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Growth Opportunities and Risk-Taking by Financial Intermediaries

RICHARD J. HERRING and PRASHANT VANKUDRE*

ABSTRACT

We show that growth opportunities which cannot be converted to cash under conditions of financial distress (G_Z) are a critical determinant of an intermediary's choice of risk. Financial institutions in which G_Z is a low proportion of total assets will be much more likely to engage in go-for-broke behavior. The model leads to a reevaluation of the effectiveness of several traditional remedies for dealing with banks that take excessive risks such as raising insurance premiums, intervening before capital is depleted, and restricting investment options. The model also has implications about a new approach to the examination of financial intermediaries.

THE INSURING AGENCIES are painfully aware that when a bank is at or near insolvency, it has an incentive to take greater risks. Stanley Silverberg (1984, p. 100), director of Research at the Federal Deposit Insurance Corporation, has observed that under such conditions: "... it is generally in the interest of managers and owners to gamble in an effort to recoup .... If the bank rolls the dice and loses, the FDIC typically bears the loss." Of course, bank shareholders, like shareholders in other limited liability corporations, have an incentive to take larger gambles than if their activities were financed entirely by equity.[1] What distinguishes go-for-broke behavior, however, is that a firm in go-for-broke mode will be willing to play with dice loaded against it.

Go-for-broke behavior occurs when a firm chooses an operating strategy that will lower the expected value of its assets. A firm in go-for-broke mode causes a loss to society since it will allocate resources to uses that have a lower expected return than the opportunity cost of funds. In this paper, we examine the conditions under which a bank has an incentive to adopt go-for-broke behavior and the challenge faced by regulators in controlling such behavior. We show that weakly capitalized banks with negligible opportunities for profitable growth pose the greatest threat and that traditional supervisory remedies are least effective against such banks.

I. The Determination of the Riskiness of the Loan Portfolio

We shall focus on a bank with the following simplified balance sheet:

Assets	Liabilities
A	D
G	Economic Net Worth

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[1] Jensen and Meckling (1976), Smith and Warner (1979), Green (1984), and Keeton (1979).

The market value at the end of the period of the bank's tangible and financial assets including the market value of the bank's commitments and assumptions of liability such as forward contracts, lines of credit, and acceptances is denoted by A. These tangible and financial assets may be converted into cash without loss at the end of the period. All deposits, D, are insured. The bank has a contractual obligation to pay depositors the risk-free rate of interest (r) and the insurer, a premium (p) at the end of the period. This contractual obligation—$A'(= D(r + p))$—defines the default point. If the bank cannot pay A' at the end of the period, the insurer will seize control and the shareholders will receive nothing. The value of A at the end of the period is determined by a cumulative distribution $F(A; w)$ where w is an index of risk. Higher values of w indicate a riskier distribution in which more of the probability density of outcomes is shifted from the center of the distribution to the tails. The outcome for A may fall anywhere within a range extending from zero to some maximum value A_M.

The difference between A and D corresponds roughly to conventional measures of the bank's net worth.[2] But what the shareholders have at risk includes not just $A - D$ but also G—the present value of growth opportunities.[3] G reflects the present value of the net income the bank would be expected to earn on new business if it were to retain only its offices, employees, customers and charter.[4] G depends on the bank's authorized powers including the power to do a particular kind of business within a particular area, the market structure in such areas, the expertise of the bank's employees, the reputation of the bank and the customer relationships it has developed. G reflects the bank's economic rents or quasi-rents.

Since banks are seldom forced to undertake growth opportunities which are not profitable, G is likely to be positive. Thus measures of the bank's capital position which ignore G will understate the economic net worth of the bank. We will show that the economic net worth of the bank has an important impact on the bank's portfolio choice. Moreover, the proportion of total assets attributable to G will have an important additional impact.[5]

[2] Of course, this measure does not correspond exactly to standard measures of book net worth. For example, accounting conventions often permit assets to be stated at historical cost rather than market value and commitments and assumptions of liability are sometimes neglected altogether. See Guttentag and Herring (1983) for a discussion of discrepancies between book net worth and economic net worth.

[3] The distinction between A and G is similar to Myers' (1977) distinction between assets in place and options for future growth. Myers emphasized that the distinction was based on the extent to which the present value of an asset depends on discretionary actions taken by the firm in future periods. The value of options for future growth depends heavily on such actions, while the value of assets in place does not. The distinction which we draw, in contrast, is based in the first instance on when the value of the asset is realized. The value of A is realized at the end of the period, while the value of G is not realized until subsequent periods. In the final analysis, however, our distinction depends on the marketability of an asset. What is crucial to our model is the existence of assets which can be liquidated only at great loss. Myers (1977, p. 163) recognizes this distinction also as an aspect of the difference between assets in place and options for growth, but he does not emphasize it.

[4] See Patinkin (1969) for the classic analysis of the charter value of a bank.

[5] After drafting this paper we discovered that Marcus (1984) has used an option pricing framework to demonstrate that a bank's charter value may constrain shareholders from exploiting non-risk rated deposit insurance. His model, however, leads to the implausible result that above a critical deposit to asset ratio, an *increase* in the variance of asset returns will *reduce* the probability of default (Marcus

In contrast to the value of A (which by assumption will be realized at the end of the period), the bank's shareholders cannot realize the value of G unless the bank is permitted to continue operation beyond the end of the period. Unless a portion of G can be converted into cash to satisfy the claims of depositors and the insurer and thereby avert default, the shareholders will lose the entire value of G.

