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Bank Capital Requirements and the Riskiness of Banks: A Review

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Introduction

Banks are required to hold capital primarily as a buffer against future losses and in order to reduce the exposure of the deposit insurer. However, as regulators and researchers have recognized, changes in capital requirements also affect bank portfolio behavior. It is possible that increased capital requirements may lead banks to increase their riskiness and thus increase their expected losses or increase the potential exposure of the deposit insurer.

The object of this article is to show that the impact of increased capital requirements depends on the extent to which deposit costs reflect bank portfolio risk.[1] In particular, we show that with risk-based deposit insurance, the incentives to increase leverage or portfolio risk in response to an increase in bank capital requirements are reduced.

The article is organized as follows. First, we define bank capital and discuss the mechanisms through which it is intended to affect bank behavior. Next, we discuss the incentives for banks to decrease their capital buffer (increase their leverage). These incentives mainly stem from conflicts between the interests of creditors (depositors) and stockholders. We also show how these incentives are influenced by pricing deposit insurance. Previous research has shown that deposit insurance that is not adjusted for risk may encourage banks to increase their riskiness. We discuss previous research on the impact of increased capital requirements. We then present a model in which deposit costs are allowed to vary with risk, including the risk associated with leverage and, thus, with the capital buffer. By comparing our results with those of previous studies where explicit deposit costs do not vary with portfolio risk and leverage, we show that risk-based deposit insurance reduces the incentives to increase leverage or portfolio risk in response to an increase in bank capital requirement~We also show that risk-based deposit

■ 1 For uninsured deposits, deposit costs are the interest rate banks have to pay on the deposits. For insured deposits, the cost of a dollar of deposits is the interest rate paid on the deposits, plus the per-dollar deposit insurance premium.

■ 2 Even though we do not assume correctly priced deposit guarantees, we do not get perverse effects from risk-based premiums (see Pyle [1983]) because we assume that the FDIC does not make relative pricing errors (that is, that it can measure risk and price it consistently).

insurance reduces the variance of earnings and the expected loss to the federal deposit guarantor when banks fail.

Functions and Definitions of Bank Capital

Regulators define bank capital in terms of book values. The regulatory definition of bank capital usually includes claims on bank profits (equity), reserves on loans or securities, and long-term subordinated debt. The primary function of bank capital is to serve as a cushion against unanticipated losses on assets, thereby ensuring the solvency of the bank. Bank capital is also used to finance asset purchases and thus bank growth. Minimum capital requirements (measured in terms of capital-to-asset ratios) constrain bank growth when it is costly to raise capital by issuing stock. Otherwise, if the rate of return on assets exceeds the cost of funds, banks would try to increase size as much as possible. In this article, we focus on how capital requirements affect bank risk, rather than bank size.

Incentives for Banks to Engage in Risky Behavior

While banks in some ways may be different from other firms, banks' incentives to engage in risky behavior are in some ways similar to the incentives of nonfinancial corporations. In particular, in the absence of conflicts between stockholders and bondholders (depositors), total bank value maximization and bank equity value maximization lead to identical results. However, as Jensen and Meckling (1976) argue, conflicts arise between stockholders and bondholders that cause total bank value maximization and equity value maximization to differ. By increasing the risk of the bank's portfolio or by increasing financial leverage, stockholders may be able to reduce the risk-adjusted value of the depositor's claim on the bank and thereby reallocate wealth from depositors to the stockholders. Wealth is reallocated if the reduction in the value of the bank is less than the reduction in the value of creditor claims on the bank. This type of conflict is referred to as an agency problem in the finance literature.

In most models of bank behavior, banks maximize the market value of equity and thus have the incentive to increase the portfolio variance. Because the value of equity cannot fall below zero but can increase without limit, stockholders will choose investments with a greater likelihood of high profits, regardless of the chance of loss. Unlike stockholders, bondholders receive only the promised amount if returns are high, but lose increasingly more as returns fall below the total amount of their claim. Thus, creditors have an incentive to control stockholder behavior.

