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Department of Finance
Working Paper Series 1998

FIN-98-043

A Theory of Bank Regulation and Management Compensation

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May 1998

This Working Paper Series has been generously supported by a grant from

CDC Asset Management
AMERICAS

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Current Version: May, 1998

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Abstract

This paper examines the incentive structure underlying the current features of bank regulation. We show that capital regulation has limited effectiveness, given the observed high leverage ratios of banks. We propose instead a more direct and effective mechanism of influencing incentives through the role of top-management compensation, whereby a fair and revenue-neutral FDIC premium incorporates incentive features of top-management compensation. With this pricing scheme (for FDIC insurance), we show that bank owners choose an optimal management compensation structure which induces first-best value-maximizing investment choices by a bank's management. We also characterize the parameters of the optimal managerial compensation structure and the FDIC premium schedule explicitly.

1. Introduction

Capital requirements and mandatory restrictions on asset choice have been central features of recent U.S. bank regulation. For example, a central feature of the FDIC Improvement Act (FDICIA), passed in 1991, is a system of capital-based regulations based on prompt corrective action (PCA). In this regulatory framework five capital zones for banks are specified ranging from well capitalized to critically undercapitalized. Importantly, as a bank's capital adequacy ratio declines -- moving from well capitalized to undercapitalized -- regulators are required to take (or consider) a number of mandatory and discretionary actions restricting the asset and liability activities of weakly capitalized banks as well as imposing constraints on their payment of fees, dividends and management compensation.

In this paper, we examine the incentive structure underlying the existing PCA regime -- especially the potential role of capital rules, asset restrictions, and mandatory interventions by regulators in controlling the risk-shifting incentives of banks. We argue that bank regulation, through capital requirements and asset restrictions, has limited effectiveness, given the high leverage ratios of banks. Instead, we propose a more direct and effective mechanism for curbing risk-shifting incentives through exploiting the incentive features inherent in bank management compensation structures. Specifically, we propose an actuarially fair, revenue-neutral, scheme for pricing FDIC insurance by explicitly incorporating features of a bank's management compensation schedule in the risk-based pricing of deposit insurance. Such a pricing scheme is shown to provide bank-owners with appropriate incentives to put in place optimal management compensation structures which induce the best, or most efficient, bank investment policies. In fact, for any level of deposit financing (or leverage) for a bank, we can characterize the optimal management compensation structure that bank-owners will choose (in their own self-interest) as well as the appropriate actuarially fair revenue-neutral FDIC insurance premium. In particular, the investment policy implemented by a bank is shown to be Pareto-optimal.

As is well known, stockholders of limited-liability banks financed by deposits (whether insured or uninsured) have incentives to take risk beyond that which is optimal for an "all equity" bank (see, for example, John, John and Senbet (1991)). This risk-shifting behavior by banks has been widely viewed as a major culprit in the recent S&L crisis. Capital regulation, prompt corrective action, asset restrictions and FDIC premiums -- based on the level of capitalization and supervisory characterization (CAMEL) of bank risk -- have been major policy initiatives by regulators since the 1991 passage of the FDICIA. In the first part of the paper we examine the risk-shifting incentives of banks in a simple model of asset choice in the presence of moral hazard and incomplete contracting. We then analyze the effectiveness of FDICIA type capital regulations and asset choice restrictions in that framework.

Our analysis shows several limitations of capital and asset choice regulation. First, capital regulation still leaves a high degree of risk-shifting incentives even for the best-capitalized banks (given the high leverage of banking firms). Second, for any level of bank capitalization, the degree of risk-shifting incentives critically depends on the characteristics of its investment opportunity set (i.e., the asset technology for risk-taking available to the bank). Third, mandatory asset restrictions can result in a significant degree of investment inefficiency.

Our analysis also has good news and bad news for the FDICIA provisions regarding the risk-based pricing or premium setting of FDIC insurance premia. The good news is that there is a qualitative parallel between the 1993 implementation of FDIC insurance premia that utilizes a bank's capital ratio and supervisory classifications, on the one hand,[1] and our theoretical result which links fair insurance premia to leverage and the observable parameters of a bank's asset investment schedule. The bad news is that mandatory restrictions on asset choice, which induce a common type of risk-taking for banks, are distortionary from an investment efficiency point of view. Further, we show that capital regulation may only have limited effectiveness in curbing risk-shifting incentives. Indeed, it is particularly ineffective for certain types of investment schedules (and wholesale loan markets) facing the largest banks.