In order to demonstrate the importance of G, it is convenient to begin with a simpler, more traditional model of the portfolio decision in which $G = 0$. The expected return to shareholders, R_s, depends on the expected returns above the default point A':

$$R_s = \int_{A'}^{A_M} (A - A')f(A)\,dA. \tag{1}$$

The bank will realize a positive return only if $A > A'$ and above A' the return is equal to the amount by which A exceeds A'. Thus the bank will prefer loans that have a high probability of yielding outcomes substantially above A' even at the cost of accepting a higher probability of outcomes far below A'. Indeed since the bank experiences the same zero return no matter how much the outcome falls below A', it will prefer loans that have a high probability of yielding very large *and* very small returns over loans which have a high probability of yielding moderate returns.[6] Dividing R_s by the total expected return, $E(A)$, and multiplying by $E(A)$, we can rewrite equation (1) in terms of the share of total returns that is expected to accrue to shareholders:

$$R_s = \frac{\int_{A'}^{A_M} Af(A)\,dA}{E(A)} \cdot E(A) - A'(1 - F(A')). \tag{2}$$

The expected return to shareholders has two components: the proportion of the total expected return that will accrue to the shareholders (weighted by the total expected return) and the expected cost of the amount promised to the insurer and depositors. R_s can be increased by choosing riskier loan portfolios which have a higher proportion of outcomes in both tails of the distribution. A riskier loan portfolio will have a higher proportion of the total expected return above the default point thus increasing the first component and may well have a higher risk of default thus reducing the expected value of the promised payment to the insurer. If the set of loan opportunities is such that all portfolios yield the

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(1984, p. 561)). In contrast, our model preserves the intuitive notion that the default probability rises with increases in the variance of asset returns. Moreover we consider a much broader set of growth opportunities, investigate the importance of the marketability of such opportunities and show how the shareholders' choice of risk may change the value of the bank and affect the behavior of the bank's creditors.

[6] The convex pay-off implied by the objective function in (1) can be interpreted as a call option held by the shareholders on the bank's assets. The shareholder's decision is often posed as a choice among distributions with identical means but differing spreads. But this assumption trivializes the bank's choice of risk: so long as $A' > 0$, the shareholders will always prefer the riskiest portfolio regardless of the level of A'. Our interest, however, is the choice among a broader range of portfolios for which the expected value may change with the degree of risk. Thus we must explicitly value this call option to determine the impact of a change in A' on the shareholders' choice of risk.

same total expected return, the bank will clearly prefer the portfolio that has the highest risk.[7]

In the more realistic case, where increases in risk beyond some point reduce the total expected return, the bank's decision is more complicated.[8] We shall assume the bank faces an array of loan opportunities with differing expected total returns and that the maximum expected return is associated with a degree of risk w^* which is neither the least risky nor the most risky loan portfolio.[9] These expected total returns reflect the underlying real investment opportunities of borrowers and are unrelated to the capital structure of the bank. (See $E(A)$ in Figure 1.)

It is customary to focus on that part of the opportunity set to the left of w^* which offers the minimum risk for each level of expected return. The opportunity set to the right of w^* is usually neglected because of the implicit assumption that the lower risk investment will always dominate a higher risk investment that has the same expected return. This assumption, however, is not always valid. We wish to examine the full opportunity set, because it is apparent from (2) that under some circumstances shareholders may be able to increase their expected return by selecting a higher risk portfolio that yields a lower total expected return. When a bank has an incentive to play go for broke, it will prefer a loan portfolio with a higher degree of risk and a lower total expected return.

Keeton (1979, pp. 199–203) has developed a set of restrictions on the cumulative distribution of portfolio outcomes that describe how the cumulative distribution will shift in response to an increase in risk in this more general case where, beyond some point, increases in risk can be obtained only at the cost of some loss in expected return. In the context of our model, these assumptions may be restated as follows:

A.1. For each w, there exists an $\bar{A}$ such that $\dfrac{\partial F(A, w)}{\partial w} > 0$ for $0 < A < \bar{A}$ and $\dfrac{\partial F(A, w)}{\partial w} < 0$ for $\bar{A} < A < A_M$ where A_M is the maximum possible value of A. This condition defines an increase in risk as a shift in probability density from the center of the distribution to the tails.

A.2. For all w, there is a nonzero probability that the bank will fail and be subject to regulatory disposition. This condition focuses the analysis on situations that are relevant to the insurer.

A.3. $\bar{A} = 0$ at $w = w_m$ and $\bar{A} = A_M$ at $w = w_M$ where w_m is the minimum level of risk and w_M is the maximum level of risk. This condition insures that the bank will choose neither the least risky nor the most risky portfolio. As w

[7] Rothschild and Stiglitz (1970) characterize such a situation as a choice among mean-preserving spreads.

[8] See Stiglitz and Weiss (1981) for a similar assumption.

[9] The degree of risk associated with w^* is socially optimal in the sense that society will achieve the highest return if the bank chooses this portfolio. This assertion is plausible if society is risk neutral or if the portfolios do not differ with respect to systematic risk. But even with these assumptions, the assertion that w^* is the social optimum is not beyond question. The number of bank failures associated with w^* may impose social costs such as an increase in intermediation costs or a loss of liquidity which justify trading off some decline in expected return for a lower w. See Bernanke (1983) and Diamond and Dybvig (1983) for a discussion of the real costs of bank failures.