Any analysis of the impact of capital requirements must also consider the banks' incentives to increase leverage (that is, to minimize their capital holdings). If the cost of raising funds from issuing stock exceeds the cost of raising funds from deposits, stockholders will prefer to increase their asset holdings via deposits and thus lower their capital ratios. Lower capital ratios (higher leverage) increase the probability of bankruptcy and thus of losses to creditors. The cost of raising funds from deposits is influenced by the pricing of deposit insurance. When deposit insurance is not priced so as to reflect bank risk, we refer to it as being "mispriced." We contend that it is the mispricing of deposit insurance that is at least partially responsible for an incentive for increased leverage. It is this incentive that makes capital requirements binding.

At least for nonfinancial corporations, it is common practice for bond covenants to contain restrictions on stockholder/manager behavior (see Smith and Warner [1979]). In fact, capital requirements and restrictions on bank portfolios can be viewed as bond covenants designed to protect the creditors. On the other hand, creditors may be protected if interest rates reflect bank risk. Risk- or leverage-related deposit rates could influence stockholders' incentives to increase portfolio risk or leverage.

It is an accepted conclusion that fixed-rate deposit insurance encourages risky behavior. Even if the deposit insurance agency adjusts the deposit insurance premium so that banks on average pay high enough premiums to cover expected losses, safe banks subsidize risky banks. In the absence of "correct" pricing of deposit insurance, and given the unresolved agency conflict between creditors and stockholders, banks will attempt to maximize the subsidy provided by the deposit insurance agency by increasing portfolio variance and leverage.[3] In this situation, there is a rationale for restrictions on bank leverage. However, if deposit costs reflect the increased risk associated with higher leverage, capital restrictions may no longer be necessary or binding.

3 Correct pricing means that the deposit guarantor charges a deposit insurance premium equal lo the risk premium the market would charge for uninsured deposits (see Thomson [1987]).

Mathematical Models of the Impacts of Increased Capital Requirements

Most mathematical models of the impacts of increased capital requirements assume that the bank is run for the benefit of the owners or stockholders. The creditors (depositors and deposit guarantors) are viewed as passive, perhaps being protected somewhat by bank portfolio restrictions designed to limit the ability of banks to engage in risky activities and the covariation of deposit costs with portfolio risk. Without an explicit model of either the creditors' position (for example, the market value of their claim) or the exact nature of the agency conflict, these analyses cannot explain the financial structure or capital position of the bank. The unresolved agency conflict pushes the capital-asset ratio towards its minimum.

The impact of capital regulation also depends on the overall regulatory structure. Both the difficulty of monitoring banks and uncertainty about the willingness of the guarantors to honor explicit and implicit guarantees play a role (see Kane [1986]). Pyle (1986) and Merton (1977) show how the value of deposit insurance depends on the closure policy and auditing frequency. Pennacchi (1987) shows how banks' preferences for greater leverage depend on the regulator's closure policy.

In our model, as well as in the models we survey below, the bank is closed at the end of a finite period of time. If the gross return on assets is insufficient to pay off depositors, the insurer provides the difference. In effect, these studies simplify the analysis by assuming that insolvent banks are closed and that there are no monitoring difficulties or uncertainties about closure.

A relatively early study by Koehn and Santomero (1980) viewed banks as utility-maximizers. They concluded that increased capital requirements would lead to increased asset risk, and possibly to increased risk of bank failure. However, interest rates did not reflect increased riskiness, as we would expect if deposits were uninsured. Neither was there an explicit treatment of deposit insurance. Keeley and Furlong (1987) emphasize the problems with the utility-maximization approach.

Karenken and Wallace (1978) utilize the state-preference framework and assume that the deposit rate is fixed. However, due to the presence of the deposit-insurance subsidy, the net deposit cost varies with asset risk and leverage. Lower leverage or lower asset risk decreases the probability of bankruptcy and hence the value of the subsidy.