The principal message of our paper is to argue for a prominent role for managerial compensation structures in bank regulation.[2] Unlike capital and asset regulations, which have at best *indirect* effects on managerial incentives and thus on managerial decisions, altering top-management compensation is a direct and effective way of influencing managerial return and risk taking incentives. Indeed, not only is management compensation readily observable by regulators, but recent empirical studies by Houston and James (1993) and Saunders, Strock and Travlos (1991), Evans, Noe, and Thorton (1997), and Teall and Knopf (1996) have found that managerial compensation -- salary and bonus in the case of Houston and James and managerial equity stakes in the case of SST -- are significantly correlated with bank returns and risk. Esty (1998) analyzes how liability rules and, therefore, the shape of the equityholders' payoff function affects incentives for risk-taking among banks. Studying a sample of national and state banks during

[1]The FDICIA required risk-based premiums to be fully implemented by 1994. The 1993-95 premium structure allowed for a 9bp spread in premiums between the best and worst banks. The premiums were set according to a bank's capital ratio and supervisory rating. In 1996, the premiums for the best banks were reduced to zero in response to falling bank failure rates and the build up of reserves at the FDIC to over 1.25% of bank deposits.

[2]The FDICIA of 1991 required regulators to restrict the compensation of managers in significantly undercapitalized banks. This implied a systematic regulation of compensation structures in undercapitalized banks. In 1992 Congress amended this regulation, allowing bankers to determine their own compensation structures, but giving regulators the *discretion* to impose restrictions on undercapitalized banks on a bank by bank basis.

during 1863 to 1935 operating under a range of differing liability rules, Esty documents that risk-taking is negatively correlated with the severity of stockholders' liability, i.e., bank stockholders subject to stricter liability exhibit less risk. There is also evidence consistent with managerial contracts in place influencing bank managerial behavior towards risk-taking in the 1980s, see Barth, Bartholomew and Labich (1990), and Cole, McKenzie and White (1990).

In an environment of moral hazard, investment-risk choices made by management are not readily observable by depositors and regulators, and hence are not contractible. However, for a given compensation structure in place, the risk choices which will be made by managers, in their own "self-interest," can be correctly anticipated by outsiders, such as depositors and regulators. This anticipated risk-taking can be incorporated in pricing all claims issued by the bank, including the pricing of deposit insurance premia. Therefore, for any level of bank capitalization, the incentive features in a bank's top-management compensation structure should be crucial inputs into deposit insurance pricing and other aspects of bank regulation. Thus, even though the setting may be one of moral hazard, and investment choices are unobservable, stockholders can be viewed as effectively precommitting to specific risk choices through the observable parameters of the compensation structure they put in place. Thus, incorporating the parameters of the compensation structure, as a determinant of FDIC insurance premia, prices the risk choices that will optimally be made by bank management.

Given such a FDIC pricing mechanism, which we characterize explicitly as a function of incentive parameters in the management compensation structure, we show that bank insiders (acting on behalf of the stockholders) would directly choose -- and put in place -- an optimal management compensation structure. The compensation structure is optimal in that it would induce management to undertake Pareto-optimal (value-maximizing) investment policies, *with no risk-shifting*. That is, stockholders use the management's compensation structure to precommit to the implementation of an optimal investment policy.[3] We show that for any level of deposits (or debt) such an optimal compensation scheme can be structured, and the associated FDIC premium can be characterized, in terms of the level of bank capitalization and the features of the bank's compensation structure. Moreover, the resulting investment policy is shown to be socially optimal. It should also be pointed out that the proposed scheme not only achieves an optimal bank investment policy and fair (revenue-neutral) pricing of FDIC insurance, but does so for any level of depository financing. This feature of the proposed scheme is important in that a socially optimal investment policy can be induced while simultaneously maintaining leverage levels which optimize an alternative objective that the social planner may have (e.g., provision of liquidity in the economy).

The rest of the paper is organized as follows: Section 2 characterizes a bank's risk shifting incentives and examines the efficiency of capital requirements and mandatory restrictions on asset choice. Section 3 provides a generalized analysis which incorporates the crucial role of a bank's management compensation structure on its asset choice and risk-taking. Section 4 is a summary and conclusion.

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[3]As it is well known in the agency tradition, it would be in the best interest of the stockholders to adopt *ex ante* compensation contracts which will induce the self-interested manager to implement *ex post* the value-maximizing investment policy. Given that all other claims such as deposits and insurance guarantees are properly priced, fully anticipating this induced investment policy, equity-holders cannot do better choosing any other compensation contract. The value decline resulting from the investment policy induced by any alternative (suboptimal) contract would thus be reflected in lower equity value and thus borne by the equity holders. Hence the equity holders (the residual claimholders) will find it in their best interest to put in place contracts which provide managers incentives to implement the investment policy which maximizes firm value.