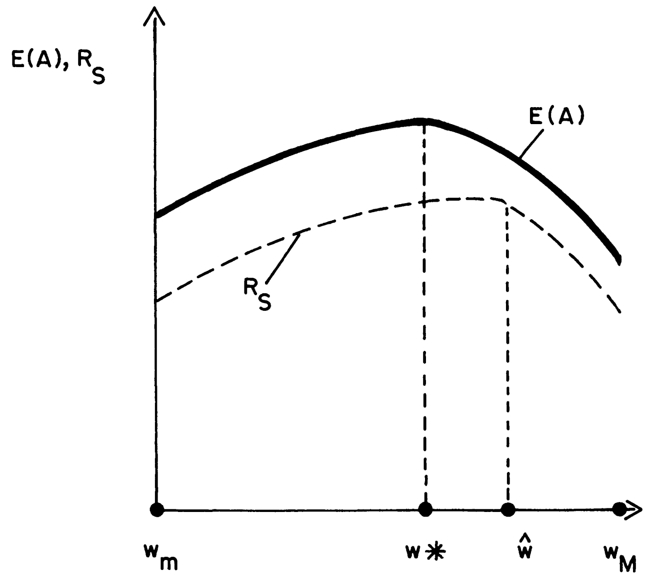

Figure 1. Expected Return on Assets as a Function of Risk and Expected Return to Shareholders Given A′

increases from w_m, the entire cumulative distribution $F(A, w)$ shifts downward, raising the total expected return on the bank's portfolio. Conversely, as w approaches w_M, the entire cumulative distribution shifts upward reducing the total expected return on the portfolio.

A.4. If $w_2 > w_1$, $F(A'', w_2) = F(A'', w_1)$ implies $F(A, w_2) > F(A, w_1)$ for $0 < A < A''$ and $F(A, w_2) < F(A, w_1)$ for $A'' < A < A_M$. In conjunction with A.1. this assumption implies that as the degree of risk increases from w_1 to w_2, $F(A, w_2)$ cuts $F(A, w_1)$ only once from above and the point at which an increase in risk has no impact on the cumulative distribution $\left[\frac{\partial F(A, w)}{\partial w} = 0\right]$ shifts to the right.[10]

A.5. $F_{wA} < 0$ for any w. This implies that as A varies from 0 to A_M, F_w decreases uniformly thus extending A.4., which implies that $F_{wA} < 0$ around the crossover point $\bar{A}$.

Given A'—the bank's contractual commitment to the insurer and depositors—the bank will choose the level of risk which maximizes the expected return to its shareholders. Thus differentiating (1) with respect to the level of risk, we find that the optimal level of risk, $\hat{w}$, is

$$\frac{\partial R_s}{\partial w} = -\int_{A'}^{A_M} \frac{\partial F}{\partial w} (A, \hat{w})\, dA = 0. \tag{3}$$

[10] These assumptions are not sufficient to insure that the bank's optimal choice of riskiness w is unique; but, Keeton (1979, p. 198–208) shows that the conclusions regarding the bank's choice of risk hold even when $\hat{w}$ is not unique.

This level of risk is greater than the level of risk w^* which yields the highest total expected return. We can demonstrate this point by noting how the condition would change if the bank were financed entirely by equity. If the bank were financed entirely by equity the integral would extend from 0 to A_M and the optimal value for $w(w^*)$ would be such that a marginally higher value of w would raise $F(A)$ for lower values (thus lowering the expected value in the lower range) precisely as much as it lowers $F(A)$ for higher values (thus raising the expected value in the higher range). Note that this integral is defined over the full feasible range of outcomes for A, so that the expected return to the bank is simply the total expected return. Thus, when the bank is entirely financed by equity, the optimization calculation by shareholders will yield the maximum total expected return.

The shareholders' calculation changes, however, when part of the loan portfolio is financed by deposits equal to A'. The range of integration will be correspondingly truncated and so part of the upward shift in the distribution which causes a decrease in the expected value of outcomes in the lower range, will become irrelevant to the shareholders. Consequently, $\partial R_s/\partial w$ will have a positive value at w^*. Since the slope is positive at w^*, the bank will have an incentive to opt for a higher level of risk until the value of the slope is zero (and (3) defining the optimum is satisfied).

This result can also be demonstrated by graphing the expected return to the shareholders (given that the bank owes A' to creditors and the insurer) as a function of w. (See R_s in Figure 1.)[11] The difference between $E(A)$ and R_s increases from w_m to w^*, both shareholders and the creditors and insurer can achieve higher expected returns since the total expected return is increasing; but, note that $\hat{w}$, the optimal degree of risk from the shareholder's perspective, is greater than w^*.

The bank's willingness to take risk depends on the extent of its reliance on equity financing. When reliance on equity financing is complete ($A' = 0$), the bank will prefer level of risk w^* which yields the highest total expected return; but, as soon as the bank issues a dollar of deposits it will have an incentive to select a level of risk above w^*. Of course, this departure from the level of risk that yields the highest total expected return may not be very serious. If the opportunity set presents a very unfavorable trade-off between expected return and risk, the bank will choose a level of risk that is only marginally higher. Similarly, if the bank has a very strong capital position, its level of risk may differ only slightly from w^*. But differentiation of the first order condition for an optimum with respect to A' shows that the smaller the bank's reliance on equity (that is, the higher A'), the higher its preferred degree of risk:[12]

$$\frac{d\hat{w}}{dA'} = \frac{\dfrac{\partial F(A', \hat{w})}{\partial w}}{\int_{A'}^{A_M} \dfrac{\partial^2 F(A, \hat{w})}{\partial w^2}\, dA} > 0. \tag{4}$$

[11] See Keeton (1984, p. 32) for a similar graph.