A third approach utilizes the cash-flow version of the Capital Asset Pricing Model (Lam and Chen [1985]). Deposit interest rates vary but do not necessarily reflect asset risk or leverage. Hence, there may still be a subsidy provided by deposit insurance. Nonetheless, the covariation between deposit rates and the rate of return on assets plays a role in the bank's portfolio decisions. When deposit interest rates covary with the return on the bank's portfolio, the marginal return associated with increased asset risk or leverage is reduced. Therefore, the impact of increased capital requirements on bank risk and the probability of bankruptcy depends on whether interest rates are held fixed or whether they covary with the rates earned on assets.

Deposit Insurance Pricing

A separate body of research shows how deposit insurance should be priced. Merton (1977) models deposit insurance as a put option, showing how the value of the put option, and thus the position of the insurer, varies with the bank's leverage and portfolio risk.[4] Since increased leverage implies greater expected costs to the insurer, with correctly priced deposit insurance the premium charged each bank increases with bank leverage and portfolio risk, where the portfolio risk is measured as the variance of the earnings on assets. With correct pricing, there is no subsidy to the banks. Higher leverage results in higher insurance premiums, ameliorates the incentives to increase leverage, and modifies the impact of increased capital requirements.

I. The Joint Effects of Capital Requirements and Risk-Based Deposit Insurance on Optimal Bank Portfolios

The Model

In Osterberg and Thomson (1988) the cash-flow version of the Capital Asset Pricing Model (CAPM) used by Lam and Chen was modified to allow for an endogenously determined cost of deposits. The cost of deposits varies in a manner

■ 4 A put option is a contract that gives its holder the right to sell an asset at a predetermined pice to the issuer of the option on or before a specified date. It represents a right but not an obligation to sell the asset.

similar to that suggested by the literature discussing the "correct pricing" of deposit insurance (for example, Merton [1977]). By comparing the results of our paper with those of previous studies where explicit deposit costs do not vary with portfolio risk and leverage (Lam and Chen [1985], and Koehn and Santomero [1980]), we show how risk-based deposit insurance changes the incentives to increase leverage or portfolio risk (as measured by the variance of earnings) in response to an increase in bank capital requirements.

The organization of the model and the basic results are presented below. As in our earlier paper, we make the usual assumptions necessary for the CAPM to hold. Furthermore, we assume that bankruptcy costs and taxes are zero and that the bank is operated by its owners.[5] The owners seek to maximize the value of bank equity, V, which has three components:

$$(1)\quad V = \frac{1}{R}\,[E(\tilde{\pi}) - \lambda CV(\tilde{\pi},\tilde{W}) - \lambda CV(\tilde{\pi},\tilde{\pi})], \text{ with}$$

$$CV(\tilde{\pi},\tilde{W}) = \sum_{j=1}^{n} A_j\,\sigma_{j,w},$$

$$CV(\tilde{\pi},\tilde{\pi}) = \sum_{i=1}^{n}\sum_{j=1}^{n} A_i A_j\,\sigma_{i,j},$$

and A_i = amount invested asset i,
$\sigma_{i,j}$ = covariance between rates of return on asset i and j;
$\sigma_{j,w}$ = covariance between rates of return on asset j and cash flows of all other firms;
R = one plus the risk-free rate;
$\tilde{M}$ = aggregate cash flow of all firms in the market;
$\tilde{\pi}$ = cash profit of the bank;
$E(\tilde{\pi})$ = expected value of cash profit;
λ = market price of risk-bearing services;
$\tilde{W}$ = aggregate cash flow in the market, excluding the bank.