2. Capital Regulation and Risk-Shifting Incentives

In this section we study the effectiveness of capital adequacy requirements, and the risk-shifting incentives of a bank, as a function of its asset or investment opportunity set. The model developed in this section also provides the setting for an analysis of the potential role of bank management compensation structures in bank regulation (and the setting of FDIC insurance premia) in section 3.

We show that the effectiveness of capital regulation depends on the shape of the investment schedule facing a bank. Different investment schedules imply different optimal levels of bank risk-taking, in the sense of the efficient allocation of bank funds. Mandatory provisions, that attempt to force banks into adopting a common pool or level of risk, induce allocational inefficiencies. Likewise, deposit insurance premia should, at a minimum, recognize differences in bank investment schedules as well as bank leverage.

In a market with a large supply of risky (near) zero-net-present-value investments (such as those in the capital markets or wholesale loan markets), the investment schedule is such that even at high levels of capitalization there are incentives for a high degree of risk-shifting. The current, post-FDICIA, risk-based FDIC deposit insurance premium schedule does not seem to reflect the existence of such an investment opportunity set. Even for high degrees of capitalization, large premiums may be required for some banks (e.g., wholesale money center banks) to take into account risk-shifting to very high levels under such investment opportunity sets.[4]

[4]It is not unreasonable to expect that different banks face different investment opportunity sets. For example, JP Morgan as a wholesale bank will tend to face a different investment opportunity set than more retail oriented banks such as Nationsbank and Citibank.

2.1 An Analytical Framework

A detailed model of the asset-risk choices made by a bank under moral hazard and incomplete contracting is developed here.[5] The model is designed to capture the key regulatory issues in a simple framework. This model serves as the analytical framework to study the relative effectiveness of capital regulation and for the development of the deposit insurance pricing mechanism based on management incentive structures proposed in section 3.

We begin with a representative depository institution (bank) under moral hazard and incomplete contracting. Consider a three date two-period model. At $t=0$, the bank collects deposits and engages in residual financing through equity subject to existing regulatory constraints. Deposits are insured by a government agency (the FDIC) and the bank pays the relevant insurance premium π. All associated contracts are written and "priced" at $t=0$, given the information available at $t=0$ and admissible contracting opportunities. The prices of the bank's financial claims (interest rates on deposits and the price of equity) are determined in a rational-expectations manner.

At $t=1$, asset investment opportunities appear. This represents the possible loans (asset choices) that the bank can make. For simplicity we assume that these investment opportunities are of two types: (1) safe investments which are loan opportunities (to which the bank has monopoly access) with zero risk and non-negative net present value (NPV), and (2) a choice from a menu of possible risky investments (loans) which are indexed by a parameter q. The investment required at $t = 1$ is an amount I. The returns from the risky loan-backed projects are

[5]In the structure of its basic set-up, the model is similar to that in section 2 of John, John and Senbet (1991). The reader may refer to that paper for additional details.

high or low (H dollars or L dollars, respectively), with $H>I>L>0$, where q is the probability of the high outcome H, and (1 - q) the probability of the low outcome, L. The bank's insiders observe the parameter q at $t=1$ before they choose between the riskless loan and risky loans. The value of the parameter q is not observed by outsiders -- that is, by either depositors or regulators (government). This precludes any contracting contingent on the value of the parameter q. However, all the relevant parties know that q is distributed uniformly over the interval [0,1]. This modeling device captures the intuition that, given the level of monitoring undertaken by regulators and outside investors, the managers/owners of the bank have additional (inside) information about the prospects of the loan (captured in q).[6] Therefore, bank insiders have discretion in their choice of investment risk.

The amount $(I + \pi)$ needed by the bank for investment and payment of the FDIC premium is raised at $t = 0$, in the form of deposits (debt) and equity. For simplicity, we assume that the deposits are in the form of pure discount debt of promised payment F due at $t = 2$. The depositors pay an amount B at $t = 0$ into the bank, where B represents the rational expectations price of the guaranteed promised payment F, incorporating the rationally anticipated loan choices to be made by the bank. In our framework, π can also be determined in a rational expectations manner as the actuarially fair value of the deposit insurance premium for the bank. However, the regulator may choose to charge an insurance premium that is less than actuarially fair (e.g., fixed) as a means of inducing a bank to expand its deposit base. This may serve the regulator's social objectives better (e.g., achieve a greater supply of liquidity to the economy).

