Wharton

The Role of Capital in Financial Institutions

Working Paper 95-01

Allen N. Berger
Richard J. Herring
Giorgio P. Szegö

Allen N. Berger is at the Board of Governors of the Federal Reserve System and the Wharton Financial Institutions Center, the University of Pennsylvania. Richard J. Herring is at the Wharton Financial Institutions Center, the University of Pennsylvania. Giorgio P. Szegö is at the Università de Roma 'La Sapienza.' The opinions expressed do not necessarily reflect those of the Board of Governors or its staff. The authors thank the Wharton Financial Institutions Center for sponsoring the conference on which the special issue is based at the Wharton School, March 9-11, 1994. We also thank Sankar Acharya, Franklin Allen, Bob Avery, Mark Carey, Doug Cook, Mark Flannery, Diana Hancock, Dave Jones, Myron Kwast, Jim O'Brien, Steve Pilloff, Tony Santomero, and Greg Udell for helpful comments, Jalal Akhavien and Joe Scalise for excellent research assistance, Alpha Bauer, Terry DiNardo, and Debbie Tiller for invaluable administrative work, and all of the conference participants for making the conference and special issue possible.

JEL classification codes: G21, G28, G32, E58, L89.
Key Words: bank, capital, regulation, securitization, credit crunch

The Role of Capital in Financial Institutions

January 1995

Abstract: This article examines the role of capital in financial institutions -- why it is important, how market-generated capital 'requirements' differ from regulatory requirements, and the form that regulatory requirements should take. Along the way, we examine historical trends in bank capital, problems in measuring capital, and some possible unintended consequences of capital requirements. Within this framework, we evaluate how the contributors to the special issue of the same title (*JBF*, April 1995) advance the literature and suggest topics for future research.

I. Introduction

The point of departure for all modern research on capital structure is the Modigliani-Miller (M&M, 1958) proposition that in a frictionless world of full information and complete markets, a firm's capital structure can not affect its value. This proposition contrasts sharply with the intuitive notion that a firm with risk-free debt could borrow at an interest rate below the required return on equity, reducing its weighted average cost of financing and increasing its value by substituting debt for equity. But the powerful arbitrage arguments employed by M&M demonstrate that market prices will compensate for any leverage decision by the firm. When leverage is higher, so are the risks to shareholders, increasing the costs of equity just enough so that the weighted average cost of financing remains constant. More general versions of M&M showed that the same result holds with risky debt -- the costs of both equity and risky debt respond so that the cost of financing is independent of leverage. The challenge to those who have come after M&M has been to identify credible departures from this frictionless world, analyze the implications of these departures for `optimal' capital structure, and test these implications against the empirical evidence.

This research is of particular relevance for financial institutions because these institutions lack any plausible rationale in the frictionless world of M&M. Most of the past research on financial institutions has begun with a set of assumed imperfections, such as taxes, costs of financial distress, transactions costs, asymmetric information, and especially regulation. Nonetheless, as Miller (1995) argues below, these imperfections may not be important enough to overturn the

M&M Proposition. In contrast, most of the other papers in this special issue take the view (implicitly or explicitly) that the deviations from M&M's frictionless world are important, so that financial institutions may be able to enhance their market values by taking on an `optimal' amount of leverage.

The purpose of this introductory article, and indeed this entire issue, is to investigate the role of capital for financial institutions -- why it is important, how market-generated capital `requirements' differ from regulatory requirements, and the form that regulatory requirements should take. In the process, we examine the history of bank capital, discuss issues involved in implementing capital requirements, analyze problems in measuring capital, and investigate some of the unintended consequences of capital requirements. We also point out how the articles in the special issue contribute to this literature, as well as suggest topics for future research.

Most of the analysis focuses on commercial banks in the United States, although many of the arguments apply more broadly to other financial institutions and regulatory systems. Banks serve as a useful focus for analysis because many of the frictions that make capital structure relevant -- costs of financial distress, asymmetric information, transactions costs, and regulation -- have been carefully studied in the banking literature. Moreover, banks play an important role in the global economy, and are the first category of institutions to be subject to internationally coordinated capital regulation. Finally, banks systematically have the highest leverage of firms in any industry, in sharp contrast to the implications

of the M&M proposition, which predicts that capital structures should vary randomly across firms and industries. [1]

II. Why Do Markets `Require' Financial Institutions To Hold Capital?

In this section, we examine why markets may encourage or `require' banks or other firms to hold certain capital ratios in the absence of regulatory capital requirements. Regulatory capital requirements will be considered later. We follow the tradition in the banking literature of referring to the capital ratio as the ratio of equity to assets, although we will use other regulatory definitions below.

We begin by defining a bank's market capital `requirement' as the capital ratio that maximizes the value of the bank in the absence of regulatory capital requirements and all the regulatory mechanisms that are used to enforce them), but in the presence of the rest of the regulatory structure that protects the safety and soundness of banks. [2] This market `requirement', which may differ for each bank, is the ratio toward which each bank would tend to move in the long run in the absence of

regulatory capital requirements. This construct will be useful for examining departures from the conditions under which M&M holds. Note that unlike regu-

---

[1]Because of space constraints we have been unable to include all of the important references on capital and we have focussed narrowly on capital without fully discussing related issues such as deposit insurance pricing, optimal closure rules, and other means of controlling risk.

[2]The value of banks is defined as the sum of market values of equity and debt. For small, closely-held banks without actively traded shares, we define market value of equity as the discounted
net present value of expected future cash flows to shareholders.

latory requirements, sanctions for departures from market capital `requirements' are two-sided in the sense that the value of the bank will decline if it has **either** too little or too much capital.

The search for an optimal capital structure or market capital `requirement' begins with the introduction of imperfections into the frictionless world of M&M. We will first consider taxes and costs of financial distress, followed by transactions costs and asymmetric information problems. These considerations apply quite broadly to all firms. We then consider an additional imperfection that is specific to banks -- the regulatory safety net, defined more fully below.

Taxes and Financial Distress

Taxes and the costs of financial distress were the first majo r frictions considered in determining optimal capital ratios. Sinc e interest payments are tax deductible, but dividends are not, substituting debt for equity enables firms to pass greater returns to investors by reducing payments to the government. Other things equal, owners prefer to fund the firm almost entirely with debt.[3] But increasing leverage also increases the risk of incurring the costs of financial distress (defined below). The expected costs of financial distress increase as the capital ratio declines and the probability of insolvency rises. The capital ratio at which the tax advantages of additional debt are just offset by the increase in the ex pected costs of financial distress determines the optimal capital structure or market capital `requirement' in the presence of these two frictions.

---

[3]See Miller (1977) and DeAngelo and Masulis (1980) for detailed treatments of taxes.

Financial distress occurs when the bank is expected to have difficulty honoring its commitments. Costs of financial distress include the costs of bankruptcy -- i.e., the costs of transferring ownership of the firm from shareholders to creditors. Financial distress costs also include the loss in value that may occur as a result of the perception that bankruptcy may be imminent -- even if bankruptcy may ultimately be avoided. Talented employees may leave, suppliers may demand more timely payments, revenues from credit-risk-sensitive products such as long-term swaps and guarantees may decline, and conflicts of interest between shareholders and creditors may lead to suboptimal operating, investment, and financing decisions (discussed more fully below).

Financial distress should be distinguished from economic distress. The cost of financial distress may be measured as the additional loss from economic distress for a leveraged bank versus an identical bank that is unleveraged. When asset quality deteriorates, both banks will experience economic distress, but the leveraged bank experiences a greater loss of value because of the increased risk of bankruptcy, greater uncertainty that the bank will honor its commitments to other stakeholders, and the increasing costs of controlling conflicts of interest between shareholders and creditors.

Research on the costs of financial and economic distress in banking illustrates the difficulty of separating these two types of costs. For example, James (1991) found that in FDIC-administered bank failures, bank assets lost an average of 30% of book value when sold, and the administrative and legal expenses associated with a failure averaged another 10% of assets. The 30% loss of book value from asset sales

exaggerates the cost of financial distre ss because part of the 30% undoubtedly reflects economic distress incurred earlier, since the reported book values of assets at failed banks often overstate economic value (see GAO 1990). There is als o disagreement over how much of the remaining costs of liquidating the individual assets should count as financial versus economic distress costs. [4] Interestingly, losses to creditors (including the FDIC) from bank insolvencies are often less than losses from insolvencies of nonbanking firms that go through the bankruptcy process, presumably because the resolution process for banks is more efficient (Kaufman, 1994).

Part of the costs of financia l distress are borne by the bank's creditors and part by shareholders. To the extent that creditors can foresee the probability of incurring these costs at the time that the debt is issued, they will raise their required interest rates and shift the entire **expected** costs of financial distress to shareholders under risk neutrality. In response, shareholders may choose to reduce these expected costs by increasing the capital ratio of the bank to the point at which the reduction in the expected costs of financial distress just offsets the r eduction in the tax benefits of debt. In effect, market capital `requirements' increase in response to a rise in the expected costs of financial distress. [5]

---

[4]Under ideal bankruptcy procedures, liquidation occurs only when the liquidation value exceeds the value of the bank as a going concern. Haugen and Senbet (1978) therefore argued that liquidation costs should be regarded as a consequence of economic distress and not as a cost of financial distress.

[5]Berger (1995) found empirical evidence supporting this hypothesis. He found a positive relationship between capital ratios and earnings for U.S. banks during the 1980s, a period when the probability of bank failure and the expected costs of financial distress raised market capital `requirements'. Banks that did not respond to these 'requirements' paid much higher rates on their uninsured liabilities, which caused them to suffer lower earnings than other

Asymmetric Information and Transactions Costs

Relaxation of the M&M assumption of full information leads to a number of additional reasons that capital ratios may matter. [6] The implications of asymmetric information have been studied extensively in the banking literature because the modern theory of financial intermediation stresses the information acquisition function of banks. This theory (e.g., Diamond 1984) implies that financial intermediaries exist because they enjoy economies of scale and/or comparative advantages in the production of information about borrowers. Commercial banks specialize in lending to information-problematic borrowers, i.e., firms with idiosyncratic needs that are costly to communicate, particularly small firms without established reputations. Banks acquire information in the loan screening and contracting process, and then augment this information over time by monitoring the borrower's loan repayments and deposit activity.

The private information produced by banks regarding their loan customers also creates an asymmetric information problem for banks vis-a-vis financial markets. Bank managers will generally have more information about their own earnings prospects and financial condition than the capital markets. Because of this opacity (Ross 1989), the market will draw inferences from the actions of the bank. Managers may signal information to the market through capital decisions. If it is less costly for a `good' bank to signal high quality through increased leverage than for a `bad' bank,

---

banks.

[6]Harris and Raviv (1991) surveyed more than one hundred papers on capital structure theories, many of which assume some sort of asymmetric information.

a signaling equilibrium may exist in which banks that expect to have better future performance have lower capital (Ross 1977). Alternatively, a signaling equilibrium may exist in which higher, rather than lower capital signals favorable private information (Acharya 1988).[7]

Asymmetric information combined with transactions costs of new issues may also influence the relative costs of internal versus external finance and the relative costs of debt versus equity. When managers have significant private information, shareholders may be reluctant to issue new equity because it may sell at a discount.[8] In addition, transactions costs in raising funds from external sources, particularly the costs of issuing equity, may be quite substantial. These costs include preparation of the registration statement and prospectus, registration fees, printing and mailing costs, underwriting fees, and possibly the cost of the issue being `underpriced' (e.g., Ibbotson et al 1988). In contrast, banks typically have very low transactions costs in issuing new debt in the form of deposits. Banks may also hold a substantial buffer of additional capital as financial slack so that they can borrow additional funds quickly and cheaply in the event of unexpected profitable investment opportunities. Similarly, such a buffer of capital protects against costly unexpected shocks to capital if the financial distress costs from low capital are substantial and the transactions costs of raising new capital quickly are very high.

