Volume Title: Risk and Capital Adequacy in Commercial Banks

Volume Author/Editor: Sherman J. Maisel, editor

Volume Publisher: University of Chicago Press

Volume ISBN: 0-226-50281-3 (cloth); 0-226-50282-1 (paper)

Volume URL: http://www.nber.org/books/mais81-1

Conference Date:

Publication Date: 1981

Chapter Title: Insolvency and Capital Adequacy

Chapter Author(s): Sherman J. Maisel

Chapter URL: http://www.nber.org/chapters/c13520

Chapter pages in book: (p. 19 - 40)

2 Insolvency and Capital Adequacy

2.1 Introduction

In most industries, the amount of capital deemed adequate for a firm is found to vary widely depending upon the type of firm and the attitudes of its owners and creditors toward risk. Among banks, in contrast, capital adequacy can be defined more rigorously. The amount of capital needed hinges upon what risks of insolvency are considered suitable for the economy. Such hazards, in turn, depend upon the combination of assets, liabilities, and capital in a bank's portfolio. Determining capital adequacy requires evaluating the risks of insolvency that result from particular portfolio choices. The amount of risk in a set of assets and liabilities, as well as the true or economic value of capital, must be measured.

The contrast between banks and other firms is inherent in the nature of their functions. Most firms deal with a limited number of suppliers of funds who tend to be sophisticated and, in addition, can impose restrictions on the firm's borrowing and operations to protect their funds. Banks, on the other hand, deal with numerous depositors and creditors. Most customers have no choice except to hold the bank's liabilities as long as they need deposit services. To perform their primary function, banks must offer deposit contracts that contain a minimum hazard of default. The efficiency of deposit contracts declines as their default risk rises (Merton 1979).

Default risks cause a loss in efficiency because they increase information and transaction costs and threaten the reliability of the payments system. The costs when a default-free deposit is accepted are minimal. In contrast, if risk of default exists, time and effort must be spent in assessing the probabilities of default and of the losses that would result.

This chapter was prepared by Laurie Goodman of the staff of the Federal Reserve Bank of New York before she joined the Reserve Bank.

This chapter defines and explains the forces that cause capital to be adequate or inadequate in banks. These depend upon the amount of a bank's capital compared with the risks it assumes when it selects its portfolio of activities. The discussion shows that risks arise because of the probability that a bank will have a negative real income large enough to wipe out all its capital and make it insolvent. For each period, a bank expects to earn a particular amount of real income that includes its net earnings plus changes in the net value of its assets and liabilities. Because the future will differ from expectations, however, only a small likelihood exists that this exact income will result.

When a bank selects its portfolio of assets, liabilities, and other commitments, it chooses both the level of income expected at the end of the period and the shape of the distribution of possible outcomes around this expected amount. The distributions depend upon how the income of the portfolio of activities will vary with economic events that have some possibility of occurring. This chapter discusses the forces that determine both the level of the expected returns and the shapes of the distributions around such expectations. In addition it outlines some of the factors that must be examined in determining the true (economic) capital of an institution.

2.1.1 Adequate Capital

Capital is adequate either when it reduces the chances of future insolvency of an institution to some predetermined minimum level or, alternatively, when the premium paid by the bank to an insurer is "fair"; that is, when it fully covers the risks borne by the insurer. Such risks, in turn, depend upon the risk in the portfolio selected by the bank, on its capital, and on the terms of the insurance with respect to when insolvency will be determined and what losses will be paid. The first paper in part 2, by W. F. Sharpe, discusses some of the technical problems in measuring adequate capital.

A correct measure of the risks of insolvency is extremely important to a bank's managers, shareholders, and uninsured creditors, as well as to the insuring authorities. At the time of insolvency, there is a major restructuring of the rights of the claimants against the firm. In insolvency, the economic value of the firm is considerably reduced because of bankruptcy and related costs. Such costs can be large because of high legal fees and heavy transaction and liquidation charges.

Losses in value arise because prospective buyers of the firm or its assets have inadequate information as to the value of the assets compared with that available to its managers. Loans whose value depends upon prior knowledge of the borrower often can be sold only at discounts. Other assets such as local municipal bonds also have narrow markets and therefore potentially large transaction costs for a sale. If the bank actually goes out of existence, other losses from loss of information based on past

relationships occur to borrowers, to employees, and even to depositors, who will have to build up new connections.

2.1.2 Risks in Portfolios

Portfolio theory supplies the necessary tools for measuring the risks of insolvency. A bank selects a portfolio consisting of a variety of individual activities with respect to assets, liabilities, commitments, non-balance-sheet operations, and net worth (capital and reserves). Activities include such aggregates as consumer loans, government bonds with a particular maturity, lending and borrowing of federal funds, foreign exchange trading, and similar operations. The functions that combine into an aggregate activity depend upon both empirical and analytical concepts.

The risk of insolvency is a function of the current economic value of the bank's capital—that is, the present value of the expected cash flows from the firm's portfolio—and the probabilities that either the expected cash flow or the discount rate at which the flow is valued will alter. The existing capital and activities and the expected changes in them give an expected end-of-period net worth. However, expectations are unlikely to be realized exactly. Because of economic events, total income (including changes in capital values) will exceed or fall short of expected levels (Markowitz 1971; Sharpe 1964; Lintner 1965*b*; Mossin 1966; Merton 1974, 1977*a*).

Measuring the risk of a portfolio requires calculation of its expected end-of-period net worth and of the probable distribution of possible net worth values around this level. The bank will become insolvent if events cause its income to be so negative as to more than offset its initial capital plus any contributions less any dividends paid during the period. Risk depends on both the probability of insolvency and the expected losses in case of such failure.

2.1.3 Insolvency

For purposes of measuring adequate capital, a bank may be considered *insolvent* either when its liquidity is so low that it cannot pay its debts (i.e., a negative cash flow cannot be met); or when the market value of its assets reduced by the costs of bankruptcy is less than the value of its liabilities to its customers, computed under the assumption that all such obligations will be met fully.