As in Lam and Chen (1985), the covariance between the cash profit of the bank and the aggregate cash flow of all firms, $CV(\tilde{\pi},\tilde{M})$ is partitioned into internal portfolio risk $CV(\tilde{\pi},\tilde{\pi})$ and external risk $CV(\tilde{\pi},\tilde{W})$ by separating the aggregate cash flows $\tilde{M}$ into $\tilde{\pi}$ and $\tilde{W}$, where $\tilde{W}$ is the aggregate cash flows in the market, excluding the bank. This allows us to isolate the risk of the asset portfolio (internal risk) from market risk in the maximization problem.

5 The owner-manager assumption is used to resolve the agency problem that may exist between outside stockholders and managers (see Jensen and Meckling [1976]).

Suppose that there are N risky assets in which the bank can invest. Let $\tilde{r}_j$ be the uncertain return on asset j. Furthermore, the bank issues only insured deposits, D, and a fixed amount of capital, K. The bank pays its deposit guarantor (henceforth, the FDIC) a premium of g per dollar of deposits. Its expected cash profits at the end of the period are

$$(2)\quad E(\tilde{\pi}) = \sum_{j=1}^{n} \bar{r}_j A_j - (R+g)D.$$

The deposit insurance premium, g, varies with the bank's leverage and asset portfolio decisions (internal risk). We assume that the bank knows how its choices influence g, and thus what g results from its asset portfolio and capital structure decisions.

We can view the minimum ratio of deposits to capital, $C \equiv D/K$, as a covenant imposed on the bank by the FDIC in exchange for its deposit guarantees. A second restriction is the balance-sheet constraint that sources of funds must equal uses of funds. Thus, the problem facing the bank is to maximize V with respect to A_j and D, subject to

$$(3)\quad \sum_{j=1}^{n} A_j = D + K \text{ and}$$

(4) $D \leq CK$ ($D = CK$ when the capital constraint is binding).

The solution to this problem is a series of optimality conditions describing the bank's choices (see Osterberg and Thomson [1988]). We assume that the capital constraint is binding and thus that equity value could be increased with a looser capital requirement. The bank will choose its asset mix so that marginal expected returns of all assets are equal. The marginal increase in equity value from a lower capital requirement, γ, is just equal to the risk-adjusted return on assets less the cost of deposits. Changes in leverage and portfolio composition affect γ.

We utilize Merton's (1977) put option formulation of FDIC deposit insurance, which indicates how g varies with portfolio variance (ρ) and leverage (δ). ρ and δ are nonnegative functions of portfolio variance and leverage, respectively. We do not assume, however, that the deposit guarantor correctly prices the insurance and drives the net value of the FDIC's claim to zero (see Osterberg and Thomson [1987]). As a result, the agency problem is not completely resolved, and the stockholders still have incentives to increase leverage and portfolio risk (hence the binding capital constraint).

Bank stockholders seek to maximize equation (1) subject to **(3)** (the balance-sheet constraint) and (4) (the capital constraint). The optimality conditions, from the constrained maximization problem, for the n assets can be written as (see Iam and Chen [1985] or Osterberg and Thomson [1988])

$$(5)\quad 2[\lambda + \rho CK]\sum_{i=1}^{n} A_i\sigma_{i,k} + R\gamma + CK\delta = \alpha_k - R - g, \qquad (k = 1,2,\ldots,n).$$

The right side of (5) represents the expected spread associated with investing in asset k. α_k is the return on asset k adjusted for external risk. y is the Iagrangian multiplier associated with a binding capital constraint. Note that the risk-based deposit insurance premium affects portfolio decisions by affecting the spread of return over cost and by affecting the risk adjustment associated with changes in leverage and variance.

Portfolio Composilion

As in Osterberg and Thomson (1988), the solutions for the multiplier, y, and the optimal portfolio shares, A_k^*, are

$$(6)\quad \gamma = \{[2(\lambda + CK\rho)]^{-1}\sum_{i=1}^{n}\sum_{j=1}^{n} v_{i,j}\}^{-1} \{[2(\lambda + CK\rho)]^{-1}\sum_{i=1}^{n}\sum_{j=1}^{n} v_{i,j}[\alpha_i - R - g - CK\delta] - (1 + C)K\}.$$

$$(7)\quad A_k^* = [2(\lambda + \rho CK)]^{-1}\{\sum_{j=1}^{n} v_{k,j}\alpha_k - R - g - CK\delta - \gamma\} \quad (k = 1,2,\ldots,n).$$

Here $v_{i,j}$ is the *ij*th element of the inverse variance-covariance matrix of the asset shares A_j.