[6]This informational friction gives rise to noncontractability of specific levels of q, and hence of investment risk-choices. This results in the well-known risk-shifting incentives in the presence of risky debt. This modelling device is consistent with the literature on agency cost of debt.

At t = 2, loans mature and the proceeds are collected. Let T denote this terminal cashflow which is equal to I if the riskless investment was chosen at t = 1, or equal to H or L depending on the outcome from the risky investment if that choice was made at t = 1. The firm pays the depositors *min* (F, T) and the deposit insurance agency (FDIC) honors its guarantee by paying the depositors *max* (0,F-T). Depositors are thus paid off fully if their deposits are fully insured for failure. We assume that all deposits are insured.

In this section, we assume that management's compensation in place completely aligns their incentives with those of the shareholders. In section 3, we will consider the choice of managerial compensation structures and their effect on risk choices and risk-shifting incentives, and how they should affect FDIC insurance premiums and regulatory actions. We do this through the following full-fledged, more elaborate, regulatory game: at t = 0 the regulator announces the "rules of the game" for the pricing of deposit insurance premium, π, and the bank stockholders optimally choose the structure of the management compensation scheme to be put in place also at t = 0. (Two classes of regulatory regimes for determining π, differentiated by whether or not the parameters of managerial compensation are incorporated in determining π, are studied along with the corresponding choice of managerial compensation structures). At t = 1, given the compensation structure in place, the manager observes the parameter q and chooses between safe loans and the risky loans. As in the model of section 2, all claims and contracts are settled at t = 2.

We abstract from discounting in all time periods by assuming that the riskless rate of interest is zero and we assume universal risk-neutrality.

2.2 *Bank's Optimal Investment Policy*

Definition 1:

For a given cut-off value of q^c, $0 \leq q^c \leq 1$, an investment policy of investing in the risky asset (loan) for $q \geq q^c$ and in the riskless asset (loan) for $q < q^c$ will be denoted as an investment policy $[q^c]$.

Lemma 1:

Given that q is uniformly distributed over [0,1], an investment policy $[\tilde{q}]$ *produces the distribution of terminal cashflows as follows: H with a probability* ½ $[1-\tilde{q}^2]$, *I with a probability* $\tilde{q}$ *and L with a probability* ½ $[1-\tilde{q}]^2$.

Proof: Straightforward computation yields the probabilities of the outcomes, L, H, and I as stated. ▩

The value of the terminal cashflows resulting from an investment policy $[\tilde{q}]$ denoted $V(\tilde{q})$, can easily be specified:

$$V(\tilde{q}) = \tilde{q}I + \frac{L}{2}[1-\tilde{q}]^2 + \frac{H}{2}[1-\tilde{q}^2] \qquad (1)$$

The standard deviation (risk) of the terminal cashflows, $\sigma(\tilde{q})$ can also be specified in the obvious manner. It is easily seen that as $\tilde{q}$ varies from 1 to 0, $\sigma(\tilde{q})$ varies from 0 to $(\frac{H-L}{2})^2$. This relationship between $\tilde{q}$ and $\sigma(\tilde{q})$ is strictly monotonic (decreasing), and hence one-to-one. $V(\tilde{q})$ also varies with $\tilde{q} \epsilon [0,1]$. The Pareto-optimal investment policy $[\hat{q}]$ which maximizes $V(\tilde{q})$ is given by:

$$\hat{q}=\frac{I-L}{H-L}. \qquad (2)$$

and the resulting value V($\hat{q}$) can be specified at follows:

$$V(\hat{q})=\hat{q}I+\frac{L}{2}[1-\hat{q}]^2+\frac{H}{2}[1-\hat{q}^2] \qquad (3)$$

When $\tilde{q}$ is varied from 1 to 0, the value of terminal cashflows increases from I to V($\hat{q}$) and then decreases to (H+L)/2. We can now combine the behavior of the standard deviation $\sigma(\tilde{q})$ and mean V($\tilde{q}$) achievable under different investment policies [$\tilde{q}$] to obtain the following pattern: as $\tilde{q}$ varies from 1 to 0, the investment policy becomes increasingly riskier (i.e., $\sigma(\tilde{q})$ increases monotonically) but the mean value first increases (from I to V($\hat{q}$)) attains a maximum at $\hat{q}$ and then decreases to (H+L)/2. As risk $\sigma(\tilde{q})$ increases from 0 to $\sigma(\hat{q})$, the mean increases first (from I to V($\hat{q}$)), and then for further increases in risk (from $\sigma(\hat{q})$ to $\left(\frac{H-L}{2}\right)^2$), the value declines from V($\hat{q}$) to $\frac{(H+L)}{2}$.