[12] We can infer that the numerator is positive from (3) which implies that $dF(A, w)/dw$ takes on both positive and negative values between A' and A_M. By assumption, the cumulative distribution associated with w can cut the cumulative distribution associated with a marginally higher level of

Thus the weaker the capitalization of the bank, the riskier the loan portfolios it will prefer.[13] In the next section we show how growth opportunities modify these results.

II. Options for Future Growth and the Choice of Risk

A. How Growth Opportunities Influence the Choice of Risk

To illustrate the importance of G we shall first assume that contractual provisions prevent the bank from liquidating part of G—either by borrowing against G or selling G—to avert a default.[14] This sort of safety convenant is a fairly typical feature of bond indentures. Thus if A falls below A', the insurer will seize control of the bank.[15,16] The expected return to the bank (or, more precisely, expected shareholder wealth) is:

$$R_s = \int_{A'}^{A_M} (A - A')f(A)\, dA + G \int_{A'}^{A_M} f(A)\, dA. \tag{5}$$

Valuable growth opportunities enhance the expected return to shareholders in all states of the world in which the bank does not default. This will reduce the bank's incentive for taking additional risk since an increase in the probability of default reduces the expected value of growth opportunities to the bank's shareholders.[17] After integrating equation (6) by parts, we can express the shareholder's

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risk only once from below and so $dF(A', w)/dw$ must be greater than zero. The denominator is positive at the optimum level of risk, since the second-order condition for an optimum is that:

$$\frac{\partial^2 R_s}{\partial w^2} = -\int_{A'}^{A_M} \frac{\partial^2 F(A, \hat{w})}{\partial w^2}\, dA < 0.$$

[13] Koehn and Santomero (1980) report a similar result in a mean-variance model of bank portfolio selection.

[14] For the classic analysis of opportunities for future growth see Myers (1977). For discussion of growth opportunities for financial institutions see Buser, Chen and Kane (1981), Dermine (1984), and Guttentag and Herring (1983).

[15] See Black and Cox (1976, p. 355) for a discussion of similar contractual provisions. Black and Cox define safety covenants as "contractual provisions which give the bondholders the right to bankrupt or force a reorganization of the firm if it is doing poorly according to some standard. One standard for this may be the omission of interest payments on the debt. However, if the stockholders are allowed to sell the assets of the firm to meet the interest payments, then this restriction is not very effective. In this situation a natural form for a safety covenant is the following: if the value of the firm falls to a specified level . . . then the bondholders are entitled to force the firm into bankruptcy and obtain the ownership of the assets."

[16] If the compensation of the managers of the bank is tied to the market value of the bank's stock (either through stock options or explicit contractual clauses), the managers will have an incentive to raise new capital in order to preserve G. Managers will experience difficulty in persuading others to invest if they have information that permits them to evaluate G, but the market does not. But if the managers cannot raise additional capital on their own and cannot persuade others to invest, then G will be lost.

Note that when the bank is not in financial distress, asymmetric information does not present an obstacle to new investment. The management of the bank can increase equity contributions pro rata by retaining earnings. The problem arises only when there are no earnings to retain.

[17] Merton (1978) achieves a similar result in a different model. He assumes that in the event of a default, the bank would lose an intangible asset which is the discounted present value of the auditing costs that can be passed on to depositors so long as the insurer permits the bank to continue operations.

expected return more conveniently as:

$$R_s = A_M - A' - \int_{A'}^{A_M} F(A)\, dA + G[1 - F(A')]. \tag{6}$$

The optimal level of risk is:

$$\frac{\partial R_s}{\partial w} = -\int_{A'}^{A_M} \frac{\partial F(A, \hat{w})}{\partial w}\, dA - G\,\frac{\partial F(A', \hat{w})}{\partial w} = 0. \tag{7}$$

Note that opportunities for growth enter this expression with a negative coefficient. Thus a $\hat{w}'$ which yields the maximum expected return to the shareholders when $G = 0$ will be suboptimal when $G > 0$. Indeed dR_s/dw would have a negative value at $\hat{w}'$ when $G > 0$ which will induce the bank to reduce the riskiness of its portfolio in order to increase its expected return. If G is very large—that is, if growth opportunities are quite valuable—it will exercise a powerful constraining influence on the bank's choice of risk so that the bank will maximize its expected return at a level of risk which is lower than w^* the level of risk that would yield the highest total expected return. In the appendix we present some empirical evidence which suggests that the market's estimate of growth opportunities is indeed negatively correlated with the risk of default.

Growth opportunities also have an indirect influence on the bank's choice of risk because they will affect the bank's cost of credit. Creditors and the insurer set A' to yield an expected return equal to the competitive return available in the market. As we have seen, growth opportunities cause the bank to choose a less risky portfolio. The perception that the bank will choose a less risky portfolio enables creditors and/or the insurer to charge a lower default premium (lower A'), yet achieve the same competitive expected return. But a reduction in A' will also affect the bank's choice of risk.[18] By implicitly differentiating (7) we get the following expression for the change in the bank's preferred level of risk in response to an increase in A':

$$\frac{d\hat{w}}{dA'} = \frac{F_w(A', \hat{w}) - GF_{wA}(A', \hat{w})}{\int_{A'}^{A_M} F_{ww}(A, \hat{w})\, dA + GF_{ww}(A', w)} > 0. \tag{8}$$

The denominator of this expression is positive where $\hat{w}$ maximizes the expected return to shareholders and assumptions A.4. and A.5. imply that the numerator is positive as well. Thus a decline in A' will induce the bank to choose a lower level of risk.