Let γ_F and *A;* be the multiplier and the optimal asset share for the fured-rate deposit insurance case (that is, $g = \overline{g}$, p = 0, and 6 = 0). Equations (6) and (7) can be rewritten as

$$(6a)\quad \gamma = \gamma_F - CK\delta - CK\rho(1 + C)K,$$

$$(7a)\quad A_k^* = \frac{2\lambda A_k^F + \rho CK(1 + C)K}{2(\lambda + \rho CK)}$$

Note that y is smaller under risk-based deposit insurance than under fixed-rate deposit insurance because by definition *C, K,* 6, and p are positive.[6] y can be interpreted as the cost to the bank of a more restrictive capital constraint. In this model, the y is positive because of agency problems. By tying deposit costs to bank-asset risk and leverage, the risk-based deposit-insurance premiums in this model partially resolve the agency conflict and, hence, lower the cost of the capital constraint.' Intuitively, deposit rates that do not vary with risk or leverage provide a subsidy to the stockholders. The subsidy increases with the risk and leverage of the bank. Risk-based deposit rates reduce the risk- and leverage-related subsidy and therefore the cost to stockholders of increasing the capital constraint.

Equation (7) shows that the optimal portfolio share for asset k is a function of y. Since y is smaller for banks paying risk-based deposit rates than for banks paying fured-rate deposit rates, the impact of the capital requirements has less impact on portfolio composition for banks paying risk-based premiums than for banks paying fixed-rate premiums. Equation (7a) gives the relationship between the optimal portfolio share for asset k under fixed- and variable-rate premiums. From (7a) it is clear that adjusting deposit-insurance premiums for asset risk and leverage has an uncertain impact on portfolio composition. To see more clearly the effects of risk-based premiums on portfolio composition, we substitute (6) into (7),

$$(7b)\quad A_k^* = [2(\lambda + \rho CK)]^{-1}\{\sum_{j=1}^{n} v_{k,j}\alpha_k - \frac{\sum_{j=1}^{n} v_{k,j}}{\sum_{i=1}^{n}\sum_{j=1}^{n} v_{i,j}}\sum_{i=1}^{n}\sum_{j=1}^{n} v_{i,j}\alpha_k\} + \frac{(1 + C)K\sum_{j=1}^{n} v_{k,j}}{\sum_{i=1}^{n}\sum_{j=1}^{n} v_{i,j}} \quad (k = 1,2,\ldots,n).$$

If we set p equal to zero in (7b) we get A_k^* for a bank paying fured-rate deposit-insurance premiums.

6 This differs from Lam and Chen's stochastic interest-rate case where the capital constraint multiplier may be larger or smaller than the capital constraint multiplier in the'deterministic deposit case.

■ **7** The risk-based deposit-insurancepremiums only partially resolve the agency conflict because we do not assume the FDIC charges the bank the full value of the insurance. That is, we do not impose correct pricing on the model.

From (7b) the optimal asset share is a function of the expected asset returns adjusted for outside risk weighted by the elements of the inverse of the variance-covariance matrix. The fixed-rate deposit insurance result is identical to Iam and Chen's result when Regulation Q prevails and is equivalent to Koehn and Santomero's results. For both fixed-rate and risk-based deposit insurance, A_k^* is also a function of the capital constraint. When variable-rate deposit insurance is introduced into the model, A; is also a function of the change in the cost of deposit insurance due to a change in the risk of the bank's portfolio, *p*. It is interesting to note that A_k^* is not a function of 6 or g.