---

[7]However, the 1980s data on U.S. banks was not consistent with the empirical implications of either of these signaling hypotheses (Berger 1995).

[8]Shareholders may also be reluctant to issue more equity because it may transfer wealth from old shareholders to old creditors if interest rates on outstanding debt cannot be easily lowered to reflect the increased safety of the debt (Miller 1995).

Myers (1984) and Myers and Majluf (1984) argued that firms establish a pecking order in developing their financing strategies. At the top of the pecking order is internally generated cash flows, which have no issue costs and no information problems. If external funds are needed, debt is usually preferred to equity because its issuing costs are usually lower, and because debt reduces verification costs (e.g., Townsend 1979). All of these incentives may be accentuated for small banks which typically face very high transactions costs in issuing new equity.

Asymmetric information problems may also lead to agency conflicts between shareholders and creditors that are exacerbated by conditions of financial distress. Shareholders may find that actions which maximize the value of all claims on the bank do not necessarily maximize the value of their own claims. This may lead to attempts to shift wealth from creditors to shareholders. First, shareholders may have a moral hazard opportunity to exploit creditors by substituting riskier assets for safer ones (possibly undertaking negative net present value investments) if creditors do not have sufficient information to react. Second, when a bank is near default, shareholders may lack incentives to contribute new capital even to fund value-increasing investments, since most of the benefits would accrue to creditors (Myers 1977). Third, shareholders have incentives to continue the bank's operations beyond the point at which it should be liquidated in order to maintain at least an option value for their claims. Finally, the bank may manipulate its accounts to mask the deterioration in condition by understating loan losses or by `gains trading' in which assets with market values above book values are sold and those with market values below book are kept (Carey

1993). These problems of expropriation of creditor value are compounded if the debt has long maturity and is difficult to redeem in the short term. This is because shareholders are more likely to expropriate value if there is more time before creditors can react by raising rates or withdrawing credit (Flannery 1994).

Similar to the arguments above for the other costs of financial distress, creditors will demand compensation in the form of higher interest rates on debt for the expected value of these expropriations of their claims by shareholders under risk neutrality. In response, banks may optimally increase their capital ratios to assure creditors that the bank is safe and shareholder and creditor interests are closely aligned, so that shareholders are unlikely to engage in expropriation activities. In effect, agency problems between shareholders and creditors raise market capital `requirements'.

Other agency costs arise from a conflict of interest between shareholders and managers when shareholders cannot effectively monitor managers' actions (Jensen and Meckling 1976, Grossman and Hart 1982, Jensen 1986). Higher debt puts pressure on managers to generate cash flows and avoid their loss of human capital from bankruptcy and therefore may give incentives to work harder, reduce expense preference behavior, and make better investment decisions. Shareholders may also compensate managers in shares and oblige them to hold the shares in order to enhance these incentives. Given the managers' holdings, further increases in overall leverage magnify the managers' stake in the bank's performance and may further heighten these incentives. In addition, increasing debt reduces the scope for managers to keep the firm going after the point at which shareholders would gain from liquidation

(Harris and Raviv 1990). Thus, shareholder-manager agency conflicts are reduced by increasing leverage.[9]

Taken together, the agency problems between shareholders and creditors and between shareholders and managers confront shareholders with a tradeoff. Higher capital avoids expropriation problems between shareholders and creditors but aggravates conflicts of interest between shareholders and managers, and vice versa for lower capital. Unfortunately, the corporate finance literature has made little progress in quantifying this tradeoff, and so the net impact on market capital `requirements' is ambiguous.

The Safety Net

The departures from the M&M assumptions considered to this point -- taxes, financial distress costs, asymmetric information, and transactions costs -- may influence the capital decisions of any firm. Banks, however, differ substantially from most other firms because they are protected by a regulatory safety net. As will be shown, this protection from bankruptcy and the costs of financial distress will affect market capital `requirements'.

We use the term `safety net' to refer to all government actions designed to enhance the safety and soundness of the banking system other than the regulation and enforcement of capital requirements. The safety net includes deposit insurance,

[9]Regulators may also be concerned about the incentives shareholders provide managers. John et al (1995) argue below that a deposit insurance premium that reflects both leverage and the structure of management compensation can lead banks to choose risk in accordance with regulators' preferences.

unconditional payment guar antees, and access to the discount window, as well as the entire panoply of regulation and supervision that is not directly related to capital. Although capital regulation and its enforcement are also intended to enhance bank safety, we want to consider how the safety net affects market capital `requirements' in the absence of capital regulation. The effects of regulatory cap ital requirements and the motivations for both regulatory capital requirements and the safety net are discussed below.

The safety net likely reduces market capital `r equirements' by insulating banks from potential market discipline. For example, federal deposit insurance insulates banks from price and quantity reactions by insured depositors to bank capital decisions.[10] This distortion could be eliminated if deposit insurance premiums fully responded to changes in risk. However, until recently, federal deposit insurance premiums were fixed and they now respond only slightly to changes in the capital ratio (discussed below). The safety net may also blunt the risk-pricing of **uninsured** debt if the market believes this debt to be de facto insured or if the safety net as a whole acts as a subsidy to the bank, raising net cash flows. These conditions would reduce market capital `requirements' further. [11]

In sum, our analysis suggests that several departures from the frictio nless world of M&M may help explain market capital `requirements' for banks. Tax co nsiderations

---

[10]The insulation may be incomplete if depositors are concerned that the insurer may not honor its commitments (e.g., Cook and Spellman 1994).

[11]The safety net may also reduce market capital requirements if it forces banks to take on less portfolio risk than they otherwise would, since safer portfolios `require' less capital to protect against financial distress costs.

tend to reduce market capital `requirements', the expected costs of financial distress tend to raise these `requirements', and transa ctions costs and asymmetric information problems may either increase or reduce the capital held in equilibrium. Finally, the federal safety net shields bank creditors from the full consequenc es of bank risk taking and thus tends to reduce market capital `requirements'. This is consistent with the fact that banks generally ha ve lower capital than firms in any other industry, including financial institutions with similar portfolios that are not subject to the safety net (e.g., commercial finance companies). Additional support for this hypothesis may be inferred from examining how the introduction of the safety net has influenced bank capital ratios over time.

III. The Historical Evolution of Bank Capital Ratios in the U.S.

The history of bank capital ratios in the U.S. reveals a rema rkable, century-long decline from the levels prior to the construction of the federal safety net. Figure 1 shows the ratio of equity to assets for the banking industry from 1840 to 1993. [12] In 1840, equity funded over 50% of banks' ass ets, after which the ratio fell fairly steadily for about 100 years until it settled in the 6% to 8% range from the mid-1940s to the 1990s.

Prior to the start of the National Banking era in 1863, capital ratios were already declining significantly. As the efficiency of the U. S. financial system improved from geographic diversification, development of regional and national money markets,

[12]This figure reproduces and extends a figure developed by Myron Kwast in U.S. Treasury (1991). We are grateful to Myron for providing the data and sharing his insights. Note that these data are not fully consistent over time, and therefore should be used only to assess general trends.

and introduction of clearinghouses and other mutual guarantee associations, the probability of bank failures declined. In the framework described above, this would reduce market capital `requirements', because less capital was needed to protect against the risk of financial distress. The data are consistent with this hypothesis.

The four vertical lines in Figure 1 identify significant changes in regulation that may have altered the historical path of bank capital ratios. The National Banking Act of 1863 contained regulations that bolstered confidence in the safety of the new national banks. These banks were required to deposit $10 in U.S. government bonds with the Comptroller of the Currency for each $9 of national bank notes issued, thus amply collateralizing the new currency. This should have greatly reduced the capital `required' by the holders of this bank debt, since the safety of the notes did not depend upon the solvency of the bank. In principle, a `narrow' national bank could have had a 10% capital/asset ratio by simply raising $9 in deposits for each dollar of equity and buying only government bonds. While this is a limiting case, the implicit 10% regulatory capital ratio for such a bank was less than one-quarter of the average capital ratio of the time. The data show an accelerated rate of decline of capital ratios following 1863, consistent with the hypothesis that the Act reduced market capital `requirements'.

The creation of the Federal Reserve in 1914 also reduced the risk of bank failure by permitting banks to obtain liquidity through discounting assets at the Federal Reserve rather than incurring losses from the distress sale of assets to meet liquidity needs. The introduction of the Federal Reserve also enhanced liquidity by providing

a more reliable system for clearing checks at par. Despite these reductions in the expected costs of financial distress, the data suggest that the creation of the Federal Reserve led to, at most, a small reduction in capital ratios.

The creation of the FDIC in 1933 provided unconditional government guarantees for most bank creditors. The fixed-rate (non-risk-based) deposit insurance lowered market capital `requirements' by guaranteeing depositors repayment even if their bank failed. Among other regulatory changes of the time, restrictions were placed on the interest rates banks could pay on deposits. This provided an additional subsidy to banking that also made uninsured bank debt safer, reducing market capital requirements further. The data suggest that these changes had a larger and more long-lasting effect than the creation of the Federal Reserve. By the early 1940s, capital had dropped into the 6% to 8% range where it remains today. Thus, after a century of substantial decline, capital ratios remained relatively stable for the next half-century.

The final event shown in Figure 1 is the initiation of the Basle Accord on risk-based capital (RBC) requirements along with some other, nearly coincident, regulatory changes. RBC requirements were partially implemented in 1990 and took full effect in 1992.[13] U.S. regulators also imposed a leverage requirement in 1990 based on total assets. In 1991, the prompt corrective action feature of the FDIC Improvement Act (FDICIA) created additional motivation for banks to raise their capital ratios to avoid

[13]We mark the implementation date as 1990, although some banks may have reacted to announcements of RBC earlier.

supervisory sanctions.[14] The introduction of risk-based deposit insurance premiums in FDICIA added yet another incentive for banks to increase their capital ratios above the new, higher, regulatory minimums. The combined effect of these regulatory actions appears to have been successful in raising capital ratios. The aggregate equity/asset ratio rose from 6.21% at the end of 1989 to 8.01% at the end of 1993, an increase of almost 30% in four years. Although market `requirements' may also have risen in the early 1990s because of concerns about financial distress in the banking system, it seems plausible that the regulatory changes accounted for much of the increase in capital ratios.

IV. Why Do Regulators Require Financial Institutions To Hold Capital?

In this section, we examine why capital ratios matter to bank regulators. As in the market capital `requirements' section above, we take as given the safety net of government guarantees and regulations that protect the safety and soundness of banks.

Regulators require capital for almost all the same reasons that other uninsured creditors of banks `require' capital -- to protect themselves against the costs of financial distress, agency problems, and the reduction in market discipline caused by the safety net. The FDIC is effectively the largest uninsured creditor of most banks in the U.S. because in the event of bank failure, it pays off the insured depositors and stands in their place for a share of the failed bank's assets along with other uninsured creditors.

---

[14]See Jones and King (1995), Garcia (1995), and Kaufman (1995) below for discussions of FDICIA, Szegö (1995) for discussion of RBC implementation in Europe, and Cummins et al. (1995) for analysis of RBC and prompt corrective action in the insurance industry.