Equation (3) characterizes V($\hat{q}$), the value which could have been achieved if q were perfectly observed by all parties (including investors and regulators) and if a complete set of enforceable contracts specifying the bank's investment policy could have been written. In other words, V($\hat{q}$) is the highest value achievable in a full-information scenario with complete contracting. Thus, the investment policy [$\hat{q}$] and the resulting value, V($\hat{q}$), form useful benchmarks to measure the distortions caused by risk-shifting incentives due to financing with deposits (debt).

2.3 An Analysis of Capital Regulation

We now consider the incentive effects of a bank's financial structure on its investment incentives. Consider a bank with an arbitrary level of equity capitalization and corresponding level of deposit claims of promised payment F. Clearly F and a bank's equity capital ratio are inversely related. i.e., as F increases the proportion of funds provided by equity holders decreases.

When the level of depository financing is high enough, such that the bank's cashflows from investment are insufficient to repay the depositors in some state of the world (i.e., $L < F$), then bank management (acting on behalf of shareholders) will implement an investment policy riskier than $[\hat{q}]$. These risk-shifting incentives, induced by outstanding debt, are well-known. For completeness, we will characterize these incentives explicitly in Proposition 1 as a basis for capital regulation.

Proposition 1: (Risk-Shifting):

For a level of deposits of promised payment $F \geq 0$, the bank manager will implement an investment policy $[q(F)]$ where $q(F)$ is given in equation (4):

$$q(F) = \hat{q} \quad \text{when} \quad F \leq L$$
$$= \frac{(I-F)}{(H-F)} \quad \text{when} \quad L < F < I \qquad (4)$$
$$= 0 \quad \text{when} \quad F \geq I$$

Proof: Follows from John, John and Senbet (1991), Proposition 1.

Remark: For any value of deposits such that $F > L$ (i.e., in some states the bank cannot honor the promise to depositors from the cashflows of its investments), the bank manager implements an investment policy [q(F)] which is suboptimal (i.e., $V(q(F)) < V(\hat{q})$) and riskier than the Pareto optimal one, [$\hat{q}$], i.e., $\sigma(q(F)) > \sigma(\hat{q})$.

Using the risk-shifting incentives of depository financing characterized in Proposition 1, we formalize the motivation for capital regulation in the following corollary.

Corollary: (Capital Regulation)

In the range of depository financing F, L < F < I, higher levels of required equity capital (and correspondingly lower levels of F) lead to lower risk in the investment policy [q(F)], implemented by the manager and higher value V[q(F)] of the firm, i.e.,

$$\frac{\partial\sigma(q(F))}{\partial F}>0, \textit{ and } \frac{\partial V(q(F))}{\partial F}<0.$$

<u>**Proof**</u>: From equation (4) for L < F < I

$$\frac{\partial q(F)}{\partial F}<0$$

is readily verified. From the remarks below equation (3), it follows that

$$\frac{\partial\sigma}{\partial F}>0 \textit{ and } \frac{\partial V}{\partial F} < 0, \textit{ for } L < F < I.$$

As shown in the corollary, the extent of risk undertaken beyond the optimal level, $\Delta\sigma(F) \equiv \sigma(q(F)) - \sigma(\hat{q})$, as well as the value lost due to risk-shifting, $\Delta V(F) \equiv V(\hat{q}) - V(q(F))$, are both functions of the bank's equity capital. With a higher capital ratio, i.e., lower F, $\Delta\sigma$ is lower and ΔV is higher. Regulating the bank's incentives, via capital requirements, leaves the bank enough freedom to pursue activities which are unique to its investment opportunity set with attendant risk $\sigma(\hat{q})$. Importantly, regulations mandating the risk level of bank activities (loans extended) may push it to levels below $\sigma(\hat{q})$. That is, while capital regulation does allow the bank to go to a risk level of $\sigma(\hat{q})$ or beyond, the bank's own incentives would limit the risk-shifting to a total risk of $\sigma(\hat{q}) + \Delta\sigma(F)$. From a regulatory perspective, since banks have different investment opportunities with different maximal $\sigma(\hat{q})$, direct intervention by regulators to push *all banks to some common* (low) level of risk will not be optimal.