The impact of increased capital requirements on asset portfolio composition is uncertain for banks facing both the fixed-rate and risk-based deposit insurance. The indeterminate sign on $\frac{\partial A_k^*}{\partial C}$ is consistent with the findings of Lam and Chen.[8] That is, although the purpose of an increase in the capital requirement is to reduce overall bank risk, it may cause the bank to choose a riskier portfolio and may increase overall bank risk.

Portfolio Risk and Expected Profits

For investors and bank regulators, it is not the. risk or return of the individual activities (or assets) that matters, it is the risk-adjusted return on the bank's portfolio. Therefore we are interested in the effects of risk-based deposit insurance and changes in capital requirements on internal risk (portfolio risk), CV $(\tilde{\pi}, \tilde{\pi})$, and on expected profits, E $(\tilde{\pi})$. From Osterberg and Thomson (1988), the portfolio risk and the expected profits of the optimal bank portfolio are

$$(8) \quad CV(\tilde{\pi},\tilde{\pi})$$

$$= (2[\lambda + \rho CK])^{-2} \{\sum_{i=1}^{n}\sum_{j=1}^{n} v_{i,j}\alpha_i\alpha_j - \frac{\sum_{i=1}^{n}\sum_{j=1}^{n} v_{i,j}\alpha_i}{\sum_{i=1}^{n}\sum_{j=1}^{n} v_{i,j}} \sum_{i=1}^{n}\sum_{j=1}^{n} v_{i,j}\alpha_j\} + \frac{[(1+C)K]^2}{\sum_{i=1}^{n}\sum_{j=1}^{n} v_{i,j}}$$

$$(9) \quad E(\tilde{\pi})$$

$$= (2[\lambda + \rho CK])^{-1} \{\sum_{i=1}^{n}\sum_{j=1}^{n} v_{i,j}r_i\alpha_j - \frac{\sum_{i=1}^{n}\sum_{j=1}^{n} v_{i,j}r_i}{\sum_{i=1}^{n}\sum_{j=1}^{n} v_{i,j}} \sum_{i=1}^{n}\sum_{j=1}^{n} v_{i,j}\alpha_j\} + \frac{(1+C)K\sum_{i=1}^{n}\sum_{j=1}^{n} v_{i,j}r_i}{\sum_{i=1}^{n}\sum_{j=1}^{n} v_{i,j}} - (R+g)CK.$$

If we set p = 0, equation (8) is the variance of earnings in the fixed-rate deposit case. Note that like A_k^*, CV (2 , $\tilde{\pi}$) is not a function of 6 or g. Furthermore, because p is positive, the variance of portfolio earnings for a bank with fixed-rate deposit insurance is greater than the variance of earnings for a bank with risk-based deposit insurance. In other words, banks that have to pay depositors (or the FDIC) for risk-bearing services will hold less-risky portfolios than banks that do not have to pay for those risk-bearing services. This result holds for all values of *C*.

As in Iam and Chen, an increase in the capital requirement leads to a reduction in portfolio risk under fured-rate deposit insurance. That is, $\frac{\partial CV(\tilde{\pi},\tilde{\pi})}{ac}$ is positive when p = 0. However, the sign of $\frac{\partial CV(\tilde{\pi},\tilde{\pi})}{\partial C}$ is ambiguous for banks facing risk-based premiums. Therefore, the joint effect of a more restrictive capital constraint and of risk-based insurance premiums may be to increase bank portfolio risk.[9] However, because the value of (8) is greater when banks face fixed-rate premiums than when they face risk-based premiums for all *C*, risk-based premiums result in less internal risk than do fixed-rate premiums. Therefore, so long as the FDIC does not make relative errors in pricing its guarantees, risk-based deposit-insurance premiums do not introduce any new perverse effects into the analysis.

If we set g = $\overline{g}$ and p = 0, equation (9) is the expected profits for a bank with fured-rate deposit insurance. As anticipated, when the risk

■ **8** Lam and Chen also get an indeterminate result for the net effect of more stringent capital requirements on overall bank risk in their stochastic deposit case.