The FDIC also bears many of the administrative costs when a bank fails. Other aspects of the safety net -- such as Federal Reserve discount window lending and unconditional guarantees on FedWire payments -- create additional uninsured risk for the government. Regulators, as representatives of the FDIC, the Federal Reserve, and the taxpayers who stand behind them, are vulnerable to the same costs of financial distress and expropriations of value as other creditors.

Regulators also respond to other externalities associated with financial intermediaries on behalf of the rest of society. The principal concern is systemic risk. The failure of a large number of banks or the failure of a small number of large banks could set off a chain reaction that may undermine the stability of the financial system. Public information about the condition of individual banks is highly imperfect and so when a number of banks fail, it may be difficult to tell whether the cause is idiosyncratic shocks to individual banks or a more widespread shock that jeopardizes many other banks. Thus, the news that some banks failed may create destructive `panic' runs on other solvent, but illiquid banks by uninsured creditors who are unsure whether the shock may affect their banks (Bhattacharya and Thakor 1993). Interbank markets may be another channel through which the problems of one bank are transmitted rapidly to other banks since interbank transactions are large, variable, and difficult for outsiders to monitor (Guttentag and Herring 1987).

These systemic problems can inflict heavy social costs. Banks build up private information on informationally opaque loan customers through screening, contracting, and monitoring over the course of bank-borrower relationships. When a number of

solvent but illiquid banks fail, the value of this information and the relationships themselves may be lost, making it difficult for some borrowers to continue financing investments. In turn, this reduction in credit extended may exacerbate regional or macroeconomic difficulties (Bernanke 1983). Significant bank failures may also threaten the integrity of the payments system, making it difficult for financial resources to flow to where their returns are highest. Moreover, widespread bank failures could undermine the effectiveness of monetary policy. According to the `lending view', monetary policy operates largely through changing the quantity of bank loans, which would be difficult to control in a banking panic (Bernanke and Blinder 1992). Concern about these social costs from a systemic crisis may lead regulators to attempt to achieve a higher degree of safety for banks by requiring higher capital ratios than if they were acting solely to protect the government's position as uninsured creditor. Note that concern about systemic risk is not only a motivation for regulatory capital requirements, but is also a major motivation behind the safety net itself.

Not all observers agree that systemic risk is an important issue (e.g. Benston and Kaufman, 1995). In the absence of systemic risk or other significant negative externalities from bank failures, the government should behave, in principle, like a private-sector uninsured creditor. The government should price risk through deposit insurance premiums and set capital standards and closure rules similar to covenants contained in standard debt contracts (e.g., Black et al 1978, Acharya and Dreyfus 1989).

Despite the fact that the government is the largest uninsured creditor of banks,

it does not exercise market discipline and `require' capital in the same way that other uninsured creditors do. First, it relies very little on explicit risk pricing. FDIC insurance premiums were not tied to risk until recently, and the current differential for risk is very small. As of 1994, banks with the best examination ratings (composite CAMEL ratings of 1 or 2) that were also well capitalized (at least 10% total risk-based capital ratio, 6% Tier 1 ratio, and 5% Tier 1 leverage ratio) paid 23 basis points of total deposits (23 cents per $100 of deposits). In contrast, banks with the worst examination ratings (CAMEL 4 or 5) that were undercapitalized (less than 8% total ratio, 4% Tier 1 ratio, or 4% Tier 1 leverage ratio) paid 31 basis points. This maximum price difference of 8 basis points for risk is far below the differential that would be charged in the debt markets for such large differences in risk (e.g., the differential between B-rated and AAA-rated bonds is typically well over 100 basis points).

The 8-basis-point differential is also far less than the differences in actuarially fair insurance premiums estimated from option pricing models. For example, Kuester and O'Brien (1990) estimated that fair premiums for most firms would be very low, less than 1 basis point, while a few very risky outliers had fair premia in the 1000's of basis points. While this approach requires a number of simplifying assumptions, the result that most banks are very safe and a few banks are extremely risky is consistent with the rest of this literature (e.g., Ronn and Verma 1986), and suggests that the 8-basis-point maximum FDIC differential does not capture the existing risk differences. Moreover, it is not clear that this small price differential would by itself be a critical factor in deterring banks from holding low capital ratios.[15] Since the FDIC does so lit-

tle pricing of risk, it must re ly more on capital requirements than the private sector. [16]

Also, regulators usually do not ration their credit -- i.e ., deposit insurance coverage -- to limit their risks as market participants do. Markets routinely refuse to extend additional credit to a bank or other firm if the going interest rate does not cover the risk and raising the interest rate would create moral hazard or adverse selection problems. In con trast, regulators generally do not explicitly ration deposit insurance coverage. In most cases, the FDIC's insurance liability is simply determined by the demand and supply for the individual bank's insured deposits. Similarly to the weak pricing response, the fact that regulators usually do not ration credit increases their reliance on capital regulation.

Regulators do have some indirect means of pressuring banks to raise capital ratios, such as cease-and-desist orders, total withdrawal of insurance coverage, bank closure, limits on asset growth and brokered deposits, prohibition of dividend payments, etc. (Buser et al 1981). However, these tools are blunt, unc ertain, and apply to only a small percentage of institutions. One of the purposes of t he prompt correction action feature of FDICIA was to improve capital-based incentives by making some of

---

[15]The 8 basis point differential is an upper bound to the additional cost to the bank, because banks can reduce also premiums by shifting from deposit to non-deposit funding, by shifting assets into lower risk-weighted categories, or by shrinking the size of the bank. At the upper bound, the 8 basis points
would reduce return on assets (ROA) by about 5 or 6 basis points pre-tax (assuming deposits fund about 60-80% of deposits), or by about 3 or 4 basis points after-tax.

[16]Note that when banks have private information about their portfolio risks, it may be undesirable or even impossible for regulators to price the expected costs of risk on an actuarially fair basis. In order to reduce moral hazard incentives, it may be desirable to provide a subsidy to banks that increases their franchise values and improves their incentives to keep their risks under control (Buser et al 1981, Chan et al 1992).

these regulatory actions mandatory when the capital ratios fell into designated zones. Nonetheless, Jones and King's (1995) evidence below suggests that the mandatory actions are not likely to apply very often to the banks that are undertaking substantial risks.

In addition, there is the possibility that these blunt actions could create additional moral hazard incentives to take advantage of the safety net. For example, the deposit insurer could suffer increased expected losses from raising the capital ratio at which banks are closed because some banks may take higher risks and suffer larger losses before the insurer can detect them (Herring and Vankudre 1987, Davies and McManus 1991). This is because the capital ratio at which moral hazard incentives become important depends more on how far the capital ratio is from the closure point than on the absolute level of the capital ratio. Similar increases in risk-taking could be forthcoming in response to other costly interventions by regulators.

Thus, regulatory capital requirements differ substantially from market-based capital `requirements'. They are generally blunt standards that respond only minimally to perceived differences in risk rather than the continuous prices and quantity limits set by uninsured creditors in response to changing perceptions of the risk of individual banks. The limited ability to price or ration the benefits of the safety net in response to changes in bank risk may be quite costly if it permits risky banks to take advantage of the safety net by choosing lower capital ratios than the market would require them to hold in the absence of the safety net. [17,18]

---

[17]Kwan and Eisenbeis (1995) below provide evidence that cost-inefficient banks take greater risks to exploit the safety net than other banks because they have lower market values

V. How Should Regulatory Capital Standards Be Set?

Capital regulation is motivated in part by concern over the negative externalities that may result from bank default that are not taken into account in market capital `requirements'. One obvious regulatory remedy would be to require banks to hold so much equity that the probability of default is negligible. Indeed, if the M&M proposition applied to banks this would be a costless solution. But if, as we have argued, increasing equity beyond the market `requirement' reduces the value of the bank and increases its weighted average cost of financing, then higher regulatory requirements may impose social costs. In competitive markets in the long run, regulatory capital costs are likely to be passed on to bank customers, so that the size of the banking industry and the quantity of intermediation may be reduced. Thus, capital regulation involves a tradeoff between the marginal social benefit of reducing the risk of the negative externalities from bank failures and the marginal social cost of diminishing intermediation (Santomero and Watson 1977).

These social costs and benefits from regulatory capital requirements differ across banks and over time. `Ideal' regulatory capital requirements would reflect these differences to equate the marginal social cost of higher capital with the marginal social benefit for each bank for each time period. For example, a bank that poses no significant externalities would be assigned a relatively low capital requirement that

---

and higher costs of capital.

[18]Ironically, regulators may have an informational advantage in pricing risk and/or setting capital requirements because of access to confidential bank examination information (Berger and Davies, 1994).

reflects only the government's claim as an uninsured creditor. In contrast, a bank that is likely to transmit shocks to other banks because of key roles in the payments system and interbank markets would be subject to a high capital requirement. Similarly, the requirements would be continuously updated with changes in the risk positions of each bank and the external costs of these risks.

Unfortunately, implementation of such an `ideal' system would be prohibitively expensive, if not impossible. Regulators lack precise estimates of social costs and benefits to tailor a capital requirement for each bank, and cannot easily revise the requirements continuously as conditions change. Because regulation and supervision are costly, banks are monitored at only at discrete intervals. Under FDICIA, most banks receive full scope, on-site examinations only once annually.

In practice, capital regulation stipulates uniform, minimum ratios below which banks are subject to regulatory sanctions, and these minimums remain relatively stable over a period of years. Between on-site examinations, compliance with these minimums can be easily monitored by inspection of the quarterly Call Report. Regulators also have discretion to set somewhat higher requirements for individual banks that are perceived to pose higher risks.

In the remainder of this section, we examine how regulatory minimum capital standards might be set, given these constraints. We explore which financial instruments should count as regulatory capital and how the numerator and denominator of the regulatory capital ratio should be measured. We also discuss some policy alternatives to improve the effectiveness of capital regulation.

What Should Count as Regulatory Capital?

The main regulatory policy goals of protecting the government's uninsured claims on banks and guarding against the external costs of bank failure such as systemic risk suggest that instruments th at qualify as regulatory capital should have three main characteristics. First, claims that qualify as regulatory capital should be junior to those of the deposit insurer, so that they serve as a buffer to absorb losses before the government. Second, a financial instrument that counts as capital should be `patient money'. It should not be redeemable without assured refunding by the same or other creditors or shareholders during the time period needed to evaluate a significant shock so that it can provide a stable sour ce of funds during a possible panic run on the bank by other creditors. This reduces the potential for, and scope of contagious bank runs and allow s regulators more time to evaluate and respond to the shock. Finally, an instrument that counts as regulatory capital should reduce the bank's moral hazard incentives to exploit the protection of the safety net by undertaking excessive portfolio or leverage risk.

We consider next the extent to which equity meets these three criteria for regulatory capital. Equity is junior to all other claims and thus serves well as a buffer against loss for the deposit insurer.[19] It also has an indefinitely long maturity and cannot be redeemed during a crisis period. Regulators typically prohibit excessive divi-

[19]Relative to debt instruments that may be considered as regulatory capital, equity has the additional benefit that it absorbs losses before the point of bankruptcy and permits the bank to continue as a going concern. This property is important to the extent that shareholders would have difficulty raising new equity to avert bankruptcy even when the bank has positive value as a going concern.

dend payouts or stock repurchases for distressed banks, so that equity serves well as a stable source of funds while regulators and market participants sort through the effects of shocks. However, equity may not always achieve the third objective of disciplining risk taking. Regulatory requirements to increase equity-to-asset ratios reduce leverage risk, but the effect on portfolio risk and on the overall risk of bankruptcy is ambiguous in some circumstances.

