

Is Bank Capital Supervision Effective?  
Some Evidence From Bank Holding Company Behavior

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## I. Introduction

Supervision of capital adequacy is one of the most controversial aspects of regulatory oversight of commercial bank activity. The level of equity capital relative to asset risk is viewed by supervisory agencies as an important determinant of bank safety. As a general rule, supervisory agencies seek to induce banks to operate with higher capital ratios than would be the case in the absence of supervision.

At the same time, the private capital markets evaluate commercial banks, along with other types of firms, as private profit-maximizing entities which use equity capital as an input in a productive process. As a result, bank capital levels cannot be increased costlessly. Any increase in equity capital above market equilibrium levels must reduce profits of banks relative to other firms and, thus, make them less attractive for investment.

This raises the obvious question of whether bank capital supervision is effective in altering bank financial behavior. Several economists have studied this question empirically, finding quite mixed results. Using aggregated data, Peltzman [9] found no evidence that supervisory intervention results in increased capital levels for commercial banks, and even concluded that banks substitute deposit insurance for capital. Using a cross-sectional analysis on individual banks, however, Mingo [6] found evidence of a direct effect of supervision on capital levels. Mayne [5] found some significant differences among banks supervised by different agencies. And Pringle [11] concluded from cross-sectional studies that supervisory influences are more important at the margin than private market concerns in determining bank capital behavior.

These studies have not addressed the implications of ownership of banks by bank holding companies, despite the fact that bank holding companies

control over 25 percent of commercial banks nationwide and account for over 70 percent of commercial bank assets. Bank holding companies are not subject to the same capital supervision as are commercial banks and, consequently, possess considerably greater flexibility with regard to their financial structures. Analyzing the reaction of bank holding companies to bank capital supervision thus promises additional insights into its effects on bank financial structure as well as on the financial structure of the consolidated banking organization.

This paper explicitly introduces the bank holding company in a model of bank reaction to regulation. We develop a theoretical model that predicts first that the parent bank holding company would choose to issue no debt if its subsidiary banks were not subject to effective capital supervision, and second that effective capital supervision would induce the holding company to substitute debt of the parent company for debt of the subsidiary bank, channeling that debt back to the bank in the form of equity investment. The extent to which bank holding companies actually engage in this practice, which we call internal leveraging, thus provides an indirect test of the effectiveness of bank capital supervision.

We examine data on bank holding company behavior from 1976 to 1980 to determine whether bank holding companies have utilized internal leverage. Our empirical tests show that bank holding companies have used this practice to a significant degree. This suggests that bank capital supervision has been effective in increasing bank equity capital. However, it also implies that the increased capital at bank subsidiaries has been achieved without a commensurate increase in capital by the consolidated banking organization. Whether or not this is consistent with the goals of supervision depends on the linkages between failure of bank holding companies and their subsidiary banks and on the desirability on public policy grounds of reducing the riskiness of bank holding companies rather than of their commercial bank subsidiaries alone.

## II. Regulation of Bank Financial Structure

Regulatory concern over the financial structure of commercial banks traditionally has arisen from the relationship between equity capital and the risk of bank failure [8;13]. The risk of bank failure is of concern primarily because of its relationship to the stability of the economy's payments mechanism. In theoretical economic terms, we see that the regulator considers a stable payments mechanism to be a public good resulting from that sector's effect on the ability of the economy to function smoothly.<sup>1/</sup> Inasmuch as market forces will generally lead to suboptimal production of a public good [12], it may be expected that the private market will place a lower than socially optimal value on stability of the payments mechanism and will accept a higher than socially optimal level of bank risk.

From a bank's perspective, equity capital is viewed more generally as a source of funds and a means of attracting deposits as well as a buffer against insolvency. The bank chooses an optimal level of equity capital that maximizes its economic profits. This calculation takes into account the various private functions of equity capital, addressing them simultaneously within a framework also accounting for the cost of capital in terms of the opportunity for alternative investment. It also must take into account the effects of regulation.

The relationship between the optimal level of equity as determined in the unregulated market and the supervisory optimal level of equity may be analyzed within a very simple model which draws on the traditional theory of financial management. To simplify the exposition, we focus on two inputs in the banking production process--deposits and equity capital. Bank management faces

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<sup>1/</sup>Our concern is not to verify the existence of this public good and thus the desirability of capital supervision as a normative matter. Rather, we accept supervision as a given and model its effect on banking behavior.

the decision of choosing the combination of equity and deposits which maximizes economic profits, considering the market's risk preferences. We assume that the bank faces competitive capital markets. Under such conditions, market risk preferences are reflected in the costs of equity and deposits to the bank. The profit-maximizing combination of equity and deposits is that which minimizes the average cost of funds to the bank at the optimal level of output.

For the two-input case, the average cost of funds for a given asset mix and scale of operation may be expressed as:

$$(1) \quad F = \alpha r + (1-\alpha)\rho$$

where  $\rho$  = the average cost of equity;

$r$  = the average cost of deposits;

$\alpha$  = the ratio of deposits to total assets, commonly referred to as leverage; and

$$0 \leq \alpha \leq 1.$$

The following relationships are assumed to hold over the entire range of  $\alpha$ :

$$\rho > r;$$

$$(2) \quad \frac{\partial \rho}{\partial \alpha} > 0; \text{ and}$$

$$\frac{\partial r}{\partial \alpha} > 0.$$

The average cost of equity funds exceeds the average cost of deposits for two reasons. First, deposits have a priority claim on the income of the bank and thus entail lower risk to the supplier. Therefore, depositors are willing to accept a lower promised return. Second, deposit costs are an expense item and deductible from income taxes, and thus on an after tax basis deposits enjoy an advantage over equity. At the same time, use of deposit funds implies a higher

level of risk of bankruptcy for the bank than use of equity, since payments to depositors are a fixed commitment while payments to equityholders are simply a residual. The positive relationship between the average cost of each input and the deposit to asset ratio results from this risk element.

