in the rate of return on the bank's assets (asset risk), the level of insured deposits, and the time interval between bank examinations. (In applying the formula to deposit insurance, the value of the bank's assets replaces the stock price, the variation in the value of the assets substitutes for the variation in the stock price, the value of the insured deposits corresponds to the exercise price, and the examination interval is used in place of the time to maturity of the option contract.)

This options pricing formula indicates that the value of the deposit insurance guarantee increases as the bank's leverage (the ratio of its assets to invested capital) declines, or as the variability of the bank's return on assets (asset risk) increases. The reason is that an increase in either leverage or the riskiness of assets makes it more likely that the option will be exercised. Thus, a bank *not* required to pay the full value of the option could increase the value of its own stock by increasing leverage and/or asset risk if allowed to do so by regulators.

Asset risk and the deposit guarantee

The effects of varying leverage and asset risk on the value of the deposit guarantee and hence the value of the bank are illustrated graphically in the figure using the options pricing formula. For purposes of the figure, the initial assets of the bank (excluding the value of the deposit insurance guarantee) are arbitrarily set at $1 million. We also assume that the bank pays a deposit insurance premium of 1/12th of a percent of deposits (the statutory rate).

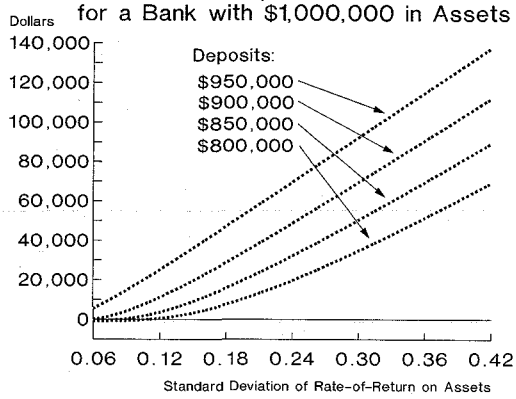
In the figure, for a given level of leverage (staying on any given line), it is evident that the value of the deposit insurance guarantee to the bank rises as asset risk increases. Similarly, for any given level of asset risk, increasing leverage by increasing deposits relative to initial assets (moving vertically from one line up to the next) also increases the value of the deposit insurance guarantee. Thus, a bank can increase its stockholder's wealth by increasing either asset risk or leverage, if permitted to do so.

The incentive to increase risk

Of key importance to the issue of capital regulation, however, is the observation that the incentive (the increase in value for a given change in risk) to increase asset risk declines as leverage declines. In graphical terms, for a given asset risk (standard deviation), the slopes of the lines become less steep as leverage declines.

Put another way, as the capital of an insured bank increases, the bank's incentive to increase asset risk falls. Thus, banks with the lowest capital ratios are those that have the greatest incentives to take on risky asset portfolios. Such banks, therefore, pose the gravest threat to the deposit insurance fund.

Net Value of the Deposit Insurance Guarantee for a Bank with $1,000,000 in Assets



These results, based on the options-pricing formula, also may be derived from another framework known as the state-preference model. A number of economists have used the state-preference model to show that with underpriced deposit insurance, banks will try to maximize leverage and/or asset risk. In an article in this Bank's Spring 1987 *Economic Review*, we extend the state-preference framework to show that it also implies that the incentive to increase asset risk declines as leverage declines.

Capital regulation

The fact that the incentive to increase asset risk falls as capital increases (leverage declines) means that more stringent capital requirements would *not* give banks more of a reason to invest in riskier assets. On the contrary, it would give them less of an incentive to do so. Therefore, if regulatory efforts were sufficient to constrain asset risk before capital requirements were increased, they certainly would be sufficient to do so afterward.

With more capital, banks would have less of an incentive to evade regulatory restrictions on asset risk. Consequently, as long as regulators do not react to lower leverage (higher capital) requirements by relaxing regulatory and supervisory efforts (through reduced bank examinations, for example) to limit asset risk, banks will not increase the riskiness of their assets. As a result, the risk exposure of the deposit insurance fund consequently will decline.

Conclusions

Currently, deposit insurance premiums are unrelated to bank risk, which depends on both leverage and asset risk. Moreover, insured depositors are not concerned with bank risk-taking and are willing to lend to banks at a risk-free rate since their deposits are insured. Under such a system, banks can benefit by increasing asset risk and/or by increasing leverage. As a result, some degree of capital regulation is needed to limit the liability of the deposit insurance fund. Similarly, for any given degree of leverage, the expected liability of the deposit insurance system can be lowered by reducing asset risk.

The analysis in this *Letter* indicates that regulatory increases in capital standards will *not* require greater efforts to restrain asset risk. On the contrary, the incentive to increase asset risk declines as capital increases. Thus, regulatory efforts to raise capital in banking would not by themselves lead to more risky asset portfolios.

Michael C. Keeley and Frederick T. Furlong

Research Department
Federal Reserve
Bank of
San Francisco

Alaska Arizona California Hawaii Idaho
Nevada Oregon Utah Washington

BANKING DATA—TWELFTH FEDERAL RESERVE DISTRICT
(Dollar amounts in millions)

Selected Assets and Liabilities Large Commercial Banks	Amount Outstanding 4/29/87	Change from 4/22/87	Change from 4/30/86 Dollar	Percent[7]
Loans, Leases and Investments[1 2]	204,711	– 505	– 301	– 0.1
Loans and Leases[1 6]	182,739	– 747	– 3,485	– 1.8
Commercial and Industrial	53,818	– 434	– 40	0.0
Real estate	67,722	– 359	1,306	1.9
Loans to Individuals	37,182	34	– 3,676	– 8.9
Leases	5,413	– 14	– 240	– 4.2
U.S. Treasury and Agency Securities[2]	14,717	206	3,823	35.0
Other Securities[2]	7,255	36	– 641	– 8.1
Total Deposits	207,317	– 2,549	1,359	0.6
Demand Deposits	53,815	– 968	1,218	2.3
Demand Deposits Adjusted[3]	49,664	– 932	1,398	2.8
Other Transaction Balances[4]	19,578	– 1,250	3,802	24.0
Total Non-Transaction Balances[6]	133,924	– 331	– 3,661	– 2.6
Money Market Deposit Accounts—Total	44,915	– 533	– 1,293	– 2.7
Time Deposits in Amounts of $100,000 or more	31,967	26	– 5,204	– 14.0
Other Liabilities for Borrowed Money[5]	22,029	– 2,992	– 6,764	– 23.4

Two Week Averages of Daily Figures	Period ended 4/20/87	Period ended 4/6/87
Reserve Position, All Reporting Banks		
Excess Reserves (+)/Deficiency (–)	89	9
Borrowings	72	9
Net free reserves (+)/Net borrowed(–)	17	1

1 Includes loss reserves, unearned income, excludes interbank loans
2 Excludes trading account securities
3 Excludes U.S. government and depository institution deposits and cash items
4 ATS, NOW, Super NOW and savings accounts with telephone transfers
5 Includes borrowing via FRB, TT&L notes, Fed Funds, RPs and other sources
6 Includes items not shown separately
7 Annualized percent change