Koehn and Santomero (1980), Keeton (1988), and Kim and Santomero (1988) used utility maximization models to show that an increase in the required equity-to-asset ratio might either increase or decrease the portfolio risk chosen by a bank. If equity is relatively expensive (for reasons discussed above), risk-averse bank owners may choose to take part of their loss from a higher equity requirement in the form of an increase in risk by choosing a higher point on the risk-expected return frontier. In effect, they may respond to a forced reduction in leverage risk that lowers expected return by choosing a portfolio with higher risk and higher expected return. In contrast, Furlong and Keeley (1989) and Keeley and Furlong (1990) found that value-maximizing banks with publicly traded stock will always reduce portfolio risk in response to a higher equity requirement because it increases the share of losses borne by the bank owners relative to the FDIC. However, Gennotte and Pyle (1991) found that value-maximizing banks may increase portfolio risk and the probability of failure if bank investments are subject to decreasing returns to investment, as may be the case for the type of information-intensive, non-marketable loans in which banks specialize. Even with an increase in the probability of failure, however, Gennotte and Pyle found

that the expected cost to the deposit insurer generally decreased in response to an increase in required equity because the size of the insurer loss decreased proportionately more than the increase in the probability of failure. Fina lly, Avery and Berger (1991b) showed that expected losses fo r the insurer could rise from an increase in required equity in the Gennotte and Pyle model, but some extreme distributional assumptions about investment returns were needed. Thus, the theoretical issue of how higher required equity ratios affect bank risk-taking is unresolved.

In contrast, the empirical evidence generally suggests that higher equity is associated with lower overall bank risk. Vi rtually every bank failure model finds that a higher equity-to-asset ratio is associated with a lower future probability of failure (e.g., Lane et al 1986, Avery and Berger 1991b, Cole and Gunther 1995). Nonetheless, the relationship between the equity-to-asset ratio and bank safety is often relatively weak. A higher equity ratio does not always predict a lower probability of failure over all reasonably near future periods (Thomson 1991), and often expla ins very little of the variation in bank performance.

This is an important area for future research. We lack clear evidence about whether the positive (albeit weak) relationship between equity and bank safety reflects a decrease in portfolio risk in addition to the decline in leverage risk. Also the extent to which the empirical results reflect the effects of regulatory versus market capital `requirements' is not always clear.

We next consider subordinated debt, which is often included in regulatory capital. Subordinated debt is junior to all claims other than equity and so serves as

a buffer against losses by the deposit insurer. [20] Subordinated debt is also generally `patient money' that helps provide stable funds to weather shocks to confidence. It typically has a long maturity and is difficult to redeem quickly during a crisis period. [21] Although subordinated debt increases leverage risk, it may deter portfolio risk taking. Subordinated creditors have strong incentives to monitor bank risk taking and impose discipline -- provided they believe that they will not be protected by the safety net. Indeed, their loss exposure, and hence their perspective is similar to that of the deposit insurer. They are exposed to downside risk that exceeds the shareholders' equity, but their potential upside gains are contractually limited. In contrast to shareholders who may choose higher points on the risk-expected return frontier, subordinated creditors generally prefer safer portfolios and are likely to penalize banks that take significant risks.

The price discipline of actively traded subordinated debt -- which is registered moment-by-moment in secondary market prices that can move by small fractions -- is arguably a much quicker and perhaps more precise way of controlling bank risk taking than regulatory measures which are often blunt and cumbersome to deploy. A falling price of subordinated debt can alert other creditors about the condition of the bank or

---

[20]In the interest of brevity, this discussion ignores hybrid instruments such as perpetual, noncumulative floating rate notes that have some of the characteristics of equity. We also neglect several other items that count as regulatory capital under the Basle Accord.

[21]To qualify as Tier 2 capital under the Basle Accord, subordinated debt must have original weighted average maturity of at least 5 years, and the amount that counts as capital is reduced over the last 5 years of term.

actions of the managers, creating a broader market reaction.[22] Ironically, when bank risk increases unexpectedly, banks may not have to pay higher rates or face possible quantity discipline for a period of time until the subordinated debt, which typically has a long maturity, must be redeemed. For this reason, it may be useful to have some regular turnover of subordinated debt, even though it weakens the role of subordinated debt as `patient money'. For example, if banks were required to stagger the maturities of their long-term debt so that only a modest proportion turned over each period, price and quantity sanctions may be effective and informative, but sufficiently limited in magnitude to provide time for crisis resolution or orderly closure (Wall 1989, Evanoff 1991).

Despite the theoretical virtues of subordinated debt, the literature on market discipline usually found that the price of subordinated debt was not very responsive to measures of bank risk taking in the early 1980s (e.g., Avery et al 1988, Gorton and Santomero 1990). The price reaction to balance sheet measures of risk was quite limited, although the response was somewhat greater to changes in bond ratings. The weak responses to measured risk may reflect a lack of market discipline, but they may also reflect difficulties in measuring bank risk. Moreover, the limited responsiveness may also reflect a presumption by investors that the large banks that issued subordinated debt in the early 1980s were considered to be `too big to fail'. More recent results suggest that subordinated debt prices may have become more sensitive to bank

[22]In addition, market prices tend to be more forward looking than regulatory examinations, and may provide regulators with valuable information on the market's perceptions of the risks taken by banks (Horvitz 1983).

risk, perhaps reflecting increases over time in the willingness of regulators to let holders of this type of debt absorb losses (Flannery and Soresca, 1994). FDICIA's emphasis on early closure and least cost resolution may undermine the `too big to fail' presumption even further, but additional resea rch will be needed to resolve this issue.

Finally, we consider the potential of uninsured deposits as regulatory capital. Uninsured depositors in domestic bank offices have claims of equal status to the deposit insurer, rather than providing a buffer that absorbs losses before the government. However, uninsured deposits in fo reign offices of U.S. banks do have the advantage of being junior claims to the FDIC. The Budget Act of 1993 provides for U.S. depositor preference in the event of bank failure, so that uninsured depositors in U.S. banking offices and the FDIC (which stands in the place of insured depositors) are senior claimants over depositors in foreign offices and all other creditors. Empirical studies usually found that bank risk affects uninsured deposit rates, but the effect was typically weaker for banks that may be `too big to fail,' similar to the results for subordinated debt (H annan and Hanweck 1988, Ellis and Flannery 1992). However, uninsured deposits are not `patient money' that provides a stable source of funding in a crisis. Depositors can usually `run' and deposits can be redeemed for cash quickly when concerns arise abou t the solvency of an institution, possibly leading to systemic risk problems. For example, the devasta ting run on Continental Illinois bank in 1984 was initiated by uninsured foreign depositors. Because of this problem, uninsured deposits are not counted as regulatory capital.

In sum, equity and subordinated debt broadly satisfy the criteria for regulatory

capital, but uninsured deposits do not. Both equity and subordinated debt are junior to the deposit insurer and provide buffers against government losses. Both instruments are also `patient money' that is usually difficult to redeem during a financial crisis, mitigating systemic risk problems and buying time for regulators to deal with the crisis. Both equity and subordinated debt likely reduce bank risk taking somewhat, but the theoretical and empirical evidence is much weaker on this point.

Measurement of Regulatory Capital

In order to be useful, regulatory capital must be measured with reasonable accuracy. However, this is seldom a simple task. For example, equity capital is the residual claim on the bank -- the value of obligations of others to pay the bank plus the value of any other tangible and intangible assets less the value of obligations of the bank to pay others. Therefore, measurement of equity depends on how **all** of a bank's financial instruments and other assets are valued.

If all claims were traded in complete, well-organized secondary markets, the measurement of equity capital for regulatory purposes would be relatively straightforward. It could be calculated as the `regulatory value of equity' -- the difference between the market value of the bank's assets (on and off the balance sheet) and the market value of the bank's liabilities (on and off the balance sheet), net of the value of limited liability (which includes the value of access to deposit insurance). That is, the market values of all liabilities would be adjusted as if the shareholders had to repay all the bank's obligations, even in the event of failure. This measure is the amount of value that could be lost before any of the bank's obligations to pay would go

unsatisfied.[23] The possible alternative of using the bank's market value of equity is unsuitable for regulatory purposes because it contains the value of the bank's limited liability, its option to put the bank's assets to its creditors . Since the FDIC bears much of the cost when this option is exercised, regulators should not count the value of the option as part of regulatory capital.

This `regulatory value of equity' -- assuming that sufficient market price information is available to compute it -- is also superior to the book value of equity typically used by regulators. The book value of equity measures most on-balance sheet assets and liabilities on an historical cost basis that may not reflect cur rent values, and treats most off-balance sheet items as having zero value. The book v alue measure does not reflect the bank's ability to withstand a loss without imposing costs on creditors, nor does it reflect the constraint on moral hazard. Moreover, as noted above, book values are subject to `gains trading' by banks to increase their r eported capital without creating value.

Unfortunately, not all of the bank's assets and liabilities are traded on well-organized secondary markets. The most difficult obstacle to computing the economic value of equity is the substantial volume of imperfectly marketable assets held by banks. As discussed above, banks specialize in making loans to and providing guarantees for information-problematic borrowers. Although banks have made substantial advances in securitizat ion, it is often difficult to overcome the asymmetric

[23]This definition may somewhat understate the economic value of capital because part of the limited liability is voluntarily absorbed by uninsured creditors and paid for by shareholders through higher interest rates.

information problem. When this problem is acute, the market breaks down because no buyer is willing to pay a price equal to the value of the asset to the bank based on its private information.

Several studies (e.g., Benston et al 1986) have recommended that banks adopt market value accounting (MVA), in which the reported values on financial statements -- and therefore measured capital -- would reflect market values. Virtually all of the MVA proposals advocate marking-to-market financial instruments that are traded in well-organized secondary markets with easily observable prices. Many also propose that estimates of market values be reported for nontraded assets, such as loans to small borrowers that do not have access to financial markets. This creates the conceptual problem of how to define the market value of an essentially unmarketable asset, such as a loan to small borrower unknown to the public. Although there are a number of possible implicit values that could be assigned to such a loan, the private nature of the information used would create a difficult verification problem for regulators and auditors (Berger et al 1991).

Accountants and bank regulators have also initiated moves toward MVA and disclosures of market values as supplementary information on financial statements. The Financial Accounting Standards Board has issued several proposals. FAS 107 required disclosures of `fair values' for all financial instruments as supplementary information starting in 1992 for large firms and in 1995 for small firms. Disclosures do not affect reported income or capital, but part of the purpose was to make available information that may be used to facilitate a future movement toward MVA. FDICIA

similarly requires disclosures of estimated market values in Call Reports and other documents filed with regulatory agencies. FAS 115 implemented a form of `partial market value accounting' in 1994, in which securities that are `available for sale' are marked to market on the balance sheet, affecting measured equity capital. There is no accounting change for other assets or for liabilities, and income statements are not affected, so that the change in retained earnings is not reported as income. Bank regulators have chosen not to implement this change in calculating regulatory capital.

Despite all this academic and regulatory attention, however, there has been relatively little empirical evidence on the effects of MVA. Three of the papers below advance this line of research. Carey (1995) examines the likely effects of a version of securities-only partial MVA (SOPMVA) similar to FAS 115 in which only tradeable securities are marked-to-market, while other assets and liabilities remain at historical cost. He finds that this change could slightly improve the system by measuring one group of assets more accurately and by reducing wasteful `gains trading' behavior. But SOPMVA may also make measured capital *less* accurate if tradeable securities function as a hedge against interest rate risk created by a duration mismatch elsewhere in the portfolio. If the hedge position is marked to market, but the underlying exposure is not, SOPMVA may also create artificial volatility in the measured capital of a bank that has a matched book on a **full** MVA basis. Carey's analysis suggests, however, that SOPMVA would have little effect on bank failure rates.