The bank chooses that combination of equity and deposits that minimizes (1).<sup>2/</sup> Assuming the second-order conditions for a minimum hold, the optimal leverage ratio may be derived as the point where  $\frac{\partial F}{\partial \alpha} = 0$ . That is, where

$$(3) \quad r + \alpha \frac{\partial r}{\partial \alpha} + (1-\alpha) \frac{\partial \rho}{\partial \alpha} = \rho.$$

Equation (3) makes it clear that the optimal bank leverage ratio is that which equates the marginal cost of deposits, including the impact of leverage on the cost of deposits and equity, to the marginal cost of equity,  $\rho$ .

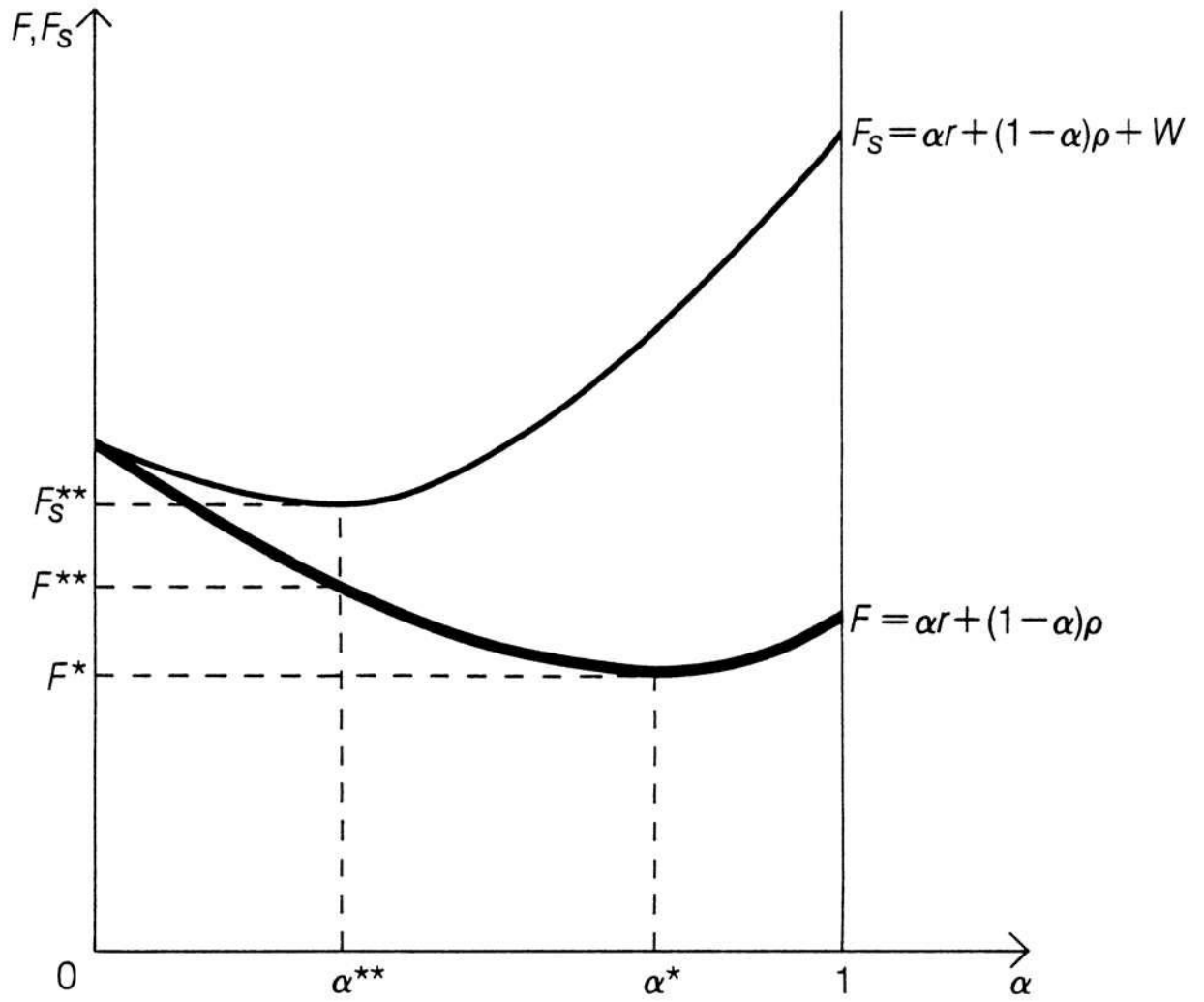
The relationship between the average cost of funds and the deposit to asset ratio is shown by the bold line in Figure 1. As the amount of deposit funding increases, the average cost of funds decreases up to  $\alpha^*$  as a result of greater use of the relatively cheaper deposit input. Beyond  $\alpha^*$ , however, the impact of increased risk on the cost of both equity and deposits outweighs this factor, and the average cost of funds begins to rise.<sup>3/</sup> The deposit to asset ratio which implies the minimum overall cost of funds is the point  $(\alpha^*, F^*)$  in Figure 1.

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<sup>2/</sup>We are ignoring the interaction of asset and liability decisions. We might view the bank as calculating the minimum average cost of funds for each possible asset combination, determining the maximum profit for each asset combination, and then choosing the asset and liability combination that globally maximizes profits. The results modeled here would hold for the global optimum.

<sup>3/</sup>This analysis follows the assumptions inherent in traditional financial theory as presented in Solomon [15]. The irrelevance of financial structure (in this case, the capital-deposit combination) has been demonstrated for the case of perfect capital markets, zero taxes, and zero bankruptcy costs [7, 16, 17]. However the existence of an optimal leverage has been demonstrated in the presence of transactions costs, differential rates for borrowers (positive probability of bankruptcy), and tax advantage of debt [11, 14, 17]. The bank is assumed to operate subject to the latter conditions.