Since $\Delta\sigma(F)$ is increasing in F, it is clear that the total risk taken by the bank $\sigma(\hat{q}) + \Delta\sigma(F)$ is increasing in its leverage ratio or decreasing in its capital adequacy ratio. This implies that with lower and lower levels of capitalization, bank asset risk-shifting will be more and more severe. As the bank's degree of capitalization falls from well capitalized to critically undercapitalized, the degree of bank risk-shifting $\Delta\sigma(F)$ may increase dramatically. In the current regulatory case of prompt corrective action (PCA) zones 3 to 5, when the bank is undercapitalized (or worse, significantly or critically undercapitalized), $\Delta\sigma(F)$ could be at unacceptable levels. Here regulators may require insiders to recapitalize the bank so as to move it to a higher capital zone. Moreover the regulator may have incentives to restrict asset choice -- especially for poorly capitalized banks. That is, the regulator may directly restrict the asset activities of the bank such that for, any given level of F, its risk-shifting incentives are low.

Proposition 2: (Pricing of FDIC Premium Under Capital Regulation):

Given a level of capitalization corresponding to F, $F < H$, a fairly priced, revenue neutral, FDIC premium is specified as follows:

$$\pi(F) = q(F)(F - I)^{+} + (\tfrac{1}{2})(1 - q(F))^{2}(F - L)^{+} \qquad (5)$$

where q(F) is specified in (4) of Proposition 1 and a quantity y^{+} denotes max $\{0,y\}$.

Proof: Given a level of capitalization corresponding to F, the investment policy implementated is [q(F)], see definition 1. By Lemma 1, this investment policy produces payouts from the guarantor to the depositors of 0 with probability $\frac{1}{2}\{1 - (q(F))^2\}$, $(F - I)^+$ with probability q(F), and $(F - L)^+$ with probability $\frac{1}{2}(1 - q(F))^2$ respectively. The expected value yields $\pi(F)$ as in equation (5). ▩

It should be noted that even though we have assumed moral hazard (and incomplete contracting *vis a vis* risk choices), an appropriate FDIC insurance premium can still be specified. This premium can be tied to the capital ratio maintained by the bank as well as observable parameters of its investment opportunity set. In our framework the FDIC premium could be tied to F (the capital ratio) and {I, H, L}, the parameters of a bank's investment technology. Even though the details of the bank's risk choice (the realized level of q) are not observed by the regulator and are not contractible, the investment policy which will be implemented is [q(F)], as specified in Proposition 1. Hence the appropriate fair, revenue neutral, FDIC premium π is given by Proposition 2. For any level of debt $F > L$, equation (5) specifies the fair pricing of FDIC insurance incorporating the investment policy q(F) that would be induced. However, $q(F) \neq \hat{q}$ which follows from proposition 1.

Note that $\pi(F)$ is completely specified in terms of the bank's capitalization level and the observable parameters {I,H,L} of its investment opportunity set. In spite of moral hazard, the level of bank capitalization fixes the investment policy [q(F)] that a bank's management will pursue in their own best interests (in this case -- also the best interests of the stockholders). If the regulator further restricts the bank's activities directly, so as to alter the bank's investment parameters {I,H,L}, this will also be reflected in the premium $\pi(F)$ specified in (5). The implementation of the post-1993 FDIC premium based on capital zone rating and supervisory ratings (i.e., CAMEL or Capital, Asset Quality, Management Quality, Earnings and Liquidity) does have its parallels to our specification where the premium depends on capital and observable asset or investment technology parameters. However, the following limitations of capital regulation are immediate:

(1) For any level of risky debt, i.e., $F > L$, Proposition 1 tells us that $q(F) < \hat{q}$ and there is risk-shifting (i.e., $\Delta\sigma(F) > 0$) even if the FDIC premium is priced fairly (as given in (5)). This is because risk-shifting incentives remain, since banks typically have high leverage levels even in the high capitalization zones of the FDICIA's PCA provisions.