Barth et al (1995) examine the validity of common criticisms of MVA by analyzing the empirical effects of SOPMVA on bank income, capital, and stock market

values. This is also similar to FAS 115, although as noted, FAS 115 does not affect reported income. They find that SOPMVA does raise the volatility of reported earnings, but that bank share prices do not reflect this extra volatility. SOPMVA would also increase the number of violations of regulatory capital standards, which may distort behavior if banks use securities to hedge interest rate risk elsewhere in the portfolio that is not marked-to-market. Barth et al's finding that the stock market generally does not react to the volatility in the earnings on sec urities is consistent with the possibility that these securities often do hedge risk elsewhere in the portfolio.

Jones and King (1995) test an alternative approach to MVA for adju sting capital to reflect changes in the credit quality of the loan portfolio. Instead of adjusting the values of individual loans to reflect changes in the creditworthiness of borrowers -- which poses numerous problems for loa ns to informationally opaque borrowers -- they adjust the loan loss reserve account to reflect changes in the credit condition of the bank's entire loan portfolio. This has the same effect on reported equity capital as reductions in individual loan values. Berger et al (1991) earlier showed that adjusting loan loss reserves to reflect nonperforming loans (past due, nonaccrual, or renegotiated) improved the prediction of future loan charge-offs and could potentially make risk-based capital significantly more accurate. Jones and King (1995) show that adjusting loan loss reserves to reflect classified assets -- assets categorized by **bank examiners** as substandard, doubtful, or loss -- does an even better job of capturing declines in credit quality. Moreover, a simulation of the prompt corrective action rules of FDICIA using data from the 1980s suggested that this adjustment to capital may

significantly improve the tradeoff between Type 1 errors (troubled banks not being categorized as undercapitalized) and Type 2 errors (healthy banks being categorized as undercapitalized).

Thus, the implementation of SOPMVA is unlikely to improve the measurement of capital significantly. However, a form of partial MVA in which **all** financial instruments -- including off-balance sheet instruments and informationally opaque loans -- are adjusted for changes in market interest rates and foreign exchange rates could result in significantly better measurement of capital. Movement toward full MVA or an approximation to it awaits future research on the problem of adjusting values for changes in credit quality of information-problematic borrowers along the lines of Berger et al (1991) and Jones and King (1995).

How Should the Capital Ratio Denominator Be Measured?

The measurement of capital for the numerator of the capital ratios is only half of the problem, indeed, perhaps the easier half. Capital adequacy depends on the ratio of capital to the risk it should be prepared to absorb. Thus, the denominator of a regulatory risk-based capital ratio should measure the bank's risk exposure, or the variability of a bank's net worth. There is disagreement over which measure of net worth is most appropriate, but we prefer the `regulatory value of equity' measure described above -- the market values of all assets less the values of liabilities adjusted for limited liability. The greater the variability, the higher capital must be to protect against the social costs of bankruptcy.

In practice, however, it is difficult to develop an accurate measure of risk

exposure that is reasonably simple and can be uniformly applied across banks. The Basle Accord's risk-weighted assets denominator (RWA) focuses on credit risk, reflecting the perception that credit risk poses the most serious threat to bank solvency. Other types of risk are to be incorporated later.[24] All assets and off-balance sheet instruments are assigned risk weights of 0%, 20%, 50%, or 100%, depending on the group to which the obligor belongs and the type of financial instrument. The risk weights do not reflect some obvious determinants of credit risk, such as differences in credit quality across commercial loans (all of which are in the 100% category), concentrations of risk in a specific asset category or to a particular obligor, industry, or region, and covariances among the values of financial instruments.

Several empirical studies have analyzed the correspondence of RWA with actual risk. Avery and Berger (1991b) and Bradley et al (1991) found that RWA for banks and thrifts, respectively, was positively related to the probability of failure and some accounting measures of risk, but these relationships were fairly weak. Moreover, the relative risk weights in RWA were often out of alignment with actual risk.

Cordell and King (1995) below obtain similar results, but use an entirely different methodology. They apply option pricing methods to market data on publicly traded banks and thrifts to measure their risks, making several technical improvements to this literature. After measuring the value of the deposit insurance put option,

---

[24]The Basle Committee also proposed a procedure for taking market risk into account and guidelines for measuring exposure to interest rate risk. To date, U.S. regulators have been unable to agree on a procedure for incorporating concentration risk and interest rate risk in the requirements. However, the European Union has already incorporated market risk into its capital requirements (Szegö 1995).

they determine the capital ratio for each institution needed so that the value of the put option equals the existing flat-rate deposit insurance premium prevailing at that time. They find numerous problems with the relative risk weights for both banks and thrifts, and also conclude that accounting measures of capital may overstate the actual value of capital that is available to absorb losses.

Jones and King (1995) below show that RWA can be improved by increasing the risk weights on assets that are classified as substandard, doubtful, or loss by bank examiners. Greater quantities of classified assets increase the variance of future bank losses as well as raising the expected value of future losses. Thus, by giving more weight to classified assets, a modified RWA is likely to be closer to our ideal denominator -- the variability of net worth. Their simulation of the effects of the prompt corrective action rules of FDICIA described above yielded an even better tradeoff between Type 1 and Type 2 errors when the RWA capital ratio denominator was modified to give higher weights to classified assets. That is, the policy tradeoff was improved more than when just the capital numerator was adjusted to take classified assets into account.

Another potential problem with any regulatory measure of risk exposure used as a denominator is that it may be subject to manipulation by bank management. Banks may be able to restructure their transactions to reduce their capital requirements without reducing their actual risk exposures. Merton (1995) below provides an example of how the current RWA denominator can be circumvented -- in place of a portfolio of mortgages, a bank can hold the economic equivalent of the same

portfolio at a risk weight one-eighth as large. The extent of such manipulation that has taken place since impleme ntation of RBC is an open question for future research.

Thus, the denominator of the Basle Accord RBC capital ratio appears to reflect the variability of net worth or the economic value of equity quite imperfectly. Researchers have suggested some practical ways to improve the denominator. But the more fundamental problem, as Merton (1995) argues below, is that we need a new kind of `risk accounting' focused on **exposures** rather than values, that would capture how values are likely to change in response to changes in the underlying environment.

Alternatives to a Simple Risk-Based Capital Ratio

The foregoing discussion implies that a simple risk-based capital ratio is a relatively blunt tool for controlling bank risk-taking. The capital in the numerator may not always control bank moral hazard incentives, it is difficult to measure, and its measured value may be subject to manipulation by `gains trading'. The risk exposure in the denominator is also difficult to measure, corresponds only weakly to actual risks, and may be subject to significant manipulation. These imprecisions worsen the social tradeoff between the externalities from bank failures and the quantity of bank intermediation. To keep bank risk to a tolerable level, capital standards must be higher on average than they otherwise would be i f the capital ratios could be set more precisely, rai sing bank costs and reducing the amount of intermediation in the economy in the long run.

A way to resolve these problems at least partially is to have multiple capital ratios. For example, it may be desirable to have a minimum standard with equity in

the numerator and a separate standard with subordinated debt in the numerator because each has different benefits and deficiencies. This is similar to the current Basle Accord standards, which have minimums for Tier 1 capital (which contains equity) and Total capital (which contains both equity and subordinated debt). Avery and Berger's (1991b) analysis suggested the both of these ratios had independent value in capturing risks. Analogously, an additional denominator may catch some risks that are otherwise missed by the risk-based denominator and make it more difficult to manipulate the system. The leverage requirement for U.S. banks, which requires a minimum amount of capital per unit of **unweighted** assets, may be viewed as such a response to problems with the risk-based ratios. Avery and Berger's (1991b) data also suggested that the addition of the leverage requirement would improve the correspondence between risk and the regulatory capital standards, provided that this requirement is set high enough to be binding. However, the leverage requirement is imperfect as well. Merton (1995) shows that the same transaction can be financed in two different ways that lead to strikingly different leverage ratios, but do not affect the net worth or risk of the bank. Moreover, if the ratio is set too high, the extent of bank intermediation may be inappropriately constrained.

Kane (1995) below argues that regulatory capital requirements are an inefficient means of controlling the government's risk as uninsured creditor because regulators do not limit risk exposure as rigorously as private entities would. The weaker the ability of regulators to identify, measure, and control risk-taking by depository institutions, the more burdensome capital requirements must be in order to protect the

government's claim as uninsured creditor. Kane contends that the same degree of protection could be attained at lower cost by making greater use of transparency and other loss control mechanisms in addition to capital requirements. He advocates privatizing some of the monitoring and disciplinary activities traditionally undertaken by government through making broader use of risk-sharing contracts -- not only subordinated debt as above, but also collateralization, coinsurance, and reinsurance -- to enlist the greater accountability and quicker responsiveness of private entities in controlling bank risk taking.

Miller (1995) below advocates scrapping capital requirements and official surveillance of risk in favor of a `narrow bank' in which insured deposits must be invested only in short-term Treasury bills or close equivalents. [25] Banks would also issue non-guaranteed securities to fund conventional bank loans, just as finance companies and leasing companies now do. Alternatively, most of the benefits of the transparency and simplicity of this approach could be maintained while allowing greater flexibility in portfolio choice if banks are permitted to hold not only short-term Treasuries, but also other assets that are regularly traded on well-organized markets and can be marked to market daily. This could be implemented in two ways which differ according to whether or not insured deposits are kept in a separate legal entity of a diversified banking corporation: 1) the `secure depository' approach, in which institutions would be required to form separately incorporated entities taking insured deposits and holding only permissible, marketable assets; or (2) the `secured deposits'

[25] See Litan (1987), Pierce (1991), and Szegö (1994) for extended analysis of the narrow bank.

approach, in which insured deposits secured by a lien on a pool of permissible assets would be in a corporate entity holding other assets and liabilities (Benston et al 1989). Capital requirements for the `secure depository' (or the analogous excess collateral requirements for `secured deposits') would be set to insure that the chance of insolvency between daily mark-to-market points is reduced to some minimal probability with very low expected losses. These approaches share with Kane's proposal an emphasis on greater reliance on private sector mechanisms for identifying, measuring, and monitoring risk-taking by banks -- in effect, greater reliance on market capital `requirements' rather than regulatory capital requirements.

VI. Unintended Consequences of Regulatory Capital Requirements

Since actual capital standards are, at best, an approximation to the ideal, it should not be surprising that they may have had some unintended effects. Earlier we noted that in response to an increase in its required equity-to-asset ratio, a bank might increase its portfolio risk and raise its probability of failure. Risk-based capital requirements that penalize increases in portfolio risk can reduce such unintended consequences of capital requirements, but as we have seen, these standards are imprecise, leaving open the possibility that some banks may increase portfolio risks when capital standards are raised. Moreover, imperfections in setting the level of required capital and the relative risk weights may lead to allocative inefficiencies if capital requirements distort relative prices both among banks and between banks and non-bank competitors, and divert financial resources from their most productive uses.

In this section, we focus on two specific areas in which regulatory capital

requirements may have had unintended effects on bank portfolio risk and/or created allocative inefficiencies. These are (1) the explosive growth of securitization in the 1980s, and (2) the so-called `cred it crunch' or reduction in commercial lending by U.S. banks in the early 1990s. Changes in regulatory ca pital requirements have been cited in the trade press and academic literature as major factors behind both of these developments. Before turning to these two issues, however, we discuss a necessary condition for regulatory capital requirements to have **any** consequences -- that they be binding.