Figure 1  
The Overall Average Cost of Funds,  
the Overall Average Social Cost,  
and Bank Leverage



For a given asset size and portfolio composition, the objective of bank supervision is to induce the bank to operate with the deposit to asset ratio which implies the minimum overall social cost. The overall social cost of employing a particular deposit to asset ratio is equal to the sum of the private cost of funds plus any additional social cost not reflected in the market price. Denoting the additional social cost of bank risk by  $W$ , we have the average social cost of bank funds as:

$$(4) \quad F_s = \alpha r + (1-\alpha)\rho + W.$$

The additional social cost of risk is derived from the social cost of bank failure. Letting  $B$  equal the probability of bank failure, this may be expressed as follows:

$$(5) \quad W = w(B(\alpha)).$$

It is reasonable to assume that the probability of failure is directly related to the deposit to asset ratio [8]. That is:

$$(6) \quad \frac{\partial B}{\partial \alpha} > 0.$$

Further, the additional social cost may be expected to increase with the risk of failure:

$$(7) \quad \frac{\partial W}{\partial B} > 0.$$

Accordingly, we may assume:

$$(8) \quad \frac{\partial W}{\partial \alpha} = \frac{\partial W}{\partial B} \frac{\partial B}{\partial \alpha} > 0.$$

These results imply that the total social average cost curve may be expressed as a shift upward and to the left of the private average cost curve. This is demonstrated by the upper curve,  $F_s$ , in Figure 1. Bank supervision thus



aims at a point, such as  $(\alpha^{**}, F^{**})$ , with a deposit to asset ratio below the private optimal level. At this point, the bank's average cost of funds exceeds the minimum average cost of funds by  $(F^{**}-F^*)$ . The bank will not willingly bear this extra cost.

Bank capital supervision has traditionally taken the form of guidelines rather than rigid regulations, and is enforced through suasion rather than formal sanctions. This process can be viewed as one that permits banks to choose their own levels of leverage, but that imposes costs on banks that choose to maintain less capital than the supervisor desires. Thus, the level of equity capital actually chosen by the supervised bank will depend upon the relative costs imposed by the supervisor and the private market [1]. That is, faced by regulatory pressures that impose real costs on the bank, the bank will increase its capital from the unregulated optimum until the marginal cost of further movement (in terms of increased cost of funds) is equal to the supervisory-imposed cost of failing to meet the specified target.

Throughout this analysis, we have focused on capital supervision and abstracted from other supervisory influences. In the following section, we shall introduce one other element of bank safety regulation--deposit insurance. In its current form, deposit insurance is provided to banks at a flat rate, without regard to bank risk. And, while deposits are insured only up to \$100,000 per depositor, FDIC policy usually results in the purchase of assets and assumption of all liabilities by a sound bank rather than an FDIC payoff of only insured depositors. Under this scheme, the risk of loss to depositors is effectively zero and the marginal impact of leverage on the cost to the bank of deposit funds  $(\frac{\partial r}{\partial \alpha})$  is zero. By reducing this marginal impact, deposit insurance actually increases the optimal leverage from the bank's point of view.<sup>4/</sup>

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<sup>4/</sup> For further exposition of the impact of flat rate deposit insurance on bank behavior, see [3].

### III. Bank Holding Company Financial Structure

In order to predict the effect of bank capital regulation on bank holding company financial structure, we shall construct a simple model of the bank holding company. We shall consider a parent holding company whose sole subsidiary is a commercial bank and which engages in no activity other than holding the shares of that bank and financing those shares by issuing debt or equity. The subsidiary bank issues deposits to the public and sells equity solely to the parent company. As for the bank in the previous section, we assume that the holding company faces the problem of choosing the financial structure that minimizes the cost of funds for a given asset combination and scale of operation.

The financial structure of the banking organization is defined by the levels of debt and equity issued by the parent company and by its bank subsidiary. The company's financial structure can be considered to comprise the separate financial structures of the parent and the subsidiary bank or alternatively the consolidated balance sheet of the entire organization, netting out bank equity as an intracompany transaction. Within our model, the company's consolidated and unconsolidated financial structures both are completely identified by two variables, the level of debt (deposits) issued by the bank subsidiary and the level of debt issued by the parent. Since the level of total bank assets is fixed by assumption, the level of equity at the bank subsidiary is determined by the amount of deposits issued by the bank. Similarly, because the total assets of the parent equals the book value of equity in the bank subsidiary, equity at the parent is determined by the total debt issued by the parent and the subsidiary, combined. For convenience, we shall state our model in terms of the level of debt issued by the bank and the total debt issued by both bank and parent. The latter equals the level of debt in the consolidated balance sheet of

the bank holding company. These, in turn, may be expressed as the leverage ratios of, respectively, the bank and the consolidated company or parent by dividing by total assets.

The holding company is assumed to minimize average consolidated cost of funds.<sup>5/</sup> Denoting consolidated variables by the subscript, H, bank variables by the subscript, b, and parent company variables by the subscript, p, we may express the overall average cost of funds on a consolidated basis in terms of consolidated leverage and bank leverage as follows:

$$(9) \quad F_H = \alpha_b r_b + (\alpha_H - \alpha_b) r_p + (1 - \alpha_H) \rho.$$

Assuming that depositors hold a prior claim over holders of the parent company's debt and that shareholders hold a residual claim, we have, in general:

$$(10) \quad \frac{\partial r_b}{\partial \alpha_b}, \frac{\partial r_p}{\partial \alpha_b}, \frac{\partial r_p}{\partial \alpha_H}, \frac{\partial \rho}{\partial \alpha_H} > 0; \text{ and}$$

$$(11) \quad \rho > r_p > r_b.$$

Assuming that second-order conditions are met, equation (9) is minimized at the point where  $\frac{\partial F_H}{\partial \alpha_b}, \frac{\partial F_H}{\partial \alpha_H} = 0$ . That is:

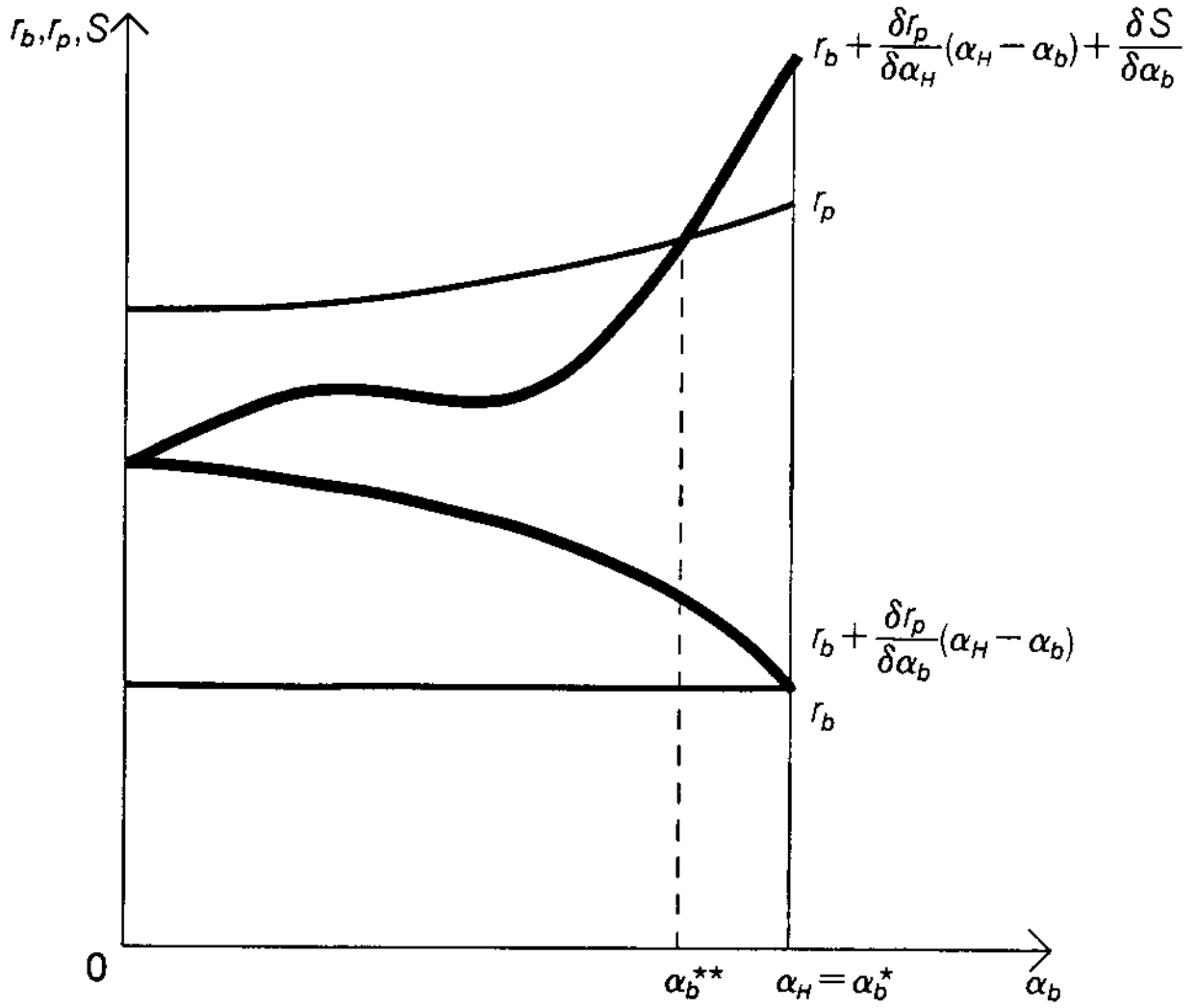
$$(12) \quad r_b + \alpha_b \frac{\partial r_b}{\partial \alpha_b} + (\alpha_H - \alpha_b) \frac{\partial r_p}{\partial \alpha_b} = r_p; \text{ and}$$

$$(13) \quad r_p + (\alpha_H - \alpha_b) \frac{\partial r_p}{\partial \alpha_H} + (1 - \alpha_H) \frac{\partial \rho}{\partial \alpha_H} = \rho.$$

Equation (13) says, simply, that the company operates at the consolidated leverage ratio at which the marginal cost of debt issued by the parent

<sup>5/</sup>A good deal of evidence suggests that holding companies make decisions on a consolidated basis [2]. This is reasonable, since supervisory restrictions on financial flows between subsidiary banks and the rest of the holding company cover only a part of all possible flows (such as dividends from the bank to the parent or loans by the bank to affiliates). These restraints are designed to come into play only in extremely adverse circumstances and, under normal conditions, are not binding.

Figure 2  
 Bank Holding Company Leverage  
 and Marginal Costs of Financing



equals the marginal cost of equity. The left-hand side of this equation represents the marginal cost of additional debt for the consolidated company, including the impact of leverage on the average cost of debt and equity, while the right-hand side is the cost of equity. Equation (12) says that the equilibrium bank leverage ratio is that for which the marginal cost of bank debt, including the impact on the deposit rate and the impact on the parent level debt rate, equals the rate paid on parent company debt. The equilibrium levels of bank leverage and consolidated holding company leverage are determined by simultaneous solution of equations (12) and (13).