(2) Given that the FDIC premium is priced as in equation (5), and all other claims are fairly priced, the stockholders of the bank still suffer the costs of risk-shifting given by $\Delta V(F) \equiv V(\hat{q}) - V(q(F))$.[7] Since this value loss is minimized at $F = L$, stockholders would want to limit deposit (debt) financing. However, low levels of debt in the bank's capital structure may be inconsistent with the regulator's social objective regarding bank's provision of liquidity services to the economy. At high levels of leverage, the bank's risk-shifting problems get aggravated. In this context, it would be useful to have a solution to the risk-shifting problem which can be implemented at any level of leverage (bank deposits) and which would also be

[7]As in the established agency tradition, the agency costs of risk-shifting here is measured as the loss in firm value resulting from the distorted investment compared to the first-best investment (e.g., Jensen and Meckling (1976), Green (1984)). Note that the equityholders bear the entire agency costs, given that all external claims (other than equity, including debt) would be priced *ex ante* anticipating the distorted investment policy which would result from the equity holders *ex post* incentives to maximize equity value. Since the equity holders bear all agency costs, they would find it in their best interest to adopt mechanisms which minimize agency costs.

acceptable to a social planner (regulator). It can be seen that the mechanisms of bank regulation that we propose in section 3 can be implemented at *any level* of deposits (debt) for the banking sector.

(3) According to the provisions of the FDICIA, for poorly capitalized banks, certain mandatory restrictions may be imposed on the bank's asset choice. While the logic of asset regulation in modifying the bank's investment technology is clear, it can potentially lead to investment inefficiencies since the restrictions imposed by the regulator may remove positive net present value projects from the bank's menu of investment opportunities.

3. Bank Management Compensation

In this section we will explore the role of management compensation contracts in bank regulation. This is done by realistically allowing for different incentives among bank managers and bank owners, *i.e.*, explicitly recognizing agency conflicts between bank owners and managers as well as between bank insiders and outsiders. A general way of looking at bank regulation and the fair pricing of FDIC insurance premia is as follows: given the lack of contracting opportunities on specific risk choices to be made by the bank manager, the ability to precommit to specific risk choices is lost -- giving way to risk-shifting incentives and the possibility of mispriced FDIC insurance. The level of bank capitalization can provide some indirect precommitment. The level of bank capitalization is generally observable and it can be used to precommit to an investment policy, [q(F)] in (4), which in turn can be used to arrive at the FDIC premium $\pi(F)$ in (5). However, as Proposition 1 shows, some risk-shifting incentives will still remain.

In many ways, the incentives of a bank manager are most directly influenced through his or her compensation structure. In other words, bank owners can precommit to specific investment choices by revealing to regulators (outsiders) the observable details of the compensation mechanism they use to influence the incentives of the decision-maker, i.e., the manager.[8] By revealing the parameters of top-management's compensation structure, owners can precommit to an investment policy, which will be freely chosen by the manager given the compensation structure (and associated incentives) put in place by bank owners. Consequently, bank regulation and the pricing of FDIC insurance should take into account the parameters of top-management's compensation. If regulators price FDIC insurance correctly (incorporating parameters of the bank's compensation structure), but otherwise leave the choice of the compensation structure itself entirely to the bank's owners, it can be shown that bank owners will choose, *on their own*, the compensation structure which will induce a Pareto-optimal investment policy, [$\hat{q}$]. Moreover, to the extent that this can be accomplished, for any level of bank capital or deposits F, we obtain an additional degree of freedom such that the regulator can optimally choose bank leverage F^*.

The analysis in section 2 dealt with the risk-shifting incentives of managers who fully act in the best interests of equity-holders. In other words, the compensation structure in place was assumed to align perfectly management's interests with those of equity holders. In this section, we study the full-fledged regulatory game which proceeds as follows: at $t = 0$, the regulator announces the determinants of π, the FDIC premium (in particular, whether π will incorporate

[8]It is assumed here that bank corporate insiders (such as the Board of Directors) establish management compensation schedules.

the parameters of the management compensation or not). At t = 0, given the announced regulatory scheme for the determination of π, the bank owners freely choose the optimal compensation structure to put in place. Given the compensation structure chosen at t = 0, the manager makes the loan choice at t = 1 (in his or her best interest), after observing the realized value of q (the probability of the high outcome H for the risky loan). As in section 2, all claims and contracts are settled at t = 2.

The augmentation of the regulatory game in this section, allowing for the bank owners to choose management compensation structures optimally in response to the "rules of the game" for determining π, is a significant change from the model analyzed in section 2. The announced determinants of π will affect the optimal choice of management compensation structures in important ways. In particular, unlike in section 2, the endogenously chosen management compensation scheme *may or may not* align management interests with those of shareholders. The structure of management compensation in place most directly affects the riskiness of the investment policy implemented by management, when moral hazard and incomplete contracting provide some degree of managerial discretion over investment policy. We examine below, in section 3.1, how the incentive features of management compensation structures, together with a bank's capital ratio, determine the investment policy (and risk) implemented by the bank's manager in his own interest. In section 3.2 we examine the optimal choice of management compensation structures by bank shareholders for different regulatory regimes for determining π. These results provide the rationale for linking features of management compensation, along with the level of capital, to FDIC insurance pricing. This is particularly important in the light of the fact that capital requirements and asset restrictions have been the primary focus for U.S.

bank regulation to date (including post-FDICIA) while, managerial compensation has, at best, played a subsidiary role in regulatory design.