Are Regulatory Capital Requirements Binding?

Regulatory capital re quirements matter only to the extent that they effectively constrain a signi ficant portion of the banks, raising capital or otherwise affecting the behavior of these banks beyond mark et capital `requirements'. Here we make precise what we mean by `binding' regulatory capital requirements and discuss some empirical research on this topic.

Recall that we defined a bank's market capital `requireme nt' as the capital ratio that maximizes the value of the bank in the absence of regulatory cap ital requirements (and the mechanisms used to enforce them), but in the presence of the rest of the regulatory structure that protects the safety and soundnes s of banks. We will say that regulatory capital requirements are `binding' if the capital ratio that maximizes the bank's value in the presence of regulatory capital requirements -- the `effective' regulatory capital requirement -- is greater than the bank's market capital `requirement'.

The `effective' regulatory capital requirement is difficult to measure because it may include a buffer above the regulatory capital minimum to allow the bank to exploit unexpected profitable investment opportunities and to cushion the effects of unexpected negative shocks as in the discussion of financial slack above. The buffer may be substantial if the regulatory penalties for falling below the minimum are very costly and if the transactions costs of raising capital quickly are very high. [26]

It is difficult to determine empirically whether capital requirements are binding in this sense, but a number of studies have attempted to show whether regulatory capital requirements raised the amount of capital held. The studies of the capital-to-asset requirements of the 1980s generally suggested that these standards were effective in raising capital-to-asset ratios (e.g., Wall and Peterson 1987). Wall and Petersen (1995) below address the question of whether RBC and other regulatory changes in the early 1990s affected large bank holding companies (BHCs). Their method involves estimating disequilibrium models for each year. Each BHC is assigned a probability as to whether the regulatory regime or the market regime is dominant in determining its capital ratio. They find that the regulatory regime is dominant in most cases, suggesting that regulatory capital requirements often were binding.

Securitization

Securitization is the transformation of traditional, non-traded bank assets into

[26]The `effective' regulatory capital ratio may be greater because of increases in the capital ratio numerator (e.g., more equity or subordinated debt), reductions in the denominator (fewer assets or smaller RWA), or both.

marketable securities. Securitization may involve off-balance sheet guarantees such as standby letters of credit or loan commitments that backup issuance of commercial paper. These off-balance sheet guarantees facilitate the borrower's access to other sources of funds by adding the credit enhancement of t he bank. This permits a partial `unbundling' of the package of services combined in a tr aditional bank loan. The bank retains the responsibility for evaluating, monitoring, and bearing most of the credit risk, but other parties provide the funds. Loan sales without recourse accomplish a further unbundling of the loan package. A bank originates a loan just as in the traditional case, but then sells the loan contract, along with the responsibility for monitoring and bearing credit risk, to another party.

Regulatory capital standards may have played a role in the expansion of both types of securitization in t he 1980s. Off-balance sheet guarantees were not subject to capital requirements in the 1980s, so shifting from loans to these guarantees may have provided a way to reduce effective regulatory capital requirements. A bank could continue to be compensated fo r providing monitoring services and bearing credit risk, but without regulatory capital requirements on part of its portfolio.

Off-balance sheet guarantees also tend to raise a bank's market capital `requirement', independent of regulatory requirements. This is because off-balance sheet guarantees give a senior claim to the beneficiaries of the guarantees, letting them keep the securitized asset in the event of bank failure (Benveniste and Berger 1987). This increases the risk of financial distress to the bank's creditors and shareholders, and therefore tends to raise market capital `requirements' for the bank.

Thus, when effective regulatory capital requirements exceed market `requirements', a shift toward off-balance guarantees tends to bring effective regulatory and market requirements closer together both by lowering regulatory requirements and by raising market requirements.

Capital standards in the 1980s led to allocative inefficiency by favoring the use of off-balance sheet guarantees even when it may have been more efficient to provide traditional bank loans. Moreover, off-balance sheet guarantees allowed banks with binding regulatory capital requirements to increase portfolio credit risks.

Loan sales without recourse may also reduce a bank's effective regulatory capital requirements. However, there are three important differences between securitization by loan sales and securitization by means of off-balance sheet guarantees. First, loan sales generally raise the market and/or regulatory capital requirement for the party that buys the loan, since this type of securitization transfers the credit risk away from the selling bank. Second, loan sales generally **lower**, rather than raise the market capital `requirement' for the selling bank because the bank's credit risk is reduced. Third, the opportunity to reduce regulatory capital requirements through loan sales is **not** likely to lead to significant allocative inefficiency or inappropriate risk-taking since the risk is transferred to the buyers who are subject to market and/or regulatory capital requirements.

One of the purposes of the Basle Accord on risk-based capital was to correct some of the allocative inefficiencies and risk-taking incentives associated with off-balance sheet guarantees. For example, a standby letter of credit that guarantees

financial performance is now subject to the same capital requirements as if the bank instead extended a loan of the same magnitude to the counterparty of the guarantee. But the risk-based standards may have created other distortions. For example, Avery and Berger (1991a) showed that the requirement that loan commitments of more than one year have 50% as much capital as loans to the same borrower may discourage long-term commitments unduly, and perversely penalize relatively safe banks.

A number of studies have tested various hypotheses regarding securitization activity, including the `regulatory tax hypothesis' that capital requirements and other regulatory incentives contributed significantly to the growth of financial guarantees and loan sales in the 1980s. The research generally suggests that the probability that a bank issued standby letters of credit was not significantly related to whether the bank was above or below the regulatory capital standards. However, the quantity of standbys (given that some were issued by the bank) did appear to be influenced by whether the bank was below regulatory standards. The research on loan commitments generally suggests that capital requirements had little or no effect on commitment activity. Research on loan sales is mixed. Early research suggested loan sales increased when a bank was below the minimum regulatory capital requirement. However, more recent research has shown that loan sales actually declined with the introduction of risk-based capital requirements, even though they led to the sharpest increase in capital for the large banks that dominate the loan sales market. These findings suggest that regulatory capital standards were not particularly important in

explaining fluctuations in this market. [27]

Two of the papers below take this line of research in new directions. Jagtiani et al (1995) model securitization activities as innovations with logistic diffusion cycles, similar to the familiar models of consumer adoption of electronic products. They then test whether changes in capital requirements affected the diffusion paths using models of the behavior of both the whole industry and individual banks. They find that changes in capital requirements had little effect on either off-balance sheet guarantees or loan sales. These results, which are broadly consistent with the previous literature, suggest that securitization is driven more by economic factors than regulatory factors. [28]

Carlstrom and Samolyk (1995) show that market capital `requirements' function similarly to regulatory requirements, encouraging loan sales even in the absence of regulatory requirements. In their model, loan sales arise when banks that have comparative advantages in lending to local, information-problematic borrowers have insufficient capital to make all such loans. By selling loans to banks that are flush with capital, the capital-deficient banks are able to exploit their comparative advantages in lending and still maintain sufficient capital to reassure markets about the safety of their remaining loans that are not sold.

Carlstrom and Samolyk's results call into question some earlier empirical work which concluded that regulatory capital requirements caused much of the growth in

---

[27]See Berger and Udell (1993) for a summary of this research.

[28]Jagtiani et al also find that economic factors are more important than regulatory capital requirements for derivatives activities such as swaps, futures, and forwards, although such contracts raise somewhat different concerns than securitization because they are not substitutes for on-balance sheet financing.

securitization. If banks with capital below the regulatory minimums have, on average, capital that is also low relative to market `requirements', an econometric identification problem arises which has not been well addressed in the empirical studies. The finding that banks which violate the regulatory capital minimums are more often engaged in securitization could reflect a response to either regulatory or to market forces.[29]

The `Credit Crunch'

The contraction in bank lending in the early 1990s may have been another unintended outcome of changes in regulatory capital requirements. Some observers have interpreted the observed shift from commercial and industrial loans into Treasury securities and other assets as a consequence of the implementation of risk-based capital (RBC) requirements. Under RBC, commercial loans are assigned a 100% risk weight which requires the most capital, while Treasuries are assigned a 0% risk weight which requires no capital. This creates an incentive to substitute from loans to Treasuries. In addition, the prompt corrective action feature of FDICIA -- which mandates increasingly severe regulatory penalties on banks as their RBC ratios fall -- accentuates the incentives to substitute from commercial lending into Treasuries and other assets in lower risk-weight categories. Clearly, some reduction in commercial loans extended by weakly capitalized banks should be regarded as an **intended** consequence of RBC and FDICIA. But the magnitude and extent of the reduction in loans -- large enough to be termed a `credit crunch' by some observers -- may have been

[29]This problem does not affect Jagtiani et al. (1995), since they are able to identify changes in regulatory capital requirements by the dates that these regulations went into effect.

an **unintended** consequence of these policies. [30]

In addition to the implementation of RBC and FDICIA, regulatory capital actions based on leverage ratios may also have contributed to a significant reduction in the supply of commercial credit by banks. The 1990 leverage requirement -- which mandated that banks hold capital of at least 3% against **unweighted** assets -- gave incentives for some banks to shrink their asset portfolios. Moreover, because the amount by which the required leverage capital ratio exceeded 3% depended upon the bank's examination rating and the discretion of the regulator, banks may also have switched out of assets with high perceived credit risks, such as commercial loans, and into safer assets, such as Treasuries. It is sometimes alleged that supervisors became tougher on individual banks in the early 1990s and required higher capital-to-asset ratios even before the official leverage requirements were in place. [31]

A number of other hypotheses unrelated to increases in regulatory capital requirements could also explain the observed reduction in commercial lending in the early 1990s. Briefly, these include the depletion of bank capital from loan loss experiences of the late 1980s (e.g., Peek and Rosengren 1994, 1995a), tightened examination criteria and loan loss reserve policies by regulators (e.g., Bizer 1993), a voluntary reduction in risk by bank managers (e.g., Hancock and Wilcox 1993, 1994b), a reduction in loan demand by business because of macroeconomic/regional recessions

---

[30]See Haubrich and Wachtel (1993), Berger and Udell (1994), and Hancock and Wilcox (1994a) for tests of whether RBC caused a `credit crunch'.

[31]See Berger and Udell (1994), Peek and Rosengren (1994, 1995a), and Hancock and Wilcox (1994a) for tests of whether regulatory leverage requirements caused a `credit crunch'.

(e.g., Bernanke and Lown 1991, Hancock and Wilcox 1993), and/or a secular decline in the demand for bank loans because of the growth of alternative sources of credit (e.g., Berger and Udell 1994).

Unfortunately, it is difficult to disentangle the effects of the hypotheses based on changes in regulatory capital requirements from each other and from the other hypotheses. To date, the evidence appears to suggest that the implementation of RBC did not cause a large reduction in lending, but that the leverage capital requirement may be responsible for a significant portion of the observed change in portfolio behavior.[32] Nevertheless, there is still much disagreement regarding these conclusions, leaving ample room for additional research.

The two empirical papers below on the `credit crunch' investigate the effects of the regulatory leverage requirements in new ways. Hancock et al (1995) trace the dynamic pattern of how bank portfolios reacted to capital shocks in the late 1980s and early 1990s and find some notable changes. Specifically, the response of banks to unanticipated drops in capital was more rapid in the early 1990s than in the late 1980s, especially for banks with capital-to-asset ratios below 5 percent. That is, banks cut back lending more quickly in reaction to a loss of capital in the early 1990s, particularly banks that were at or below regulatory capital-to-asset ratios. This is consistent with a regulator-induced cred it crunch in which implementation of tougher leverage standards reduced lending in the early 1990s. However, without specific

[32]Evidence in support of these tentative conclusions includes the finding that RBC capital ratios are not consistently related to the change in lending behavior between the 1980s and the early 1990s, but that the leverage ratio often is related to this change.

information regarding regulatory sanctions, it is virtually impossible to distinguish between such a regulatory effect and the possibility that ma rket capital `requirements' may also have tightened in the early 1990s.