In general, an internal optimum solution for (12) may exist, with  $\alpha_b < \alpha_H$  and some debt issued at each level of the holding company. However, deposit insurance has the effect of making depositors insensitive to bank risk, so that  $\frac{\partial r_b}{\partial \alpha_b} = 0$ . In this case, our model implies that all debt will be issued at the bank level and none at the parent level. The company attempts to satisfy equation (14), but reaches a corner solution as shown by  $\alpha_b^*$  in Figure 2. As long as this corner solution holds, the levels of bank debt and holding company equity are effectively determined in a simpler maximization problem involving only one variable,  $\alpha_H$ , as follows:

$$(14) \quad F_H = \alpha_H r_b + (1 - \alpha_H) \rho.$$

This is equivalent to the model of the bank discussed in Section II, and yields the same solution as long as equity capital is supplied to a holding company on the same basis as it is supplied to a commercial bank.

Bank supervisory policies change these results. As discussed in the previous section, bank capital supervision has aimed at reducing bank leverage by penalizing banks which exceed supervisory target leverage ratios. At the same time, supervisory policy has tried to permit holding companies a wide degree of

discretion in setting financial strategies, while insulating the subsidiary bank from the rest of the company.

If it is effective, therefore, bank capital supervision in its traditional form imposes a cost for bank leverage but not for consolidated leverage. The supervisory-imposed cost per dollar of assets can be thought of as a function,  $s$ , of the deviation between the actual bank leverage ratio and the supervisory target, where  $\frac{\partial s}{\partial \alpha_b} > 0$ . The presence of supervisory-imposed cost transforms equation (12) into the following:

$$(15) \quad r_b + \alpha_b \frac{\partial r_b}{\partial \alpha_b} + (\alpha_H - \alpha_b) \frac{\partial r_p}{\partial \alpha_b} + \frac{\partial s}{\partial \alpha_b} = r_p.$$

Equation (13) remains unchanged.

Under supervision, the equilibrium levels of bank leverage and consolidated bank holding company leverage are determined by simultaneous solution of equations (13) and (15), and with deposit insurance a corner solution may result. However, if supervisory-imposed costs are sufficiently large, the regulated equilibrium will yield an internal solution for the optimal bank leverage ratio,  $\alpha_b^{**} < \alpha_H$ , shown in Figure 2. This solution implies the issuance of debt by the parent holding company, which supports the holding company's investment in bank equity. Given the presence of deposit insurance, an observation of  $\alpha_b^{**} < \alpha_H$  is thus evidence of supervisory influence.<sup>6/</sup> The model predicts that the proportion of consolidated debt and deposits issued at the parent level rather than at the bank level is directly related to supervisory-imposed costs of bank leverage.

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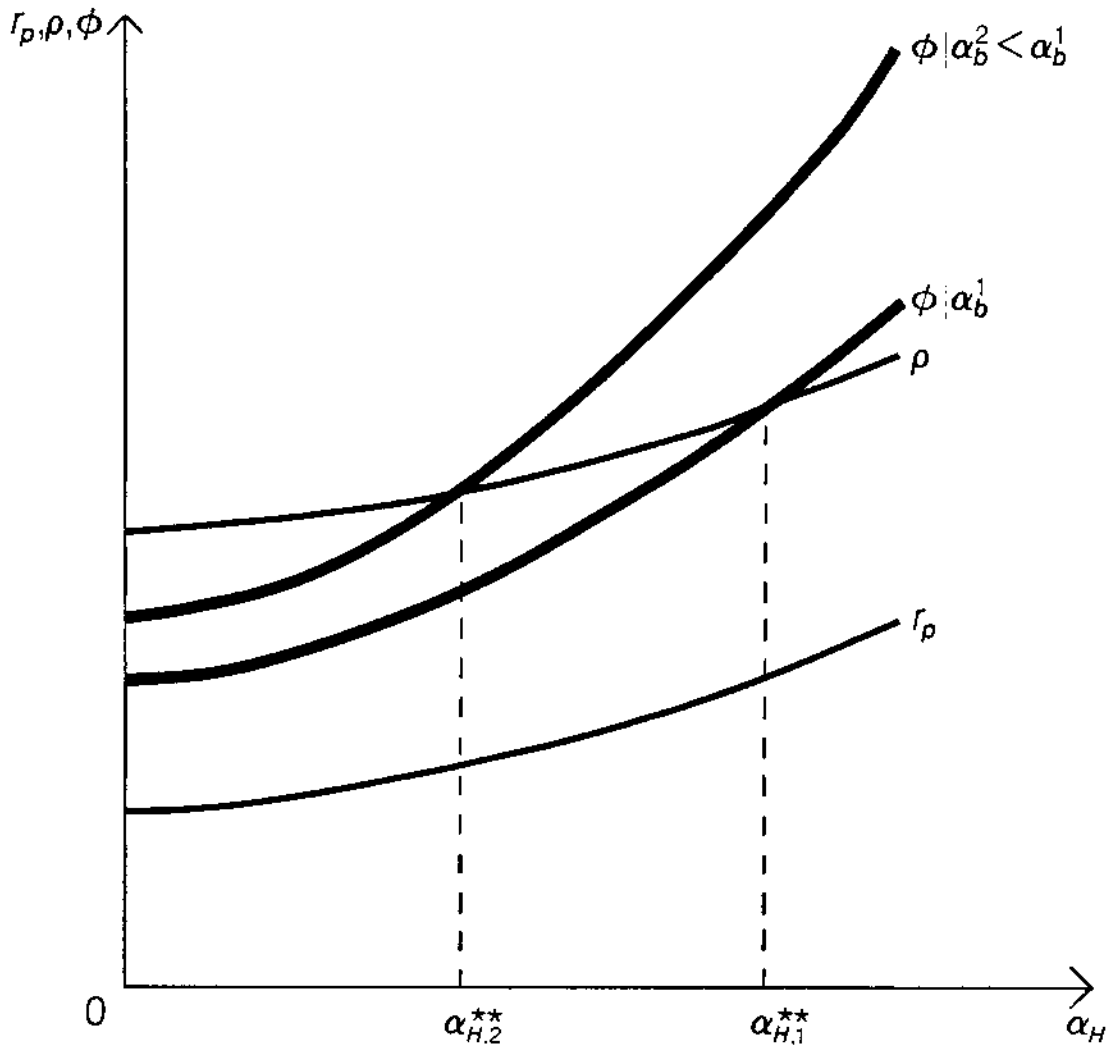
<sup>6/</sup> One measure of effectiveness of bank capital regulation would be the extent to which regulation causes banks to choose the socially optimal level of equity. Since that is unobservable, we substitute here the weaker criterion for effectiveness of whether regulation moves banks in the direction of the social optimum. Again, we note that whether the private and social optima differ in the first place is not well established.