It is difficult to determine whether a firm meeting its cash demands is insolvent. Examining current book values is not an adequate test. Large investment or loan losses reflecting higher market interest rates may not show up on the books. As the Sharpe study shows, there may also be unrecorded implicit claims against the FDIC insurance fund.

On the other hand, one cannot simply correct the book values by marking loans and investments to market and writing off losses. The balance sheet fails to show significant intangible assets. The accrued

information in an ongoing firm as well as its oligopoly position may be worth a good deal. These types of assets are traded and bring considerable returns in the market. Also, balance sheets frequently do not show future commitments such as those to make commercial and industrial loans, those to lend to financial institutions, those to make real estate loans, standby letters of credit, and foreign exchange contracts. The unwinding of these commitments may bring about gains and losses. These too must be evaluated in determining whether the firm is actually solvent.

The actual determination of insolvency is not simple. An accurate determination requires calculation of the present value of the firm based on discounting all future cash flows. There must also be an estimate of whether in future periods the firm will be able to meet projected cash demands. When they are discounted to determine present values, the future cash flows must be corrected for their risks and uncertainty. If the firm's liabilities plus bankruptcy costs exceed its assets, it is insolvent. However, under existing procedures, this may not lead to an actual declaration of insolvency. Regulators are likely to delay bankruptcy procedures beyond insolvency's economic occurrence. In a desire to be fair to the stockholders and borrowers, and to avoid political recriminations, regulators close banks only with the greatest reluctance.

2.1.4 Book versus Economic Capital

In determining a bank's insolvency it is sensible for regulators to differentiate between its economic or actual ongoing value and the amount it would be worth in liquidation. At times, however, such a policy leads to overemphasis on book and underemphasis on actual market values. There is a failure to recognize that market values reflect expected earnings while book values overstate or understate real net worth.

When interest rates rise and market values fall, no capital loss need be shown if the security is held to maturity. But this is purely an accounting convention. A real loss has occurred. The loss is reflected in the lower income earned during a holding period compared with the return on a similar investment at market prices. When regulators base decisions on book rather than economic capital, they are not using significant information available about expected earnings.

Too frequently, individuals assume that high interest rates will fall to some lower or past average rate. They are betting against the collective view of the market. Such implicit forecasts can be dangerous. If a majority of experts believed rates would fall, this would be reflected in market rates. Many institutions lost large sums in the mid-1960s by assuming that rates would return to lower levels. While they could avoid showing book losses by not engaging in capital transactions, such action did not protect them against losses through reduced income.

2.1.5 A Delay in Determining Insolvency

Because judging the value of expected future cash flows is so difficult, a great deal of discretion as to when to declare a bank insolvent has been left to the regulatory authorities. Legally, under title 12 of the United States Code, section 191, the Comptroller of the Currency may put a national bank into receivership whenever he or she becomes "satisfied of the insolvency" of that bank. Generally, state banking authorities have the same power for banks under their jurisdiction. Nowhere in the law is *insolvency* defined, and the Federal Bankruptcy Act does not apply to banks.

Courts have criticized this clause as giving too much power to the Comptroller of the Currency, but they have generally upheld it. Their rationale is that (*a*) it is a specific grant of power from Congress, and the wording of 12 USCA §191 is unambiguous, and that (*b*) the Comptroller will be able to act more quickly than a court. Legal precedent indicates that the shareholders and creditors together cannot challenge the Comptroller's decision. The bank may directly challenge the decision only on the grounds of error of law, fraud, or mistake. The court system has never reversed the Comptroller's actions.

It is important to realize that it may not always be optimal in a cost-efficient sense for the Comptroller of the Currency to declare a bank insolvent even when it is. If there are no real bankruptcy costs, it is clear that insolvency should be forced at the point where the bank cannot, in the long run, meet its obligations. If there are real bankruptcy costs, some system of transfers between shareholders, uninsured depositors, and the regulatory agencies may be possible so that the costs can be avoided, leaving everyone better off. This type of transfer may be prohibitively costly to negotiate. Moreover, if a declaration is delayed when a bank is insolvent, the uninsured depositors may take their money out, leaving the entire loss to the FDIC. If bankruptcy is not forced, the shareholders also have an incentive to reorganize their assets so as to maximize the value of their capital at the expense of the FDIC. While such costs would usually be larger to the FDIC than incurring the initial bankruptcy costs, no simple relationship exists. It depends upon the transactions costs of negotiations, bankruptcy costs, and monitoring costs.

2.2 A Model of the Risks of Insolvency

The probability that a bank will become insolvent in any period depends upon the volatility of the value of its assets, liabilities, and operating costs, on its ability to retain deposits or credit, and on the amount of capital it starts with plus what it retains or obtains from its owners. Banks choose particular assets and liabilities. As a result, the institution's ex-

pected value depends on how its portfolio will react to future events, and on the likelihood that a particular combination of events will occur (Dothan and Williams 1980). Values will alter with changes in interest rates, the gross national product, the money supply, and similar factors.

2.2.1 The Distribution of Returns

Figure 2.1 diagrams a model of the risk of insolvency. The bank's assets have a present value of A_0 and liabilities of L_0. Its net worth is $A_0 - L_0 = C_0$. This capital value, C_0, is shown in the diagram. At the end of a period, depending on its current choices and forecast events, the bank is expected to have a new expected value, shown as $\tilde{C}_1$. (Values or returns whose outcome depend upon future events are shown with a tilde [~].)

The difference between C_0 and $\tilde{C}_1$ is the expected return, $\tilde{R}_z$, adjusted to account for expected dividends or capital contributions. Between the present and the next evaluation, however, events are likely to cause unanticipated changes in the value of the bank's activities. The total expected return as well as the probable distribution of the actual return around the expected value depends on the choice of activities and on such factors as projected income, payments on liabilities, operating costs, loan losses, and changes in interest rates.