Peek and Rosengren (1995b) provide evidence that helps resolve this uncertainty about whether bank responses to capital shortfalls were primarily driven by regulatory versus market forces. They gathered data on regulatory enforcement actions in New England from 1989 through the early 1990s -- the time and region which is most often identified with the `credit crunch'. Regulato ry enforcement actions almost always included a mandate to improve the bank's capital-to-asset ratio, typically to a level of at least 6%. Thus, if banks under enforcement actions reduced their lending significantly more than similarly situated banks that were not under such orders, this would be evidence in favor of a regulatory-induced credit crunch, as opposed to a market reaction to economic factors. Peek and Rosengren do find that banks under enforcement actions r educed lending more than other banks in the same region with the same capital-to-asset ratios, suppor ting the hypothesis that regulatory actions contributed to the credit crunch. [33] Their analysis is somewhat limited by the difficulty of controlling for all the factors that might affect market capital requirements, but it provides a promising approach to disentangling regulatory and market influences.

A complete understanding of how capital requirements affect lending requires a broader analysis of how the supply and demand for loans interact. Thakor and

[33]This result is also consistent with a Wall and Peterson (1995) finding that banks subject to regulatory orders raised more capital than other banks.

Wilson (1995) take the reduction in loan supply caused by risk-based capital as the starting point for analysis and examine the supply-demand interactions. They show that an increase in capital requirements will cause banks to be less willing to renegotiate loans in the future. This anticipated contraction in future supply of loans may have substantial effects on the quantity of loans issued in the present. Specifically, borrowers that are most likely to need renegotiation services in the future may voluntarily shift from bank loans to issue debt directly in the capital markets, although such borrowers may experience difficulty in gaining access to capital markets (Carey et al 1993). This analysis adds another dimension to debate over whether and how regulatory changes may have reduced bank lending.

VII. Conclusions

The capital structure of financial institutions is determined in part by the same departures from the frictionless world of M&M that determine the capital structures of other firms -- taxes, expected costs of financial distress, transactions costs, and signaling behavior and agency problems arising from asymmetric information between shareholders and creditors and between owners and managers. If raising capital quickly is costly for any of these reasons, then financial institutions may hold additional capital as financial slack to take advantage of unexpected profitable opportunities or to guard against unexpected losses. However, banks differ from other firms in two important respects that affect their capital structures -- (1) the presence of the regulatory safety net that protects the safety and soundness of banks and likely lowers bank capital, and (2) regulatory capital requirements that raise the capital of

some banks.

We have defined a bank's m arket capital `requirement' as the ratio of equity to assets that maximizes the value of the bank to distinguish it from regulatory capital requirements. The safety net for banks -- which includes federal deposit insurance, unconditional payment guarantees, access to the discount window, and other bank safety regulations (other than capital regulation) -- likely lowers market capital `requirements' by insulating banks from potential market discipline. This may help explain why banks generally have the lowest equity-to-asset ratios of firms in any industry, including financial institutions with similar portfolios that do n ot have access to the safety net. Our review of the historical evolution of bank capital ratios is consistent with the hypothesis that the introduction of various components of the safety net played an importa nt role in the century-long decline in bank capital ratios.

Regulatory capital requirements are motivated by two main co ncerns. First, the safety net, particularly the deposit insurance component, makes the government the largest uninsured creditor of most U.S. banks. Regulatory capital requirements are a means to limit the risk exposure of the government and the taxpayers that stand behind it in much the same way that market capital `requirements' protect other creditors. Second, regulatory capit al requirements protect the economy from negative externalities caused by bank failures, especially systemic risk. Regulatory capital requirements, along with the safety net, help protect the financial system and real economy from the destructive effects of contagious bank runs on solvent, but illiquid banks.

Unfortunately, regulatory capital requirements are a rather blunt tool for controlling bank risk taking. Capital is difficult to define, measure, and monitor. Ideally, financial instruments that coun t as regulatory capital should provide a buffer against loss to the government, serve as `patient money' that cannot be redeemed during a financial crisis, and help discipline bank risk-taking behavior. Equity and subordinated debt are the most plausible candidates for inclusion as regul atory capital, but neither meets all three objectives perfectly.

Both the numerator and denominator of regulatory capital ratios pose significant measureme nt problems. The `regulatory value of equity' to be used in the numerator depends on the market values of all on- and off-balance sheet assets and liabilities adjusted for limited liability. Because banks specialize in lending to and providing guarantees for informa tionally opaque borrowers, the values of bank assets are difficult to measure and monitor. The denominator of the capital ratio -- the variability of the regulatory value of equity -- is even more difficult to measure, but some progress is being made.

Because binding regulatory capital requirements are c ostly, they involve a long-run social tradeoff between the benefits of reducing the risk of the negative externalities from bank failures and the costs of reducing bank intermediation. Inaccuracies in setting capital requirements may worsen this tradeoff because higher capital is needed on average to achieve a given level of safety, thus reducing intermediation.

Problems in setting regu latory capital requirements may have some additional unintended cons equences. Capital requirements may give incentives for some banks

to increase their risks of failure. Moreover, inaccuracies in setting capital requirements distort relative prices and may create allocative inefficiencies that divert financial resources from their most productive uses. During the 1980s, capital requirements may have created artificial incentives for banks to take off-balance sheet risks, and changes in capital requirements in the 1990s may have contributed to a credit crunch.

This introductory article has emphasized many of the unresolved issues concerning the role of capital in financial institutions. The articles which follow represent some of the best current efforts to advance this research agenda. They enhance our understanding of how market and regulatory capital requirements affect financial institution behavior and highlight additional questions that remain a challenge to future research.

REFERENCES

Acharya, S., 1988, "A generalized econometric model and tests of a signalling hypothesis with two discrete signals," Journal of Finance, 43, (June): 413-429.

Acharya, S. and J. Dreyfus, 1989, "Optimal bank reorganization policies and pricing of federal deposit insurance," Journal of Finance, 44, (December): 1313-1333.

Avery, R.B., T.M. Belton, and M.A. Goldberg, 1988, "Market discipline in regulating bank risk: New evidence from the capital markets," Journal of Money, Credit, and Banking, 20 (November): 597-610.

Avery, R.B., and A.N. Berger, 1991a, "Loan commitments and bank risk exposure, Journal of Banking and Finance, 15 (February): 173-193.

Avery, R.B., and A.N. Berger, 1991b, "Risk-based capital and deposit insurance reform," Journal of Banking and Finance, 15 (September): 847-874.

Barth, M.E., W.L. Landsman, and J.M. Whalen, 1995, "Fair value accounting: Effects on banks' earnings volatility, regulatory capital, and value of contractual cash flows," Journal of Banking and Finance, 19, (April).

Benston, G.J., D. Brumbaugh, J. Guttentag, R. Herr ing, G. Kaufman, R. Litan, and K. Scott, 1989, "Blueprint for restructuring America's financial institutions," Washington: Brookings Institution.

Benston, G.J., R. Eisenbeis, P. Horvitz, E.J. Kane, and G. Kaufman, 1986, "Perspectives on safe and sound banking: Past, present, and future," Cambridge, Mass.: MIT Press.

Benston, G. J. and G. Kaufman, 1995, "Is the banking and payments system fragile?" Journal of Financial Services Research, 9.

Benveniste, L.M., and A.N. Berger, 1987, "Securitization wit h recourse: An instrument that offers uninsured depositors sequential claims, " Journal of Banking and Finance, 11, 403-424.

Berger, A.N., 1995, "The relationship between capital and earnings in banking," Journal of Money, Credit, and Banking, 26 (May).

Berger, A.N., and S.M. Davies, 1994, "The inf ormation content of bank examinations," Board of Governors of the Federal Reserve Finance and Economics Discussion Series (FEDS) paper 94-20 (July).

Berger, A.N., and T.H. Hannan, 1989, "The price-concentration relationship in banking," Review of Economics and Statistics, 71 (May): 291-299.

Berger, A.N., K.K. King, and J.M. O'Brien, 1991, "The limitations of market value accounting and a more realistic alternative," Journal of Banking and Finance, 15 (September): 753-783.

Berger, A.N., and G.F. Udell, 1993, "Securitization, risk, and the liquidity problem in banking," in M. Klausner and L.J. White , eds. Structural Changes in Banking, Irwin Publishing, Homewood, IL, 227-291.

Berger, A.N., and G.F. Udell, 1994, "Did risk-based capital allocate bank credit and cause a `credit crunch' in the U.S.?," Journa l of Money, Credit, and Banking, 26 (August): 585-628.

Bernanke, B.S., 1983, "Non-m onetary effects of the financial crisis in the propagation of the great depression," American Economic Review, 73, 257-76.

Bernanke, B.S. and A. Blinder, 1992, "The federal funds rate and the channels of monetary transmission," American Economic Review, 82, (Sep tember): 901-921.

Bernanke, B.S., and C.S. Lown, 1991, "The credit crunch," Brookings Papers on Economics Activity,:2, 205-248.

Bhattacharya, S. and A.V. Thakor, 1993, "Contemporary banking theory," Journal of Financial Intermediation, 3, 2-50.

Bizer, D.S., 1993, "Regulatory discretion and the credit crunch," working paper, U.S. Securities and Exchange Commission, Washington DC (April).

Black, F., M. Miller and R. Posner, 1978, "An Approach to the Regulation of Bank Holding Companies," Journal of Business, 51 (July): 379-412.

Bradley, M.G., C.A. Wambeke, and D.A. Whidbee, 1991, "Risk weights, risk-based capital and deposit insurance," Journal of Banking and Finance, 15 (August): 875-893.

Buser, S.A., A.H. Chen, and E.J. Kane, 1981, "Federal deposit insurance, regulatory policy, and optimal bank capital," Journal of Finance, 36 (March): 51-60.

Carey, M.S., 1993, "Snacking and smoothing: Gains trading of investment account securities by commercial banks," Board of Governors of the Federal Reserve working paper (July).

Carey, M.S., 1995, "Partial market value accoun ting, bank capital volatility, and bank risk," Journal of Banking and Finance, 19, (April).

Carey, M.S., S. Prowse, J. Rea, and G. Udell, 1993, "The economics of private placements: A new look," Financial Instruments, Institutions, and Markets, 2.

Carlstrom, C., and K. Samolyk, 1995, "Loan sales as a response to market-based capital requirements,"Journal of Banking and Finance, 19, (April).

Chan, Y., S.I. Greenbaum, and A.V. Thakor, 1992, "Is fairly priced deposit insurance possible?" Journal of Finance, 47, (March): 227-45.

Chen, Y., S.I. Greenbaum, and A.V. Thakor, "Is fairly priced deposit insurance possible?," Journal of Finance, 47 (March): 227-245.

Cole, R.A., and J.W. Gunther, "Separating the likelihood and timing of bank failure," Journal of Banking and Finance, 19 (1995), forthcoming.

Cook, D.O., and L.J. S pellman, 1994, "Repudiation risk and restitution costs: Toward understanding premiums on insured deposits," Journal of Money, Credit and Banking, 26: 439-59.