An increase in G can, therefore, be viewed as having a double impact on $\hat{w}$: (1) given A', the bank will choose a lower level of risk and (2) given the lower level of risk, the bank's creditors and/or the insurer will charge a lower default premium which will induce the bank to lower the level of risk still further. Figure 2 illustrates the creditors' and/or insurer's choice of A' given the competitive market rate of return, π. The expected return to creditors, R_c, is a function of A' and the level of risk, $\hat{w}$, chosen by the bank: $R_c = R_c(A', \hat{w})$. As we have seen, however, $\hat{w}$ is a function of A' and G—i.e., $\hat{w} = \hat{w}(A', G)$—and so R_c can be written as $R_c(A', G) = R_c(A', \hat{w}(A', G))$.

[18] For a detailed discussion of how creditors respond to borrowers opportunities for taking risk, see Herring and Vankudre (1985).

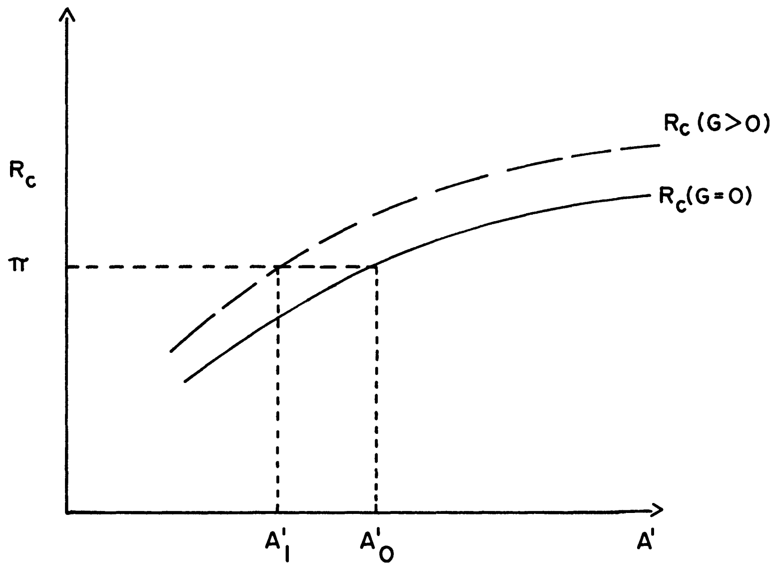

Figure 2. Choice of A′ by Creditors and/or the Insurer

The curve $R_c(A', G)$ in Figure 2 explicitly takes into account the response of $\hat{w}$ to a change in A'. $R_c(G = 0)$ shows the expected return to creditors and/or the insurer when the bank has no opportunities for growth. In order to achieve the competitive return, π, creditors and/or the insurer must charge A_0'. But if the bank develops profitable opportunities for growth, the expected return to creditors and/or the insurer will shift upward to $R_c(G > 0)$, in part because the bank will select a safer portfolio of assets. Creditors and/or the insurer will be able to obtain the same competitive return by reducing the default premium to A_1', which we know from (8), is associated with a lower degree of risk.

B. Liquid and Illiquid Growth Opportunities

Assume now that the bank can convert part of the value of G into cash in order to avert a default. The amount of cash which can be raised against opportunities for growth by selling or borrowing against part of G when it is known that the outcome for A is less than A' is denoted by G_L, while the residual value of G which cannot be converted into cash under conditions of distress, is G_Z.[19]

One reason G_Z is likely to be a substantial proportion of G is that the managers of the bank will have superior information about future growth opportunities which may be difficult to transmit to prospective buyers. Information may be of a proprietary nature, which if released would reduce the value of G to the bank. Even if the information has limited proprietary value, however, the costs of educating potential lenders or investors—the costs of supplying, assimilating and

[19] Although the market believes that some banks have $G_Z > 0$, the expected value of G_Z for any particular bank is zero.

verifying the information—may be significant. This is especially likely to be true when the managers' expertise is in understanding of how the bank can make use of some information.[20] Moreover, when the latest news is that the bank's return on assets has fallen below the default point, the managers may experience extreme difficulty in refuting the presumption that future growth opportunities are of little value.

A second reason is that property rights may be ill-defined and/or not readily transferable. A considerable proportion of the value of growth opportunities may be embodied in the human capital of employees of the bank.[21] Shareholders cannot contract to sell employees and so potential bidders will offer less than the present owners could expect to earn. Moreover the shareholders may not be able to sell control of the bank without special permission from the regulatory authorities so that potential bidders may face considerable uncertainty and very high transactions costs to determine whether they would be eligible to buy. This will adversely affect the market value of growth opportunities which are inextricably related to the control of the bank's charter.

Finally the market for some growth opportunities is rudimentary and illiquid so that substantial transactions costs must be incurred in order to match the seller of an opportunity for growth with potential buyers. The greater the pressure on the bank to raise funds quickly, the smaller the proportion of G it is likely to realize.

These factors, which inhibit the marketability of components of G, will also constrain the bank's ability to borrow against G. If it is difficult for potential lenders to ascertain the value of an opportunity for growth or difficult to use an opportunity for growth as collateral or difficult to sell the opportunity readily in the event of a default by the bank, then potential lenders will be reluctant to advance funds against the value of such assets. Myers (1977) emphasizes an additional point. The value of growth opportunities depends on some discretionary action taken by the bank in future periods. Potential lenders must recognize that in some states of the world the bank will not be willing to make additional investments to realize the value of a growth opportunity even though such investments would benefit the bank's creditors.