In figure 2.1 the curve illustrated is the distribution function of $\tilde{R}_z$ centered on the expected end-of-period net worth. To the left of the zero point in the diagram, net worth is negative, and the bank is insolvent. The solid area under the curve indicates the probability of insolvency. To determine risk requires measuring the bank's initial net worth (C_0); the expected return in the period ($\tilde{R}_z$); and the probability distribution or variance of the expected return [var ($\tilde{R}_z$)] (assuming a roughly normal distribution).

The probability of insolvency will depend on the amount of capital, C_0, and on the choice of assets and liabilities, as well as on dividend policy. These together determine both the expected return in the period $\tilde{R}_z$ and its probability distribution. McCulloch shows in his study examples of how such distribution functions can be estimated for particular activities. He also discusses in detail the importance for such estimates of the assumptions about the underlying process that determines the probable distribution of activities, the time between the estimates, and the correla-

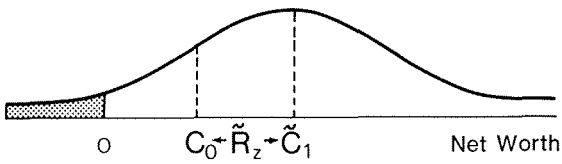

Fig. 2.1 Model of expectation and variance of net worth.

tion among movements of the individual assets and liabilities. McCulloch also demonstrates the wide dispersion of potential risks that result from different choices of portfolios, including initial capital.

2.3 The Chances of Insolvency

A bank at any time chooses a particular distribution of assets, liabilities, commitments, and operating procedures. It has capital and reserves equal to the difference between the market value of its assets and its liabilities, which, in turn, depend upon how the market forecasts and values expected movements in the economy. By the end of the period, unanticipated events are likely to lead to results far different from those projected. The paper by Craine and Pierce (chap. 12) analyzes some of the factors involved, particularly in anticipations of interest rates.

It must be noted that the amount of hazard arising from a portfolio choice depends both on the probability of insolvency caused by negative movements in income compared with initial capital and reserves, and on the amount required to make depositors, lenders, and insurers whole if insolvency occurs. Total income is not net earnings as reported on the books. To net book earnings must be added capital gains or losses in asset values. The two together make up economic income or total return. Risk measurement requires consideration of the firm's economic income and its economic balance sheet.

2.3.1 Past and Future Conditions

For purposes of analysis, it may be useful to differentiate banks vulnerable to risks that arise from weaknesses evident in the current environment from those that incur risks because they have assembled portfolios vulnerable to possible untoward events (Flannery and Guttentag 1979).

When evaluated, some banks are found to be risky because of past results or management decisions. Losses in book capital may be evident. The trend of earnings may be down. The ability to obtain funds to pay off depositors or lenders may be low. The management's ability to make proper operating choices may be questionable.

On the basis of past performance, other banks may appear far less hazardous. Their earnings trend may be strong. They may have a low record of loan losses. But they may be extremely vulnerable to possible future movements in the economic environment. Changes in interest rates may cause a drastic fall in the value of their assets. Sudden increases in takedowns against existing commitments may occur. There may be failures to repay loans and a sharp decrease in lower-cost sources of funds. Losses may arise from an overconcentration in regional, foreign, or specific industry loans. The firm may have to liquidate some assets, thereby incurring high transactions costs. The history of First Pennsylva-

nia Corporation shows an accumulation of losses from many events of this nature.

In their study of the bank examination process, Flannery and Guttentag (1979) note that most of the emphasis in existing procedures aims at finding banks that are problems because they have not adjusted well to the existing environment. They note that only a minimal effort has been made to measure risks of events that are possible but not forecast. Most discussions and texts on bank management and lending also neglect estimates of risks from unexpected events.

In contrast, this study emphasizes the need to consider the wide range of possible future events in measuring capital adequacy. Risks arise because the expected values of assets change and because alterations in cash flows require either raising funds at costs higher than returns on the existing portfolio or else liquidating assets at values below their book.

2.3.2 Movements in Portfolio Values

Markowitz (1971) has shown that probable changes in or the "risk" of a combination (or "portfolio") of assets and liabilities is a function of the risks of the individual elements, their importance in the combination, and the relationships among them. The capital asset pricing model (CAPM), based on the work of Sharpe (1964), Lintner (1965*b*), and Mossin (1966), offers an explicit expression for a bank's value.

The present value of a bank depends on expected cash flows, on risk-free interest rates, on the return on the market portfolio, and on the market price of risk. The book or face value of each activity can be translated into economic value by a three-step process:

1. The promised gross return must be equated to an expected net flow by correcting for operating expenses and nonperformance, including a provision for loss.
2. Net flows are transformed to certainty equivalents (risk-free returns) depending on the variance and covariance of the expected returns with the market and on the rate of exchange between returns and risk.
3. Each certainty equivalent return can be discounted to present values by the risk-free rate of interest for each future income period. The discount rates vary with the time to maturity of the risk-free flow from the asset.

Changes in any of these items will cause the total return to differ from that originally expected. Predictions of risk require estimating possible changes in operating expenses and losses, to obtain an estimate of net yields; the market's discount for risk; and the risk-free interest rate.

For example, a mortgage may carry a face interest rate of 11 percent. The estimated risk-free return will be the 11 percent less allowances for each of these factors. Compared with government bonds, mortgages will have larger expenses and losses. The mortgage returns must be further

discounted because they vary more than returns on risk-free securities. Finally, the value of their expected yield is reduced because risk-free long-term yields are higher and vary more than do short-term ones. On the average, these three forces may reduce the expected rate of return on a mortgage with a face yield of 11 percent by 250 basis points, or to 8.5 percent. The factors causing these reductions of promised returns compared with actual returns vary over time. Experience shows that, as a result, the average rate at which expected future mortgage cash flows are discounted will vary so that the 250 basis point reduction is merely the center of a range between 150 and 350 basis points. The expected return of an 11 percent mortgage over time has ranged from 7.50 percent to 9.5 percent around the average expected return of 8.5 percent.