Cordell, L.R., and K.K. King, 1995, "A market evaluation of the risk-based capital standards for the U.S. financial system," Journal of Banking and Finance, 19 (April).

Cummins, J.D., S.E. Harrington, and R. Klein, 1995, "Risk-based capital, insolvency experience, and prompt corrective action in property-liability insurance," Journal of Banking and Finance, 19, (April).

Dahl, D., 1993, "Managerial turnover and d iscretionary accounting decisions in banks with concentrated ownership," Proceeding of a conference on ba nk structure and competition, Federal Reserve Bank of Chicago; Chicago, IL, 269-84.

Davies, S.M., and D.A. McManus, 1991, "The effects of closure policies on bank risk-taking," Journal of Banking and Finance, 15, (September) 917-938.

DeAngelo, H. and R. Masulis, 1980, "Optimal capital structure under corporate and personal taxation," Journal of Financial Economics, 8, (March): 5-29.

Diamond, D.W., 1984, "Financial intermediation and delegated monitoring," Review of Economic Studies, 51, (July): 393-414.

Ellis, D.M., and M.J. Flannery, 1992, "Does the debt market assess large banks' risk? Time series evidence from money center CDs, Journal of Monetary Economics, 30 (December): 481-502.

Evanoff, D., 1991, "Subordinated debt: The overlooked solution for banking," Chicago Fed Letter No. 45, Federal Reserve Bank of Chicago, Chicago, IL (May).

Flannery, M.J., 1994, "Debt maturity and the deadweight cost of leverage: Optimally financing banking firms," American Economic Review, 84 (March): 320-31.

Flannery, M.J., and S.M. Sorescu, 1994, "Detecting bank market discipline using subordinated debenture yields: 1983-1991," University of Florida working paper, November.

Furlong, F.T., and M.C. Keeley, 1989, "Capital regulation and bank risk-taking: A note," Journal of Banking and Finance, 13 (December): 883-891.

Gale, D. and M. Hellwig, 1985, "Incentive compatible debt contracts: The one-period problem," Review of Economic Studies, 52: 647-63.

Garcia, G., 1995, "Implementing FDICIA's mandatory closure rule," Journal of Banking and Finance, 19 (April).

General Accounting Office, 1990, Report to the Congress on the Bank Insurance Fund, GAO/AFMD-90-100 (September).

Gennotte, G., and D. Pyle, 1991, " Capital controls and bank risk," Journal of Banking and Finance, 15, (September): 805-824.

Gorton, G., and A.M. Santomero, 1990, "Market discipline and bank subordinated debt," Journal of Money, Credit, and Banking, 22: 119-28.

Grossman, S., and O. Hart, 1982, "Corporate financial structure and managerial incentives," in J. McCall, ed., The economics of information and uncertainty, Chicago: University of Chicago Press, 1982.

Guttentag, J. and R. Herring, 19 87, "Emergency liquidity assistance for international banks," in R. Portes and A.K. Swoboda, eds. Threats to international financial stability, Cambridge University Press, 150-194.

Hancock, D., A. Laing, and J.A. Wilcox, 1995, "Bank balance sheet shocks and aggregate shocks: Their dynamic effects on bank capital and lending," Journal of Banking and Finance, 19, (April).

Hancock, D., and J.A. Wilcox, 1993, "Has there been a `capital cru nch' in banking? The effects on bank lending of real estate market conditions and bank capital shortfalls," Journal of Housing Economics, 3: 31-50.

Hancock, D., and J.A. Wilcox, 1994a, "Bank capital and the credit crunch: The roles of risk-weighted and u nweighted capital regulations," AREUEA, 22 (January): 59-94.

Hancock, D., and J.A. Wilcox, 1994b, "Bank capital, loan delinquenci es, and real estate lending," Journal of Housing Economics, 4: 121-46.

Hannan, T.H., 1991, "Bank commercial loan markets and the role of market structure: Evidence from surveys of commercial lending," Journal of Bank ing and Finance, 15: 133-49.

Hannan, T.H., and G.A. Hanweck, 1988, "Bank insolvency risk and the market for large certificates of deposit," Journal of Money, Credit, and Banking, 20, 203-11.

Harris, M., and A. Raviv, 1990, "Cap ital structure and the informational role of debt," Journal of Finance, 45, (June): 321-349.

Harris, M. and A. Raviv, 1991, "The theory of capital structure," Journal of Finance, 46 (March): 297-355.

Haubrich, J., and P. Wachtel, 1993, "Capital requirements and shifts in commercial bank portfolios," Federal Reserve Bank of Cleveland Economic Review, 29 (Quarter 3,): 2-15.

Haugen, R., and L. Senbet, 1978, "The insignif icance of bankruptcy costs to the theory of optimal capital structure," Journal of Finance, (May): 383-393.

Herring R. and P. Vankudre, 1987, "Growth opportunities a nd risk-taking by financial intermediaries," Journal of Finance, 42 (July): 583-99.

Horvitz, P., 1983, "Deposit insurance after deregulation," Proceedings of the 9th annual conference of the Federal Ho me Loan Bank of San Francisco, December 1983.

Ibbotson, R.G., J.L. Sindelar, and J.R. Ritter, 1988, "Initial public offerings," Journal of Applied Corporate Finance, 1 (Summer).

Jagtiani, J., A. Saunders, and G.F. Udell, 1995, "Bank off-balance sheet financial innovations and the role of capital," Journal of Banking and Finance, 19, (April).

James, C., 1987, "Some evidence on the uniqueness of bank loans," Journal of Financial Economics, 19, 217-236.

James, C., 1991, "The losses realized in bank failures," Journal of Finance, 46 (September): 1223-1242.

Jensen, M.C., 1986, "Agency costs of free cash flow, corporate finance, and takeovers," American Economic Review, 76, 323-329.

Jensen, M.C., 1986, "Agency costs of free cash flow, corporate finance, and takeovers," American Economic Review, 76, 323-329.

Jensen, M. and W. Meckling, 1976, "Theory of the firm: Managerial behavior, agency costs and ownership structure," Journal of Financial Economics, 3: 305-60.

John, K., A.M. Saunders, and L.W. Senbet, 1995, "A theory of capital regulation and bank management compensation," Journal of B anking and Finance, 19, (April).

Jones, D.S., and K.K. King, 1995, "The implementation of prompt corrective action," Journal of Banking and Finance, 19, (April).

Kane, E.J., 1995, "Three paradigms for the role of capitalization requirements in insured financial institutions," Journal of Banking and Finance, 19, (April).

Kaufman, G., 1194, Bank Conta gion: A review of the theory and evidence, Journal of Financial Services Research, 8 (April): 123-150.

Kaufman, G., 1995, "FDICIA and bank capital," Journal of Banking and Finance, 19 (April).

Keeley, M.C., and F.T. Furlong, 1990, "A reexamination of mean-variance analysis of bank capital regulation," Journal of Banking and Finance, 14 (March): 69-84.

Keeton, W.R., "Substitutes and complements in bank risk-taking and the effectiveness of regulation," Federal Reserve Bank of Kansas City working paper, December 1988.

Kim, D., and A.M. Santomero, 1988, "Risk in banking and capital regulation," Journal of Finance, 43, 1219-33.

Koehn, M., and A.M. Santomero, 1980, "Regulation of bank capital and portfolio risk," Journal of Finance, 43 (December): 1235-44.

Kuester, K.A., and J.M. O'Brien, 1990, "Market based deposit insurance premiums," Proceeding of a conference on bank structure and competition, Federal Reserve Bank of Chicago; Chicago, IL, 62-95.

Kwan, S.H., and R.A. Eisenbeis, 1995, "An analysis of inefficiencies in banking," Journal of Banking and Finance, 19, (April).

Lane, W.R., S.W. Looney, and J.W. Wansley, "An application of the Cox proportional hazards model to bank failure," Journal of Banking and Finance, 10 (December 1986): 511-31.

Leland, H., and D. Pyle, 1977, "Information asymmetries, financial structure and financial intermediation," Journal of Finance, 32 (May): 371-87.

Litan, R., 1987, What should banks do?, Washington: Brookings Institution.

Merton, R.C., 1995, "Financial innovation and the management and regulation of financial institutions", Journal of Banking, and Finance, 19, (April).

Miller, M.H., 1977, "Debt and taxes," Journal of Finance, 32, (May): 261-276.

Miller, M.H., 1995, "Do the M&M propositions apply to banks?", Journal of Banking, and Finance, 19, (April).

Modigliani, F. and M. Miller, 1958, "The cost of capital, corporation finance, and the theory of investment," American Economic Review, (June): 261-297.

Myers, S.C., 1977, "Determinants of corporate borrowing," Journal of Financial Economics, 5 (November): 147-175.

Myers, S.C., and N.C. Majluf, 1984, "Corporate financing and investment decisions when firms have information that investors do not have," Journal of Financial Economics, 13, 187-221.

Peek, J., and E.S. Rosengren, 1994, "Bank real estate lending and the New England capital crunch," AREUEA 22: 33-58.

Peek, J., and E.S. Rosengren, 1995a, "The capital crunch: Neither a borrower nor a lender be," Journal of Money, Credit and Banking, 27.

Peek, J., and E.S. Rosengren, 1995b, "Bank regulation and the credit crunch," Journal of Banking and Finance, 19, (April).

Pierce, J., 1991, The future of banking, New Haven: Yale University Press.

Ronn E., and A. Verma, 1986, "Pricing risk-adjusted deposit insurance: An options-based model," Journal of Finance, 41 (September): 871-895.

Ross, S.A., 1977, "The determination of financial structure: The incentive signalling

approach," Bell Journal of Economics and Management Science , 8 (Spring): 177-83.

Ross, S.A., 1987, "Finance," in J. Eatwell, M. Milgate, and P. Newman, New Palgrave, A Dictionary of Economics, London: Macmillan Press Ltd, volume 2: 322-336.

Ross S.A., 1989, "Institutional markets, financial marketing, and financial innovation," Journal of Finance, 44 (July): 541-66.

Santomero, A. and R. Watson, 1977, "Deter mining an optimal capital standard for the banking industry," Journal of Finance, 32 (September): 1267-82.

Szegö, G.P., 1994, "Financial regulation and multi-tier financial intermediation systems," in R. D'Ecclesia and S. Zenies (eds.), Operation Research Models and Quantitative Finance, Heidelberg: Physica Verlag, 36-64.

Szegö, G.P., 1995, "Risk-based capital in the European Economic C ommunity," Journal of Banking and Finance, 19, (April).

Thakor, A.V., and P.W. Furlong, 1995, "Capital requirements, loan renegotiation, and the borrower's choice of financin g source," Journal of Banking and Finance, 19, (April).

Thomson, J.B., 1991, "Predicting bank failures in the 1980s," Federal Reserve Bank of Cleveland Economic Review, 27 (Quarter 1, 9-20.

Townsend, R. 1979, "Optimal contracts and competitive markets with costly state verification," Journal of Economic Theory, 21, 265-93.

U.S. Treasury, 1991, Modernizing the financial system: Recommendations for safer, more competitive banks (February).

Wall, L.D., 1989, "A plan for reducing future deposit insurance losses: Puttable subordinated debt," Economic Review, Federal Reserve Bank of Atlanta (July/August): 2-17.

Wall, L.D., and D.R. Peterson, 1987, "The effect of capital adequac y guidelines on large bank holding companies," Journal of Banking and Finance, 11, 581-606.

Wall, L.D., and D.R. Peterson, 1995, "Bank holding company capital targets in the early 1990s: The regulators versus the markets," Journal of Banking and Finance, 19, (April).