A second question is whether bank capital regulation affects the level of equity capital in the holding company as a whole. If the total debt issued by both parent and subsidiary is unchanged, then clearly the level of equity at the parent would be unchanged. This is an important question, since the riskiness of the holding company organization as a whole is probably related to the consolidated financial structure. It has important public policy implications to the extent that the social costs of failure apply to the holding company as well as the bank, whether indirectly through the transmission of failure from the holding company to the bank or directly as a result of secondary effects of holding company failure outside the banking system.

The effect on the consolidated leverage ratio may be assessed within the framework of equation (13). Regulatory costs do not enter directly in this equation, but they enter indirectly through the bank leverage ratio, since equations (13) and (15) must be solved simultaneously. We have already shown that an increase in regulatory costs reduces the bank leverage ratio once those costs rise beyond the point associated with the corner solution. This then implies an increase in the marginal cost schedule of parent company debt, as shown by the higher line in Figure 3, and thus a reduction in the consolidated leverage ratio. Thus the reduction in bank debt is financed by increases in both debt and equity at the parent level. Equation (16) then indicates that there would be a secondary increase in bank leverage, with an equilibrium established at smaller reductions in both bank and consolidated leverage.

Thus, bank capital regulation, if it is effective in reducing bank leverage, can also be expected to reduce bank holding company leverage, but to a lesser extent. The reason for this result is simply that regulation raises the real cost of debt to the holding company. Unfortunately, this second hypothesis is not directly testable, since we are unable to observe the level of equity that holding companies would raise in the absence of bank capital regulation.

Figure 3  
 The Effect of Bank Supervision  
 on Bank Holding Company Consolidated Leverage



$$\phi = r_p + \frac{\delta r_p}{\delta \alpha_H} (\alpha_H - \alpha_b) + \frac{\delta \rho}{\delta \alpha_H} (1 - \alpha_H)$$



#### IV. Empirical Results: Supervision and Bank Behavior

In this section we want to test the hypothesis that  $\alpha_b = \alpha_H$  against the alternative hypothesis that  $\alpha_b < \alpha_H$  for a group of bank holding companies headquartered in the Second Federal Reserve District. To conduct this test, however, we must recognize that bank holding companies are, in fact, more complex than the simplified holding company modeled in the previous section. Bank holding companies often conduct real operations at the parent level in addition to holding stock of subsidiary banks, and generate financing needs in this connection. Bank holding companies also have financing needs associated with so-called "nonbank" subsidiaries, which we have not included in our model. Debt may be issued by the holding company in connection with either or both of these needs as well as to achieve the internal leveraging that we want to evaluate. Thus, consolidated debt is not necessarily a good measure of internal leverage. An alternative measure that does not suffer from this deficiency is the ratio of total equity capital summed over all subsidiaries of the bank holding company to the holding company's consolidated equity capital.<sup>7/</sup> This measure equals one if the bank holding company does not engage in internal leveraging, and exceeds one if it does. We shall refer to this ratio as the internal leverage ratio (L) in the following empirical analysis.<sup>8/</sup>

We performed cross-sectional tests of the hypothesis that  $L = 1.0$  against the alternative hypothesis that  $L > 0$  for each of the years 1976-1980.

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<sup>7/</sup>Bank holding companies do not report detailed balance sheet information for nonbank subsidiaries. Thus, to obtain the equity of nonbank subsidiaries, we used the total investment in nonbank subsidiaries reported by the parent company in the Annual Report submitted to the Federal Reserve. Equity of bank subsidiaries was taken directly from the reports of condition filed by subsidiary banks. The equity of the consolidated bank holding company was taken from the Annual Report of the holding company filed with the Federal Reserve.

<sup>8/</sup>In order to focus more directly on bank-related internal leveraging, we have restricted our analysis to companies for which at least 90 percent of consolidated assets represent bank assets.

Our sample includes 24 holding companies headquartered in three states--New York, New Jersey, and Connecticut. They range in asset size from \$400 million to \$90 billion and in number of bank subsidiaries from one to fifteen.

The average ratios of equity capital at subsidiaries to consolidated bank holding company equity are presented in Table I. This ratio ranged from 1.09 to 1.12 over the five-year period studied. On average, over ten percent of the equity of subsidiaries was not supported by equity at the holding company level in each year. A test of the hypothesis that the population mean of this ratio is equal to one relative to the alternative hypothesis that the mean exceeds one is rejected at the 99 percent significance level in each year. Thus, our results are consistent with the hypothesis that bank capital supervision has been effective in imposing costs sufficient to alter bank financial behavior. The implication is that bank leverage is lower and parent leverage higher for these companies than would be the case in the absence of supervisory intervention.

We also performed tests to explain differences among individual holding companies. Several factors within our model could cause variation in the capital behavior of individual bank holding companies. One factor is the terms on which debt is supplied to the holding company. Equation (15) implies that the degree of substitution of parent debt for bank debt will depend on the relative magnitudes of supervisory-imposed cost of leverage and the market-determined cost of parent debt. Assuming that supervisory-imposed cost is invariant across banks, we would expect that the degree to which the holding company would substitute parent debt for bank debt would vary inversely with the marginal cost of parent debt.