Of course the portion of G that is convertible into cash is very much like A. Some opportunities for growth may be separable components of the bank's going-concern value, with objectively verifiable income streams and adequate secondary markets. The value of a bank's credit card subsidiary (over and above the value of the financial claims which are included in A) or the value of a branch network (beyond the value of the real estate, loans and deposits which are included in A) are plausible examples. The bank may be able to sell such a component for an amount very close to its value in use or to borrow against it an amount close to its discounted present value in order to meet the claims of creditors.[22] Nonethe-

[20] See Myers and Majluf (1984) for a discussion of the impact of asymmetrical information on investment decisions.

[21] This need not imply that the bank is exploiting its employees by paying them less than they would receive in alternative employment opportunities. The main source of value is likely to be the synergy among bank employees.

[22] Similarly, some components of A may be very much like G_Z. Contrary to our assumption, some components of A will not mature by the end of the period and may be traded in highly imperfect

less, secondary markets for real and financial assets are generally much better developed than markets for growth opportunities and it is usually easier to borrow against marketable assets; consequently, the distinction between A and G is meaningful and G_Z is likely to be a very high proportion of G.

Taking account of the distinction between G_L and G_Z, the expected return to shareholders now has three components—the expected value of the portfolio returns in excess of A', the expected value of growth opportunities if the bank does not default and the expected value of growth opportunities that can be realized if a portion of G is liquidated to avert default:

$$R_s = \int_{A'}^{A_M} (A - A')f(A)\,dA + G\int_{A'}^{A_M} f(A)\,dA + \int_{A'-G_L}^{A'} (G + A - A')f(A)\,dA. \tag{9}$$

Figure 3 takes into account the distinction between G_Z and G_L and shows the shareholders' realized return as a function of alternative outcomes for A. Note that G_L shifts the point where shareholders receive a zero return to the left. This has the effect of extending the range of outcomes that matter to shareholders.[23] In this regard G_L acts like collateral or the deductible in an insurance policy or an increase in the bank's capital position. Equation (9) can be simplified to yield:

$$R_s = \int_{A'-G_L}^{A_M} [A - (A' - G_L)]f(A)\,dA + G_Z\int_{A'-G_L}^{A_M} f(A)\,dA. \tag{10}$$

This expression for the expected return to the shareholders shows that growth opportunities may have two different impacts. The first term indicates that G_L extends the lower limit of integration and thus is formally equivalent to a decrease in A' (or an increase in the proportion of equity financing). Thus the liquidation value of growth opportunities will reduce the optimal degree of risk, but, it cannot induce the bank to select a level of risk that is lower than w^*. The second term, the expected value to the shareholders of the residual growth opportunities, is qualitatively different because it acts as a default penalty; it is an amount the shareholders will lose if the outcome falls short of A'. A very high value of G_Z will lead the bank to choose a level of risk that is below w^*.

III. Policy Implications

Recently a series of shocks has eroded the economic net worth of many banks. Borrowers in the energy, agriculture, and real estate sectors and in several developing countries have experienced difficulties in servicing their bank loans thus reducing the value of bank assets. Economic net worth has declined (in some instances, even as accounting measures of capital positions have risen). The willingness of banks to take large gambles at the cost of a lower total

markets. For example, real estate or complicated long-term loans may be difficult to convert into cash on short notice and may, in principle, have the same impact on the choice of risk as G_Z.

[23] Kane (1986b) suggests that the liability of stockholders could be directly extended to counter excessive risk taking.

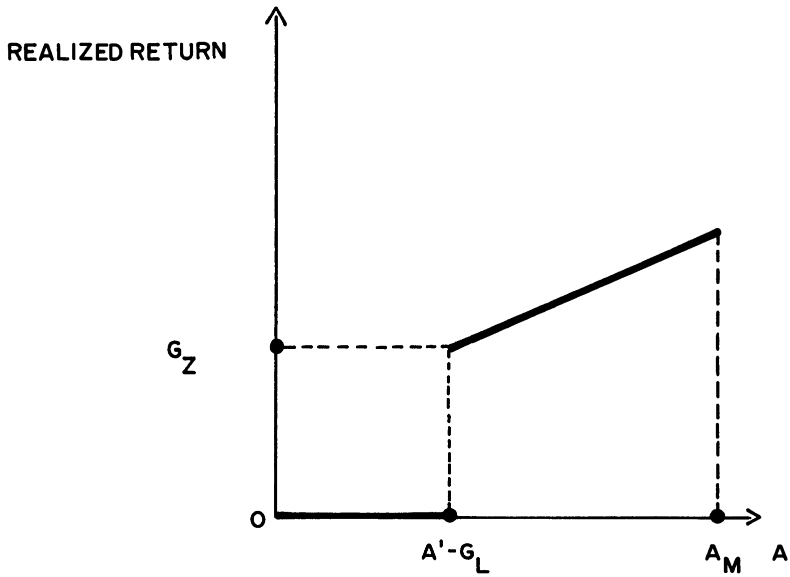

Figure 3. The Impact of Growth Opportunities on Realized Shareholder Returns

expected return is greater, the lower the ratio of total economic net worth to assets. Bank supervisors and regulators are keenly aware of this phenomenon. But an additional factor is also important. We have shown that G_Z is also a critical determinant of the bank's choice of risk. Financial institutions which are identical with respect to total economic net worth may nonetheless have very different preferences for risk. Financial institutions for which G_Z is a negligible proportion of total assets are much more likely to engage in go-for-broke behavior than financial institutions for which G_Z is a substantial proportion of total assets.