In any period, the yield from an activity is its net cash flow plus the change in its capital value between the start and the end of the period. Changes in capital values, in turn, depend on how the discount factors move. Thus, in recent years, actual returns on mortgages have been as low as -3 percent, while in others they have been as high as 13 percent. The risk of an activity depends on the expected variance of such returns. [var (r)].

In examining the hazards to a bank, it is necessary to estimate the risks of the individual assets and liabilities it picks. However, these risks do not simply cumulate. To estimate the total hazard and adequacy of capital, the action of the overall portfolio must also be analyzed.

2.4 Changes in the Returns of Individual Assets

This section describes a simple mathematical model for measuring the expected returns and volatilities of individual assets and liabilities. For purposes of analysis, they can be grouped into a limited number of activities i (K activities, with assets numbered $1 \ldots J$ and liabilities $J + 1 \ldots K$). The expected return and variance for the bank depend upon the weights of the individual activities in the portfolio, their expected returns, and their variances and covariances. Because of the importance of interest rate risk, assets and liabilities, in addition to being grouped by type, must also be grouped by their expected cash flow in each year. As an example, McCulloch shows in his paper (chap. 10) differing risks for three separate securities, each with the same maturity but with different forms of cash flows.

2.4.1 The Value of an Activity

The value (positive or negative) of an activity equals its discounted risk-free equivalent cash flow. First, expected cash flows must be estimated. These are promised returns less corrections for normal expenses, delays, or defaults. The paper by Maisel and Jacobson (chap. 9), for

example, shows gross book returns of 10.5 percent on consumer loans and 8.5 percent on commercial loans in the early 1970s. The respective net returns were 5.5 percent and 5.7 percent. Expected cash flows are projections of such net returns. Second, to find present values, these cash flows must be transformed into certainty equivalences ($\tilde{F}_{it}$) of risk-free cash flows that must be discounted at the risk-free interest rate ($\tilde{r}_{ft}$). Even though gross and net returns differ, the present value of commercial and consumer loans might be equal when they are corrected to certainty equivalences. The papers by Morrison and Pyle (chap. 13) and by Nadauld (chap. 14) develop in detail models and forecasting procedures for both $\tilde{r}_{ft}$, the risk-free interest rate, and $\tilde{F}_{it}$, certainty equivalent cash flows (cf. also Lanstein and Sharpe 1978; Boquist, Racette, and Schlarbaum 1975).

2.4.2 Certain Equivalent Cash Flows

As noted, to find the certainty equivalence of the cash flow from each of the bank's i activities requires estimating the gross, net, and certainty equivalent flows. The expected net cash flow from each activity will be volatile. The greater the variance of its returns, the less desirable will be the asset. This negative factor or risk must be paid for. In comparison with one that is risk-free, a risky asset must accrue net income beyond the risk-free return. The existence of both expected losses and expenses plus possible variances account for the larger promised gross returns on non-risk-free assets. The amount of such needed additional income increases the rate at which the flow from the asset is discounted. When the expected actual cash flows have been corrected to certainty equivalences, their market values in future years are labeled as $\tilde{F}_{i1} \ldots \tilde{F}_{iT}$ for the years $1 \ldots T$.

2.4.3 Discounting by the Risk-Free Rate

When these certainty equivalent market values have been estimated for an activity i, its present value c is found by discounting by the marketwide discount factors $\tilde{q}_i \ldots \tilde{q}_T$ that are expected to prevail in each particular future year and the present values summed. Thus:

$$c_i = \tilde{q}_i\tilde{F}_{i1} + \tilde{q}_2\tilde{F}_{i2} + \ldots + \tilde{q}_T\tilde{F}_{iT}, \tag{1}$$

where $\tilde{q}_t = 1/(1+\tilde{r}f_t)$ and $\tilde{r}f_t$ is the risk-free rate of return between periods O and t. For example, the expected return on an activity in the first period $\tilde{r}_{i1}$ equals the discounted expected cash flow $\tilde{q}_1\tilde{F}_{i1}$.

2.4.4 Changes in Discounts, Cash Flows, and Certainty Equivalences

The returns in a period can differ from expectations in at least three ways. Events in the economy and in the firm will alter discount rates, shift expected cash flows, and change the market value of risks. The actual return for any holding period will be:

(2) $$\tilde{r}_{it} = m_{it} + \tilde{c}_{i,t+1} - c_{it},$$

where m_{it} is the cash flow actually received in the period and the total return includes this cash flow plus the changes in value of the activity during the period. The risk in an activity [var($\tilde{r}_{it}$)] depends upon the way this total return may vary with events.

Changes in value depend upon movements in future risk-free interest rates and the expected cash flows during the period. To simplify presentations, it is common to assume that the cash flow received during the period is reinvested. Thus the value of an activity at the end of the first period will be:

(3) $$c^*_i = q^*_1 F_{i1}^* + \tilde{q}^*_2 \tilde{F}_{i2}^* + \ldots + \tilde{q}^*_T \tilde{F}_{iT}^*,$$

with the asterisks denoting values at the end of the period.

The actual holding period return then on activity i will be:

$$r_i = \frac{c^*_i}{c_i} - 1.$$

This holding period return is the weighted average of the changes in the return for each of the future periods over which there is an expected cash flow. As noted, it depends upon interest earned or paid during the period, the change of the discount rates applicable to each future period, and the changes in the certainty equivalent cash flows.

2.5 Changes in the Bank's Value

The expected change in a bank's value and its risk or probability distribution [var($\tilde{R}_z$)] is a function of the activities the bank picks for its portfolio, of the interrelationships or covariances among the individual activities, and of the distribution of probable future states for the economy and the bank, the so-called events.