■ **9** Separation between capital structure and portfolio decisions may not hold in our model because we do not assume that the deposit guarantor charges banks a premium equal to the fair value of the deposit guarantees.

profile of the bank results in a risk-based premium, g, equal to the fured-rate premium, $\overline{g}$, profits are lower for the bank paying risk-based premiums than for the bank paying fured-rate premiums. This result holds because, as we know from equation (8), banks paying fixed-rate premiums will hold riskier portfolios than banks paying risk-based premiums, and there is a positive relationship between risk and return (expected profits).

For both fured-rate and risk-based insurance, the effect of a change in C on expected profits is ambiguous. Since expected profits are not adjusted for risk, it is possible for a relaxation of the capital constraint to increase the value of the firm and to reduce profits. This result was also found by Iam and Chen (1985).

Bankruptcy Risk

The only time the FDIC must honor its guarantees is when a bank fails. So, the impact of changing the capital requirement on the risk of bankruptcy is an important issue for the FDIC. A bank's bankruptcy risk is a function of asset portfolio risk and leverage. Since an increase in the capital requirement reduces leverage, an increase in internal risk in response to increased capital requirements does not necessarily increase bankruptcy risk. Koehn and Santomero (1980) show that the probability of failure, P, is

$$(10)\quad P = Pr\{\,\tilde{\pi} < K\,\} \leq \frac{CV(\tilde{\pi},\tilde{\pi})}{[E(\tilde{\pi}) - K]^2}$$

Holding C constant, the impact of risk-based deposit insurance is to reduce both the numerator and denominator of P. Therefore, the impact of risk-based insurance on default risk is uncertain. On the other hand, a reduction in the variance of earnings should reduce the expected loss to the FDIC when a bank fails. From this standpoint, risk-based deposit insurance produces a desirable result.

Iam and Chen (1985) show that the impact of changing the capital requirement on P is indeterminate for fixed-rate deposit insurance. It is also indeterminate when risk-based deposit insurance is introduced. Our inability to sign $\frac{\partial P}{\partial C}$ for banks with risk-based deposit insurance is at least partially due to our assumption that the FDIC does not charge banks for the fair value of their insurance.

II. Conclusion

Studies of the impact of changes in capital requirements on bank portfolio behavior and risk are extremely sensitive to the assumptions of how deposit insurance is priced. Previous mathematical analyses of the impact of increased capital requirements on bank portfolio behavior implicitly or explicitly assume that deposit insurance is mispriced. This introduces an agency problem into the analysis that causes the capital constraint to be binding and generates the conclusions of these studies. We contend that with correct pricing of deposit insurance the capital constraint is no longer binding. Using a modified version of the cash-flow CAPM, which incorporates a put option formulation for deposit insurance, we compare the results of our earlier study (Osterberg and Thomson [1988]), where deposit rates vary with portfolio risk and leverage, to the general results of previous studies where explicit deposit costs are independent of portfolio risk and leverage.

We find that, with risk- and leverage-related deposit rates, the incentive to increase leverage is smaller than when the deposit rate and insurance premium are fured. Allowing explicit deposit costs to vary with risk and leverage also reduces the portfolio variance. In addition, asset choice is influenced by the response of the risk premium to increases in portfolio variance.

As in the case where explicit deposit costs do not vary with risk and leverage, the impact of increased capital requirements on portfolio behavior for banks paying risk-based deposit insurance premiums is generally ambiguous. In both cases, the impact of increased capital requirements on asset choice is indeterminate, as are the responses of portfolio variance, expected profits, and the probability of bankruptcy. However, our failure to impose correct pricing may be responsible for these indeterminacies. Nonetheless, allowing deposit rates to vary with portfolio risk and leverage results in reductions in portfolio variance and in the incentive to increase leverage. These would seem to be desirable results from a regulator's viewpoint.

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