This is a disquieting result because deregulation is having a significant impact on the vaue of growth opportunities that is difficult to measure. Deregulation can enhance the value of future growth opportunities by broadening the range of activities and by extending the geographical areas within which banks can operate. But, deregulation can also increase competition and erode market power, thereby reducing the value of opportunities for future growth.[24] This latter possibility presents an especially grave threat to the insurer, because a decline in G_Z increases a bank's willingness to take large gambles at the cost of lower expected returns both by reducing economic net worth and by reducing the default penalty on shareholders if the gamble fails.

In addition to specifying the circumstances under which banks will be tempted to engage in go-for-broke behavior, our model also leads to a reevaluation of the effectiveness of several policy remedies that are commonly suggested for dealing with banks that take excessive risks. For example, it is likely to be counterproductive to charge a risk-rated insurance premium to a bank that has negligible opportunities for future growth. In terms of our model this has the impact of raising A' which would increase the bank's preferred level of risk (see equation

[24] Marcus (1984, p. 557) concludes that, deregulation "... by easing entry and devaluing charters, holds the potential for increases in the incidence of insolvency. . . ."

(4)) and lead the bank to select a portfolio with a lower expected return, thereby increasing the expected loss to the insurer.[25]

Some experts have argued that the danger to the insurer can be reduced by closing banks before their capital is depleted. (See, for example, Bennett (1984)). In terms of our model this can be interpreted as raising the default point from A' to some level $A' + k$. But if the bank has negligible opportunities for future growth, this remedy too has the impact of leading the bank to prefer a higher level of risk and a portfolio with a lower expected return, thus increasing the expected loss to the insurer.

The typical response of regulators to the perception that a bank may engage in an activity that is excessively risky is to restrict its investment options. But in the context of our model, the bank that is constrained from choosing the portfolio associated with $\hat{w}$ may shift to a riskier portfolio with an even lower expected return. A bank that is constrained from choosing $\hat{w}$ will switch to its next best option and so it will compare its expected return at $F(A; w - \Delta w)$ with $F(A; w + \Delta w)$. If the latter portfolio yields a higher expected return, the bank will shift to a portfolio that increases the expected loss to the insurer. The regulatory process is inevitably slow to respond to new kinds of risk-taking since before effective action is taken regulators must perceive the problem, assess it, decide what to do and implement their decision.[26] Often there are procedural safeguards built in at every stage which add to the delay. A substantial period of time is likely to elapse before regulators are able to control the new form of risk-taking. In consequence, an attempt to constrain a particular kind of risk-taking may actually have the perverse effect of inducing the bank to choose a new kind of risk taking with an even lower expected return.

It is ironic that these remedies only constrain the riskiness of banks that have substantial opportunities for future growth. Our model implies that banks with a substantial amount of G_Z may, in any event, prefer a suboptimal degree of risk. Thus policies aimed at constraining the riskiness of banks with substantial opportunities for future growth are unnecessary and, to the extent they are effective, may actually cause even greater divergences from the social optimum than would otherwise occur. But, as we have just seen, for other banks that have negligible opportunities for future growth, these remedies may also have a perverse impact but in the opposite direction. Rather than constraining risk, such policies may induce banks that are already too risky to take even more risk.

Our model also has implications for the impact of the availability of lender of last resort assistance on the risk of insolvency. When a bank is confident that the lender of last resort will enable it to borrow against otherwise illiquid assets, the anticipated loss to the shareholders in the event of a default declines and the bank will choose a riskier portfolio.[27] Policy measures that reduce the proportion

[25] See Herring and Vankudre (1985) for a detailed exposition of this point.

[26] These lags are an essential feature of what Kane (1986c) describes as the "regulatory dialectic."

[27] This also has an implication for the treatment of shareholders in the regulatory disposition of a failed bank. In the event of a default, the regulatory authorities may choose to permit the bank to continue operation if it has substantial going concern value. See Guttentag and Herring (1983). In this way the bank may be able to realize G_Z. It is important, however, that shareholders should not expect to receive G_Z after the bank defaults. Otherwise their incentive to avert a default will be eroded.

of G_Z in the bank's portfolio thus erode the incentive to avoid a default and increase the probability of insolvency.[28] This is an explicit theoretical rationale for the often stated preference of central bankers for making access to lender of last resort facilities uncertain. For example C. W. McMahon of the Bank of England (1977, p. 108) has observed that a danger in stating clearly in advance the terms on which lender-of-last-resort assistance will be available is that "Banks might be tempted to sail too close to the wind with the presumption that support would automatically be forthcoming if they got into difficulties."

The upshot of our analysis is that a careful assessment of a bank's opportunities for future growth is a crucial component of an effective regulatory policy. This is a significant challenge because G is intrinsically difficult to evaluate. Although greater emphasis on market value accounting can help, regulators cannot rely solely on market values because part of what distinguishes opportunities for future growth is that they are *not* readily marketable. Moreover, information asymmetries may impede the market's assessment of G. The bank must be valued from an insider's perspective, not that of an external investor. This means that regulators should make a detailed examination of the economic net worth of the bank or obtain access to internal audit reports that convey comparable information.[29] Bank examiners should make projections of the bank's earning as if they were investment bankers preparing a takeover bid. Once the present value of projected earnings has been calculated, the market value of the bank's tangible and financial assets can be subtracted to yield an estimate of G. Thus, although the model provides an explicit rationale for bank examination, it suggests that bank examiners should employ analytical techniques that depart sharply from current practice.