Each class of activities i has a share (X_i) in the total portfolio (V_0) of the bank. X_i depends upon the total portfolio and is calculated from $X_i = V_i / \sum_{i=1}^{K} V_i$, where V_i is the positive or negative market value of activity i.

2.5.1 The Covariance Matrix

As just noted, to handle risks most efficiently, one should consider the cash flow from each class of activities in each period. We thus think in terms of a vector Y_z that contains the relative share of the expected annual cash flows from each activity in the bank. This is simply the share of each activity's future payments in the bank's present value.[1]

1. Note Y_{it} is the proportion of activity i's present value attributed to the payments expected in year t. Then the vector Y_z is: $[X_1Y_{11}, X_1Y_{12} \ldots X_1Y_{1T}, X_2Y_{21} \ldots X_2Y_{2T}, \ldots, X_KY_{K1} \ldots X_KY_{KT}, 0 \ldots 0]$.

We define a covariance matrix

$$D = \text{cov}(r_{it}, r_{j\tau}).$$

Most of this volume is concerned with the theory and empirical estimations of particular covariance (D) matrixes of returns. The theory is general and explains the movements of returns related to all possible events. In the empirical work, we have primarily attempted to estimate the risks for banks of different activities related to unexpected movements in interest rates, commitments, deposits, defaults, and operating expenses.

The total expected variance in the bank's return given the covariance matrix is

$$\text{var}(\tilde{R}_z) = Y_z D Y_z'. \tag{4}$$

In thinking about the factors causing a bank's expected variance and risk, a useful background is the extensive literature based on portfolio theory and the capital asset pricing model (CAPM). The study by Rosenberg and Perry (chap. 16) explains and analyzes the relationships in this model.

It is common usage in this literature to analyze these risks under three headings. Market risks (also called systematic risks) are those movements of the firm's returns that are correlated with movements of returns for the market portfolio—a combination of all securities, each in proportion to market value outstanding. Some of the bank's activities such as defaults, shifts in operating expenses, and changes in the overall price of risk are likely to react to the same events that cause movements in the value of the market portfolio. Depending on the particular set of activities the bank has chosen, the reaction of the bank's returns to these events may be greater or smaller than those of the market as a whole.

In addition, however, because it may react in a unique manner to such factors as interest rates, foreign exchanges, localized depressions, or overexpansion in the real estate market, the bank's returns may move quite differently from those of the market. Such nonmarket returns may be further subdivided into factors likely to cause banks as a group to move more or less together—called extramarket covariance—and specific risk unique to the individual bank.

2.5.2 Market Risk or Beta

These concepts can be illustrated by showing the relationship between the bank and the market given the generalized covariance matrix of returns. Let Y_m represent the vector of activities in the market portfolio equivalent to Y_z for the bank. Then the variance of the market portfolio is

$$\text{var}(\tilde{R}_m) = Y_m D Y_m' \tag{5}$$

and the covariance of the bank's expected returns with the market is

$$\text{cov}(\tilde{R}_z, \tilde{R}_m) = Y_z D Y_m' . \tag{6}$$

Beta, or the sensitivity of the bank's return to movements in the market portfolio, is

$$B_z = \frac{Y_z D Y_m'}{Y_m D Y_m'} . \tag{7}$$

This is the covariance of the bank's returns with the market divided by the variance of the market's returns. This responsiveness of the bank's returns to the market depends upon the relationship between the movements in the bank's activities and the movements in the returns on the market portfolio. The responsiveness is a weighted average of the responsiveness of the individual activities engaged in by the bank.

2.5.3 Nonmarket Risks

The nonmarket risk is designated $\text{var}(R_\epsilon)$. It is uncorrelated with the market component of risk. The two together equal the total risk or variance of the bank. Thus

$$\text{var}(\tilde{R}_z) = \text{var}(B_z \tilde{R}_m) + \text{var}(\tilde{R}_\epsilon) \tag{8}$$

or

$$\text{var}(\tilde{R}_z) = B_z^2 \text{ var } \tilde{R}_m + \text{var}(\tilde{R}_\epsilon) . \tag{8a}$$

The total risk of a bank can be analyzed in terms of its market and nonmarket risk. Moreover, the larger the bank's responsiveness to the market (B_z), the greater will be the impact on it of changes that affect the value of securities as a whole. Conversely, the larger the share of nonmarket risks, the less will its returns respond to movements that affect the market.

This share is important because the CAPM indicates that in an efficient market investors will pay for and receive higher returns than the market average only for assets that bear increased systematic market risks. The nonmarket risks of securities can be completely diversified away if the individual investor selects a diversified portfolio. From the investor's point of view, nonsystematic risks require only such a strategy of proper diversification. However, the bank manager or the FDIC or other regulators are in a different situation. The risk of insolvency depends upon the bank's total risk $\text{var}(\tilde{R}_z)$ related to its level of capital. A failure to diversify properly increases the risks, but not the bank's value to investors. In fact, the investor may avoid the bank if he finds it difficult to offset the undesired risk.

As part of the study for this volume, Goodman and Sharpe (1978) analyzed the market and nonmarket risk in an index of bank stocks in New York and outside New York. They found that the amount of risk and the relationship to the market (beta) varied a great deal over time. Risks in the 1930s, 1960s, and 1970s were two to three times as high as in the 1940s and 1950s.

In the earlier and later periods the betas were close to one. During the middle years they were much lower, falling under 0.5. Over the past twenty years, market risk for these indexes averaged about 40 percent of the total risk. Of course these indexes, because they contain ten to fifteen stocks, benefit from diversification, even if only among bank stocks, and therefore have a reduced total risk and a higher percentage of market compared with nonmarket risk than would an individual bank. The effect of specific residual risk, although not of extramarket covariance, is reduced when a group of banks is considered.