Tax considerations also are relevant. New Jersey is unique among the three states in that, until 1975, it imposed a tax on bank stock. Since this tax

was not levied on bank holding company equity capital, there was an incentive for New Jersey holding companies to raise equity capital at the parent company level and to provide the proceeds to bank subsidiaries as long-term debt. Bank holding companies in New Jersey would, consequently, have provided equity capital to subsidiary banks only to the extent that the marginal cost of doing so (the tax rate) was less than the marginal cost of not complying with the regulatory standard. Depending on the relative levels of noncompliance costs and the tax rate, the company might choose not to meet the bank regulatory standard and to support less bank equity with debt at the holding company level than it otherwise would. We note that the tax in question was repealed in 1975, but we believed that it might be relevant during our test years, since financing decisions are alterable only over a longer term.

Finally, differences may result from the regulatory jurisdiction of the subsidiary banks. Bank holding companies are subject to regulation by the Federal Reserve, but their subsidiary banks are subject to the Federal Reserve's primary jurisdiction only if they are state chartered and members of the Federal Reserve System. It might be expected that the Federal Reserve would be more likely to coordinate its regulation of the capital positions of subsidiary banks with that of the parent holding companies for banks under its primary jurisdiction than for banks under the jurisdiction of other agencies. In this case, for state member banks, regulatory-imposed costs might be independent of the company's internal debt structure, and the parent companies of these banks would tend to issue less debt.

To test for these effects, we estimated the following regression equation:

$$(16) \quad L = \alpha + \beta_1 A + \beta_2 MR + \beta_3 NJ + \beta_4 FRS + \epsilon$$

where:

L = internal leverage ratio,  
A = total assets of the consolidated holding company, in \$ billions,  
MR = 1.0 for companies rated Aaa or Aa by Moody's,  
= 0 otherwise,  
NJ = 1.0 for New Jersey companies,  
= 0 otherwise,  
FRS = 1.0 for holding companies whose lead banks are state members,  
= 0 otherwise.

In this equation, total assets and Moody's Bond Rating are proxies for the cost of debt to the holding company. The asset variable reflects the popular view that larger companies are perceived as being better managed and thus able to handle riskier financial structures than smaller companies. The Moody's rating is a more direct measure, but limited by its discrete nature. This rating was readily available only for the most recent year and appears only in our 1980 regression.

Our hypothesis predicts  $\beta_1, \beta_2 > 0$  and  $\beta_3, \beta_4 < 0$ . The results for the five-year period are presented in Table 2. The values of  $R^2$  are relatively low, and the F values indicate a low level of significance of the independent variables during 1976-1978. The signs of the coefficients on the size variable and the New Jersey dummy are as expected, but are significantly different from zero at high levels of confidence only in selected years. The decline over the sample period in the magnitude and significance of coefficients on the New Jersey dummy is consistent with theoretical expectations; the tax on bank stock in that state was removed in 1975 and should have a diminishing impact after that date, as the companies are able to readjust their financial structures. Likewise, the growing influence of size over the sample period could reflect an increasing degree of discrimination among individual companies on the part of the financial markets,

or increasing relevance of size as a proxy for risk. However, examination of the results revealed that the estimated coefficients on the size variable were extremely sensitive to the inclusion of one observation, which was an outlier with respect both to size and internal leverage in each of the sample years.

With the one outlying observation removed, the coefficient on the size variable changes signs from year-to-year, and in no case is it significantly different from 0 at high confidence levels. (See Table 3.) However, the coefficients on the New Jersey dummy continue to have the expected signs, and are significantly different from zero at the 90 percent confidence level or higher in three of the five years. Further, the regressions also continue to be consistent with the hypothesis that holding companies utilize internal leverage, since the constants in the equation are significantly different from 1.0 at high levels of confidence in all five years. The equation for 1976, for example, implies an average internal leverage ratio of 1.04 for companies in New Jersey and 1.14 for companies in New York and Connecticut.

The failure of the regressions to confirm our hypothesis that the cost of debt influences companies' use of internal leverage may reflect simply the very imperfect measure of the cost of debt utilized here. A direct measure of those costs might yield results consistent with the hypothesis. Alternatively, variation in internal leverage among holding companies may involve largely a random process or reflect omitted influences. The set of such influences certainly includes differences in costs of complying with regulatory guidelines and differences in the guidelines applied to individual banks. In this respect, it is significant that supervision is an informal process and relies heavily on judgments by officials of the regulatory agencies. Unfortunately, no obvious measures of these influences exist.

## V. Supervision and Consolidated Holding Company Structure

It can be argued that it is the consolidated holding company structure and not subsidiary bank structure that should be of concern to public policy. Our model has shown that the current practice of bank capital supervision is effective in decreasing bank risk, but that the decreased leverage of the subsidiary banks is not simply passed along to the consolidated bank holding company financial structure. Indeed, the model implies that companies with the riskiest consolidated financial structures will have the strongest incentives to use internal leverage to avoid regulatory pressures. We have verified this with a simple regression of the internal leverage ratio on the ratio of equity capital to risk assets of the consolidated company, as follows:

$$(17) \quad L = \beta + \beta CE + \epsilon.$$

The ratio of equity capital to risk assets of the consolidated company, CE, is a measure of risk often considered important by regulators.

The results of this regression, given by Table 4, show a strong negative relationship between these variables for each year. Thus, companies that show the strongest tendency to substitute parent debt for bank debt also show the weakest consolidated financial structures. This suggests that a supervisory policy that ignores holding company internal financial adjustments will be inefficient as a means to reduce holding company risk.

## VI. Summary and Policy Implications

This paper has examined the effectiveness of bank capital supervision within the context of a model of bank and bank holding company behavior. Our model predicts that capital supervision as it has traditionally been formulated has observable effects on internal financial decisions of bank holding compan-

ies. In particular, the model predicts that supervision would, if effective, cause holding companies to shift debt issuance out of subsidiary banks and into the parent company. Our empirical results suggest that such a shift has in fact occurred. Further, there appears to be a strong correlation between this shift and overall holding company financial risk.