Appendix

The Correlation Between Default Probabilities and Opportunities for Future Growth

In this appendix, we develop a proxy for the market's estimate of a bank's opportunity for future growth. We then measure the correlation of this proxy for the bank's opportunities for future growth with a proxy for the bank's probability of default, the rating that Standard & Poor's assigns to the bank's debt. This enables us to bring some empirical evidence to bear on our hypothesis that a bank's opportunities for future growth are negatively correlated with its probability of default.

[28] Of course this model does not address the problem of a contagious loss of confidence. To stem a contagious loss of confidence with minimal impact on each bank's calculation of G_Z, the lender of last resort may wish to pursue a policy of offering assistance only *after* the failure of one major bank. Thus no bank could be sure that it would have access to lender of last resort assistance since it might be the first bank to encounter trouble. Each bank would behave as if it did not have access to emergency liquidity assistance, because indeed it might not. See Mayer (1975) for a similar policy proposal.

[29] Kane (1986a) presents several useful suggestions for implementing a system of market-value accounting including a proposal for a self-regulatory board to establish standards for evaluating off-balance-sheet sources of value.

A. Empirical Proxies

We start with the hypothesis that the market value of the bank's equity per share equals the per share net present value of assets in place plus the per share net present value of future growth opportunities.[30] An immediate problem in using this relationship to estimate the value of opportunities for future growth is that although we have data on the book value of assets in place, we do not have data on the market value of assets in place. We attempt to overcome this difficulty by assuming that there is a linear relationship between the book value of equity per share and the per share value of assets in place for the cross section of banks. We then estimate the net present value of opportunities for future growth indirectly as the residual in an equation explaining price per share as a function of book value per share.

In estimating the actual equation, price per share and book value per share are normalized by the earnings per share in order to reduce heteroskedasticity and each bank's beta is introduced to account for potential differences in price due to differences in market risk. In addition a dummy variable is entered in the equation to take account of the possibility of structural differences between large banks and small banks. The dummy variable allows us to form subgroups of banks that are more homogeneous in terms of their assets in place so that estimates of the residuals from the regression are more likely to be dominated by differences in value of future growth opportunities rather than by differences in the value of assets in place. Ordinary least squares is used to estimate the following equation for a cross section of 58 banks:

$$P/E = a_0 + a_1 \cdot D + a_2 \cdot B/E + a_3 \cdot D \cdot B/E + a_4 \cdot \beta + a_5 \cdot D \cdot \beta + e$$

where

P/E = the price earnings ratio;
B/E = the ratio of book value of equity per share to earnings per share;
β = the monthly beta of equity;
D = a dummy variable, one if the bank is a large bank,[31] zero otherwise;
e = error term.

The error term in this equation is our proxy for the present value of opportunities for future growth.

As our proxy for the probability of default for each bank, we employ the Standard & Poor's rating of the most representative debt issue. In the numerical code employed by Standard & Poors, a superior bond rating is associated with a lower probability of default.

B. Data

Data for the price-earnings ratios, the per share book value of equity and the bond ratings for the year ending December 31, 1984 were drawn from the Quarterly Bank Compustat files. The estimates for the monthly betas for each bank were taken from *Common Stock Risk Measures for Period Ending December*

[30] This approach neglects the distinction between G_L and G_Z and assumes away many of the difficulties in estimating G that we emphasize in the conclusion of the paper.

[31] The dummy variable takes on a value of one if the bank is classified as a "money center" or "other large bank" by the Federal Financial Institutions Examination Council.

Table 1
The Equation Underlying the Proxy for Opportunities for Future Growth

Coefficient	Variable	Estimate	t-Value (DF = 52)
a_0		4.824	4.071
a_1	D	−1.564	−1.041
a_2	B/E	0.335	5.385
a_3	D · (B/E)	0.168	2.056
a_4	β	0.515	0.824
a_5	D · (β)	−2.078	−1.074

$R^2 = .702$ Adjusted $R^2 = .674$
F-Ratio (DF = 5) = 24.537

31, 1984 published by the Rodney White Center for Financial Research, the Wharton School, University of Pennsylvania. We included all banks listed in the Quarterly Bank Compustat files for which (a) a bond rating was available and (b) a monthly beta was available. None of the banks which satisfied these two criteria had a negative price-earnings ratio. The total sample size was 58 banks of which 16 are classified as money center or large regional banks by the Federal Financial Institutions Examination Council.

C. Results

The estimate of the regression equation is presented in Table 1. The book value of equity has the anticipated impact on price and the adjustments for beta and structural differences between large and small banks appear to be important.

We employ Spearman's rank-order correlation coefficient to measure the correlation between our proxy for present value of future growth opportunities (the residual from the regression equation) with our proxy for the probability of default (Standard & Poor's numerical code for bond ratings). This nonparametric statistic is used in order to minimize the importance of misspecified distributional assumptions in the estimation of the regression equation and to avoid assigning a cardinal scale to the bond ratings. The null hypothesis is that there will be no significant correlation between our estimate of the present value of future growth opportunities and default risk. The alternative hypothesis advanced in the paper is that higher future growth opportunities are associated with a lower probability of default so that Spearman's rank correlation will be negative.

The estimate of the Spearman rank-order correlation between the residuals computed from the regression with the numerical codes for the bond ratings is −0.233 with a one-tail critical value of −0.218 at the 5% level of confidence. Thus we are able to reject the null hypothesis of no correlation in favor of the alternative hypothesis of a significant, negative correlation.

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