The ratio of nonmarket to total risk for individual banks is much higher. Thus, table 16.2 of the Rosenberg and Perry paper (chap. 16) shows the mean and range of these factors in 1977 for individual banks. The average market beta is about 1.0, but the range for 101 banks is from 0.17 to 1.93. The nonmarket risk (in this case based on logarithmic returns) for individual banks shows a range from 0.025 to 0.125 around a mean of 0.071.

2.6 The Major Causes of Fluctuations in Values

A variety of risks face banks at all times. Skilled risk management enables the bank to absorb the shock of unexpected events that would otherwise cause insolvency. Management of the bank's portfolio depends upon the proper classification of assets and liabilities in accordance with their possible reactions to unexpected events. The portfolio must be classified so that all activities whose values are likely to react in a similar manner are grouped together. While the returns for a given loan depend on its proper underwriting, the risk and returns to a bank depend more on the relationship among activities than on individual loans. To manage risks, one must recognize the basic sources from which dangers spring. It is then necessary to estimate how much risk arises from each activity. Finally, the amount of variance in a bank's portfolio depends on the weight of each type of activity in the total.

A well-diversified portfolio of loans, even with high individual nonmarket risks, should return neither more nor less than a normal (corrected for market risk) profit. Its face interest rates should cover normal returns plus expected operating costs and losses. Insolvency develops when firms fail to recognize this fact. By reaching for what seem like high promised returns, they either fail to diversify or accept too great a market risk. Typically, they neglect past events that they consider abnormal. An

emphasis on individual loans misses the true dangers that arise from events affecting whole classes of assets and liabilities. Furthermore, because investors can diversify, nonmarket risks do not carry interest yields commensurate with their face yields. The measurement of risks should emphasize the need to examine broad classes of risks, not individual loans. An improved classification system can call attention to the most critical areas and allow a better expenditure of effort.

2.6.1 Types of Risk

Greatest is the risk of interest rate movements. When interest rates rise, banks must pay more for current liabilities. More significant, increases in the long end of the term structure raise discount factors for future promises to pay. How much this will lower capital values depends on the duration of the portfolio (the weighted average of the time periods of future cash flows, where weights are the present value of the future cash flows). Risk premiums may also increase, lowering capital values still further. The expected cash flow may become less favorable as assets are extended and liabilities lost or shortened.

If the interest rate risk is high, substantial adverse changes may cause insolvency. The degree of danger depends on the scheduled dates of cash flows from assets and liabilities and on the probable magnitude of shifts in the interest rate structure. It is the bank's net exposure, taking into account assets, liabilities, and capital, that determines its total interest rate risk (Macaulay 1938; Samuelson 1943; Hicks 1946; Grove 1974).

The papers by McCulloch, Craine and Pierce, Morrison and Pyle, Nadauld, and Lane and Golen (chaps. 10, 12, 13, 14 and 15) analyze in detail the theory underlying interest rate risks. They also measure the degree of risk in particular activities. They show how risks can be lowered by reducing the duration of the portfolio either by choosing assets with a lower duration or by increasing the maturity of the liabilities. The risks they find include changes in portfolios through outflows, delays in repayments, and speeding up of takedowns against commitments, as well as the effect of interest movements on capital values and total income.

Many discussions in the banking literature concentrate on loan loss or credit risk—the risk that borrowers will default or perform poorly. Variations in the default rate of typical banks around industry averages have not been large. However, occasionally an individual bank may depart considerably from the average. This potential must be estimated. Poor underwriting of individual loans can lead to above-normal losses, but errors of this kind are typically caught in time. Banks with above-average losses in one period tend to have a reduced probability of a second year of unanticipated losses. They regress back to the mean.

As the Maisel and Jacobson paper (chap. 9) shows, banks whose loans carry high interest rates seem, as theory says they should, to charge enough to offset any added risk. One cannot assume that a well-

diversified portfolio of loans whose individual risks appear high is either more or less profitable or risky than a similarly diversified portfolio of loans whose individual risks appear low. In a fairly competitive market, loans carry interest rates related to their true risks. A class of loans may stay out of line for several years, and a bank may underestimate individual risks in attempting to compete, but such errors are not fatal. Studies of bank examinations seem to show that both lenders and examiners are able to recognize past mistakes.

Another risk is that operating margins may deteriorate. Margins depends on receipts from assets, on costs of funds, and on operating expenses. Banks may err in their liquidity management. When rates on current liabilities shift, movements may also occur in the amount and source of funds. A rise in market rates may be accompanied by unexpected surges in takedowns of commitments. In considering operating risks, attention must be paid to items not shown on the balance sheet. In addition to commitments, foreign exchange contracts, letters of credit, and trust operations may be important. One fortunate fact with respect to operating risks is that, on the whole, a sudden deterioration is unlikely. Most situations cast shadows well in advance. Dangers arise primarily from failure to correct past trends.

Among banks as a whole, the greatest risks and most common causes of failure are fraud, either internal or external, and insider abuse. Owners and managers alter the portfolio to enhance their personal investments or those of family and friends. There can also be defalcations by members of the staff; or the bank can be defrauded as a result of undue trust or inadequate investigation of borrowers.

The risk from fraud and insider abuse varies with the size of the bank. Most failures of small banks are due to fraud. As the size of the bank grows, the probability that a defalcation can be large enough to cause insolvency decreases. It does not disappear, however, as is evidenced by the demise of the United States National Bank of San Diego.

The most significant risk for most banks is a failure to diversify. This risk may arise from a concentration of long-term maturities and, therefore, excessive interest rate risks. It may also stem from a concentration of loans in specific industries or locations—small banks in single neighborhoods or towns; large banks assuming too many foreign risks; or banks lending to a related group of investors or companies. A similar lack of diversification may arise from excessive short-term borrowing or a concentration in other types of managed liabilities.