These observations have two important implications for bank supervisory policy. First, they lend support to the hypothesis that supervisors have been successful in imposing costs for bank risk-taking. In this sense, supervisory policies have been strong enough to be effective. At the same time, however, the degree of parent company leverage which we have observed appears to be significant. If consolidated financial structure is more important than bank financial structure from a public policy perspective, the traditional supervisory approach is inefficient. It should also be noted, however, that the desirability of capital supervision for either commercial banks or bank holding companies is not well established analytically. If capital supervision should be shown to be not warranted at all, then the increased financial flexibility provided by the bank holding company clearly plays a positive role in our financial system.

Table 1

Internal Leverage Ratio<sup>a</sup>  
 Twenty-Four Bank Holding Companies  
 in the Second Federal Reserve District

<u>Year</u> <sup>b</sup>	<u>Sample Mean</u>	<u>Sample Standard Deviation</u>	<u>t</u> <sup>c</sup>
1976	1.119	0.104	5.46
1977	1.119	0.112	5.13
1978	1.109	0.113	4.63
1979	1.106	0.113	4.52
1980	1.090	0.113	3.81

<sup>a/</sup> Ratio of the sum of equity capital at all subsidiaries to the equity capital of the consolidated bank holding company.

<sup>b/</sup> For 1976-1979, data are as of December 31. For 1980, data are as of June 30.

<sup>c/</sup> Test of  $H_1: L = 1.0$  vs.  $H_0: L > 1.0$ . For a one-tailed test and 23 degrees of freedom,  $t_{99} = 1.75$ .



Table 2

Regression Results on the Internal Leverage Ratio  
(Twenty-Four Observations)

<u>Year</u>	<u>Constant</u>	<u>A</u>	<u>MR</u>	<u>NJ</u>	<u>FRS</u>	<u>R<sup>2</sup></u>	<u>R<sup>2</sup></u>	<u>F</u>
1976	1.141*** (0.046)	0.00021 (0.00138)		-0.0940* (0.0522)	0.0143 (0.0447)	.22	.10	1.87
1977	1.139*** (0.050)	0.00074 (0.00127)		-0.0895 (0.0564)	0.0020 (0.0484)	.20	.08	1.70
1978	1.117** (0.050)	0.00107 (0.00113)		-0.0746 (0.0570)	0.0033 (0.0490)	.20	.08	1.67
1979	1.110*** (0.043)	0.00192** (0.00083)		-0.0761 (0.0491)	-0.0212 (0.0423)	.40	.31	4.48
1980	1.072* (0.044)	0.00301** (0.00119)	-0.092 (0.0751)	-0.0628 (0.0505)	0.0311 (0.0488)	.41	.29	3.33

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Standard errors in parentheses.

\*\*\*Statistically significant at the 99 percent confidence level.

\*\*Statistically significant at the 95 percent confidence level.

\*Statistically significant at the 90 percent confidence level.

Tests of significance for the constant relate to  $H_1: \alpha = 1.0$  vs.  $H_0: \alpha > 1.0$ .

Tests on the remaining variables relate to  $H_1: \beta_i = 0$  vs.  $H_0: \beta_i \neq 0$ .

Table 3

Regression Results on the Internal Leverage Ratio  
(Twenty-Three Observations)

<u>Year</u>	<u>Constant</u>	<u>A</u>	<u>MR</u>	<u>NJ</u>	<u>FRS</u>	<u>R<sup>2</sup></u>	<u>R̄<sup>2</sup></u>	<u>F</u>
1976	1.145*** (0.046)	-0.00105 (0.00184)		-0.0992* (0.0523)	0.0252 (0.0459)	.22	.10	1.83
1977	1.148*** (0.048)	-0.00120 (0.00167)		-0.0996* (0.0542)	0.0197 (0.0475)	.20	.07	1.58
1978	1.126*** (0.048)	-0.00081 (0.00145)		-0.0855 (0.0540)	0.0227 (0.0472)	.17	.04	1.29
1979	1.120*** (0.40)	0.00028 (0.00111)		-0.0882* (0.0460)	-0.0023 (0.0404)	.23	.11	1.90
1980	1.082** (0.040)	0.00057 (0.00153)	-0.0291 (0.0736)	-0.0691 (0.0459)	0.0337 (0.0443)	.21	.04	1.23

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Standard errors in parentheses.

\*\*\*Statistically significant at the 99 percent confidence level.

\*\*Statistically significant at the 95 percent confidence level.

\*Statistically significant at the 90 percent confidence level.

Tests of significance for the constant relate to  $H_1: \alpha = 1.0$  vs.  $H_0: \alpha > 1.0$ .

Tests on the remaining variables relate to  $H_1: \beta_i = 0$  vs.  $H_0: \beta_i \neq 0$ .

Table 4

Regression Results on Internal Leverage Ratio  
(Twenty-Four Observations)

<u>Year</u>	<u>Independent Variable</u>				
	<u>Constant</u>	<u>CE</u>	<u>R<sup>2</sup></u>	<u><math>\bar{R}^2</math></u>	<u>F</u>
1976	1.30*** (.057)	-2.53*** (.759)	.34	.31	11.2
1977	1.33*** (.061)	-3.15*** (.874)	.37	.34	13.0
1978	1.31*** (.064)	-3.17** (.948)	.34	.31	11.2
1979	1.31*** (.057)	-3.18*** (.823)	.40	.38	14.9
1980	1.27*** (.061)	-2.65*** (.860)	.30	.27	9.5

Standard errors in parentheses.

\*\*\*Statistically significant at the 99 percent confidence level.

\*\*Statistically significant at the 95 percent confidence level.

\*Statistically significant at the 90 percent confidence level.

Tests of significance for the constant relate to  $H_1: \alpha = 1.0$  vs.  $H_0: \alpha > 1.0$ .

Tests on the remaining variables relate to  $H_1: \beta_i = 0$  vs.  $H_0: \beta_i \neq 0$ .

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