This list makes it clear that, while the basic rules and regulations prohibiting lending more than 10 percent of capital to a single borrower is a step toward diversification, it is far from sufficient. Nondiversification develops when a group of loans or investments are likely to react in the same way to outside forces. While concentration of loans to a single

borrower can be important, other factors can also dominate non-diversification. If movements in the returns from the individual loans and investments are completely correlated, diversifying into innumerable separate loans or securities does not reduce risk at all. The effectiveness of diversification depends upon selecting loans or activities where the correlation among the activities is either negative or slight.

Holding a number of assets and liabilities with identical patterns of expected cash flows, but half positive and half negative, gives almost complete protection against interest rate risk. On the other hand, because each one's return will move almost identically with interest rates, no matter how well diversified is a portfolio of twenty-year municipal bonds there will be virtually no reduction of such risk. Similarly, the number of loans to different real estate investment trusts or to different companies and government agencies in country X or region Y might give very little reduction of risk if the borrowers are similarly affected by economic or political events. Measuring diversification requires a proper model of actual risks. One cannot simply count loans or borrowers; one must classify the portfolio into those activities whose returns are closely correlated.

2.7 Capital

In assessing the total risk of the portfolio, capital plays a critical role. As shown in figure 2.1, available capital can offset other losses. The greater the initial capital and the more is added from earnings or new investment, the less is the danger of insolvency. That equity capital requires no fixed outlays means that the average duration of a portfolio grows with its ratio of capital to other liabilities. As the paper by McCulloch shows, the relationship between risk and capital is nonlinear. Given a certain risk in a portfolio, the danger of insolvency falls rapidly as capital is increased, but after a point additional capital has only a minor effect.

The cost of capital or the value of leverage in a bank is difficult to measure. There may well be differences between the cost of capital to the public or to the economy and the cost to the stockholders or managers. Differences arise because of possible subsidies through the chartering and insurance system, because of tax advantages to the firm but costs to the government, and because of imperfections in financial markets, especially for small banks.

The previous discussion noted that *capital* refers to the market value of a bank's capital. It reflects the fact that the market values of both assets and liabilities will differ from book values, and that numerous intangible assets and liabilities may not appear on the books. Capital may be thought of as the difference between the asset side of the economic

balance sheet, where all tangible and intangible assets are valued at market or economic values, and the economic value of deposits, borrowed funds, and implied as well as actual commitments.

2.7.1 The Economic Value of Liabilities

Sharpe notes that the "economic value" of the insured deposits will be less than the nominal value if there is any possibility of default. Assume a depositor puts $100 into a checking account. The bank promises to pay the depositor $100 if the bank is still in business when the customer returns. Suppose the bank will be able to pay off the depositor in full with a probability of 0.9, and with a probability of 0.1 will not be able to pay the depositor anything. The economic value of the deposit is $90. The depositor in effect has a claim of $90 on the bank and a claim for $10 on the FDIC. Thus the true value of the bank's promise to pay deposits on demand is less than the nominal deposit amount, since the bank may not be able to pay all claims. The depositor may be thought of as having a claim on the bank for the actual value of the promise to pay and a claim on the FDIC for the difference between the nominal value of the deposits and the "economic" or actual value of the promise to pay.

Uninsured depositors are in fact partially insured because the FDIC usually arranges mergers with other banks instead of simply paying off the insured depositors. Barnett (1976*a*) has noted that

> out of $4 billion in deposits at failed banks through 1975, approximately $267 million was lost or is expected to be lost. Of this amount unprotected depositors stood to lose about $13 million, the corporation absorbing the remainder . . . the high recovery rate for depositors is attributable at least in part to the fact that $9 out of every $10 in deposits were in bank failures which were handled by purchase assumption transactions in which the FDIC provided assistance enabling another bank to assume the failed bank's liabilities. This arrangement provides, in effect, 100 percent insurance to uninsured depositors and general creditors as well as to FDIC insured depositors.

Hence uninsured depositors, like depositors, may be viewed as having a claim on the bank for the actual value of the bank's promise, that is, less than the nominal value of the deposits. They also have a claim on the FDIC for an amount somewhat less than the difference between the nominal value of the deposits and the present default-free value of the bank's promise.

Borrowed money consists primarily of federal funds, securities sold under repurchase agreements, certificates of deposit, commercial paper, borrowings from foreign banks, and borrowings from the Federal Reserve Board. The value of borrowed funds on the economic balance sheet is the actual value of the promise to repay the amount borrowed plus interest that has accrued. Although federal funds are not insured, the

actual value of the promise to repay principal plus interest would be very close to the nominal value. Since federal funds are overnight or very short-term borrowings, and since the regulatory agencies are not known for their swiftness, there is generally time to get the money out once it becomes known the bank is weak and before it is declared insolvent. For banks in a rather weak capital position, but not actually insolvent, federal funds are not available. Certificates of deposit (CDs) are insured up to $100,000. For the insured CDs, the FDIC liability is the difference between the nominal value of promise and its actual value. The economic value of large negotiable CDs may be evaluated by their secondary market value. Borrowings from the Federal Reserve would be listed on the economic balance sheet for somewhat less than their nominal value, but not nearly as little as might be anticipated, since the Federal Reserve often demands secured creditor status with respect to their loans.

2.7.2 The Economic Value of Assets

Assets refers to tangible and intangible assets. Securities usually have an easily discernible market value. The market value of loans may be difficult to find, as there is no active secondary market. However, they may be looked upon as roughly equivalent to bonds with the same promised stream of payments and the same degree of riskiness. Footnotes to bank balance sheets show the difference between the market and book values of their securities. Similar factors cause gaps between book and economic values of loans, but they fail to appear anywhere in reports.

Intangible assets and liabilities are of numerous types. The present discounted value of monopoly rents generated from demand, time, and savings deposits would be listed on the asset side of the economic balance sheet. These rents would consist of the difference between the cost of servicing demand deposits and the alternative cost of funds with a similar term to maturity. This would be part of the intangible asset category. The Maisel and Jacobson paper (chap. 9) contains information on such values.

The present discounted value of bank-customer relationship includes two factors. First a company may make regular loan payments, where it otherwise would not, to maintain a good relationship with its bank and make funds more readily available in the future. Second, the bank may have information about a borrower from past lending relationships that cannot be sold. Thus the loan may be worth more to the bank as an ongoing concern than it would to a bank without access to the information.

Credit lines, standby letters of credit, and other future commitments including loans and securities sold under repurchase agreements will be included in the value of the intangibles. The entry under intangibles will be the difference between the amount the customer paid to gain access to

the credit line or standby letter of credit and the expected cost to the bank. If, for example, the line of credit is on relatively unfavorable terms to the bank, that is, if the expected marginal cost of funds is greater than the expected return, this will be entered as a negative number under the value of future commitments and make the value of intangibles smaller. In this example, if the credit line is not legally binding and is on extremely unfavorable terms, the bank can refuse to make the credit available, thereby terminating the bank-customer relationship. It must decide which course of action is cheaper.

The value of the charter is the economic rents that can be derived because entry is limited. This cannot be totally distinguished from monopoly rents from deposits owing to legal interest rate ceilings, since even with legal restrictions the level of services would presumably bid away excess rents. The distinction between rents extracted from the position of the bank as the monopoly supplier of loans and the rents extracted owing to the bank-customer relationship is very murky. When trying to value intangibles one must be careful not to double count.

The *value of management* refers to the fact that managers of some banks can earn more than the normal rate of return for their shareholders because they have very specialized skills. The relevant intangible value is the present value of future management-derived profits. This raises the issue why the managers do not demand their "rents" in the form of additional compensation. One possibility may be that management as a whole and not a single manager is responsible for the rents. There may be very high transaction costs in organizing the managers into a bargaining unit and figuring out how the rents should be distributed.

2.7.3 The Market Value of Capital

The market value of capital can be illustrated by a few examples. Consider the change in the balance sheet if the assets become riskier but the value of the assets remains unchanged. This is what Sharpe in his paper (chap. 8) refers to as a value-preserving spread. The economic value of the deposits and borrowed funds goes down, since the bank is less apt to pay off the depositors, even as the added risk raises equity values.

A bank increases the riskiness and potential return of its assets. As a result, the bank will be able to pay off $100 of depositors' money only 80 percent of the time rather than 90 percent. The other 20 percent of the time the bank will be able to pay off nothing. The economic value of deposits has fallen to $80. The value of the FDIC liability has gone up to $20. However, the asset side of the economic balance sheet remains constant. Assets still sell for their expected value of $100 even though their risk or variance has increased. Higher promised interest rates make up for the greater risk. On the opposite side of the balance sheet,

however, the value of capital rises. This occurs because the institution's stockholders will reap rewards if the risky assets pay out better than expected. If returns fall below expectations, they will share the losses with the FDIC. They have an improved position.

If the assets become more valuable, both the value of the deposits and the value of capital will go up. With less chance of default, the actual value of the promise to pay depositors and the holders of borrowed funds is higher. The rest of the gain will go to the stockholders.

Liquidating value will in general be lower than the economic or "ongoing concern value." At best, part of the intangibles will be lost. Often, assets such as loans cannot be sold at "market value" because the market for buying a given bank's loans is thin. If only a few banks are bidding, they will be willing to trade off a smaller probability of a larger profit for a larger probability of winning. If it were costless for individuals and other businesses to buy secondary loans, they could always be sold at market. This is apparently not the case. Attempting to liquidate quickly will lower liquidating value even further.

2.8 Controlling Capital Adequacy

This chapter has shown that capital is adequate when a bank controls the risk in its portfolio and maintains a level of capital sufficient to reduce possible losses and insolvency to an acceptable minimum. Insolvency can be avoided either by increasing the amount of capital or by reducing the level of portfolio risk. Experience shows that, left to themselves, some banks will pick a relationship between capital and risk that will bring about insolvency. Bankruptcy may occur because of either inadvertence or greed. Some managers may not have sufficient knowledge of the risks they are assuming, while others may take extraordinary risks to increase their profits.

Selection of a risk/capital ratio that threatens insolvency is possible if either the market or the insurer fails to require adequate levels of capital. The market, left to itself, is likely to fail in this sphere because of the difficulty and the expense a large number of depositors face in policing each institution. Attempts by the market to control a bank's risks have been inefficient and historically have not worked well. Such inefficiencies and losses in the general welfare were greatly reduced by the introduction of deposit insurance. However, since the advent of the FDIC, individuals and firms have left almost all of the policing to the insuring agency, a task it shares with other regulators. The FDIC has assumed most of the risks that depositors and creditors of banks would normally have to bear.

Either the market or the insurer can use various techniques to make certain that capital is sufficient. One method is regulation. The risks of insolvency can be reduced to any desired level by restricting the types and

amounts of assets and liabilities held by a bank. Banks holding only short-term government notes would be virtually risk-free. But removing or greatly restricting banks' function of lending to businesses and individuals would eliminate some of the most valuable services they perform.

In a similar way, banks could be restricted to lending primarily their own capital. With a high enough level of capital, risks could be reduced to any acceptable level. But, again, inefficiencies would be large. The public would lose the great advantages of intermediation through deposits or other risk-free assets.

A better procedure is to determine what maximum level of risk is desirable from the point of view of the bank, the public, and the insurer. Such levels of risk can then be approximated by establishing procedures to measure and control the dangers of insolvency in individual banks. Such measurements and establishment of limits require an understanding of how risks arise and how they combine in portfolios.

The chapters that follow explain how bankers and insurers or regulators can measure both the risks in activities and in portfolios and the level of economic capital. They also show examples of actual measurements. If similar measures are refined, they can serve to improve bank operations while making the process of insuring and regulating more efficient.