3.1 Incentive Features of Management Compensation

Although a large variety of compensation structures can be considered as candidates for bank management compensation contracts, we will consider a simple family of contracts with some important incentive features. This family is closely related to the structures observed in practice and includes among its members an optimal contract. In this sense, we believe that a restriction of the compensation structure to this piecewise linear family is without too much loss of generality.

The compensation structure is characterized as follows:

The manager gets a fixed cash salary, $S \geq 0$, and a fraction α of the equity of the bank. In addition to the salary he (or she) gets a bonus which is increasing in the degree of capitalization of the bank (or equivalently in the terminal cash flows realized).[9] If the bank is insolvent, or severely undercapitalized, the bonus is zero.[10] When the terminal cash flow T is such that $T - F > 0$, the first λ dollars of $T - F$ is paid to the manager as a bonus. The total payout to equity holders is max $\{0, T - F - \lambda\}$, and the manager gets a fraction, α of the pay-off to equity holders. Such a compensation contract will be called the contract $\{S, \lambda, \alpha\}$. For convenience, we will assume that the fixed salary component is paid out of the bank's operating

[9]See, Houston and James (1993) for a discussion of the greater relative empirical importance of cash compensation - salary plus bonus -- in banks relative to non-bank firms.

[10]This is intended to capture the adverse impact of financial distress on management such that management incentives are partially aligned with depositors. This is consistent with the empirical evidence on increased management turnover in financial distress (e.g., Gilson (1989)) and reduced management compensation in financial distress (e.g., Gilson and Vetsuypens (1993)).

cashflow such that the terminal cashflow T = {I, H, L} is residual to the fixed payments, S, to the manager (see Figure 1).

Insert Figure 1 Here

The manager will implement an investment policy, [q^m], which is optimal for him, given his compensation contract {S, λ, α}. It is clear that the investments undertaken (e.g., loans made) will depend on the parameters λ and α of the management compensation structure as well as the level of bank capitalization implied by F.[11]

In the next proposition, we assume that I - F - λ ≥ 0, for expositional convenience. That is, equity has some payout even when the riskless asset is chosen. We will now characterize the investment policy [q^m] and some of its properties.

__Proposition__ __3:__ **(Incentive Effects of Compensation Features):**

Given the management contract {S, λ, α} and a capitalization level F > L,

(a) The investment policy [q^m] implemented is given by equation (6).

$$q^m = \frac{(1 - \alpha)\,\lambda + \alpha\,(I - F)}{(1 - \alpha)\,\lambda + \alpha\,(H - F)} \qquad (6)$$

(b) For any λ > 0 and α < 1, q^m > q(F), i.e., the investment policy is less risky than when manager's interests are fully aligned with equity interests.

(c) $q^m(\lambda)$ is increasing in λ, i.e., the larger the bonus, the more conservative the investment policy.

(d) $q^m(\alpha)$ is decreasing in α, i.e., the larger the equity share of the manager, the riskier,

[11]There is now growing attention to the interaction between managerial compensation and capital structure in corporate finance. The relationship between investment policy and managerial compensation, given an existing capital structure, has been studied in John and John (1993). Also, Madan, Senbet, Soubra (1993) study the relationship between compensation structure and capital structure in the context of a three-party conflict between management, shareholders, and debtholders.

the investment policy.

Proof:[12]

(a) Given a management compensation schedule $\{S, \lambda, \alpha\}$ and $I - F - \lambda \geq 0$, the manager undertakes the risky project only when q is such that:

$$q[\lambda + \alpha (H - F - \lambda)] \geq [\lambda + \alpha (I - F - \lambda)]$$

Equivalently, when $q \geq q^m$, where q^m is given by equation (6), the investment policy implemented is $[q^m]$.

(b)Since $(H - F) > (I - F) \geq \lambda$, we have from (6),$q^m > q(F) = \frac{\alpha(I-F)}{\alpha(H-F)}$, *from* (4)

(c)Given $H > I$, and $0 < \alpha < 1$, we have $\frac{\partial q^m}{\partial \lambda} > 0$, *for* $\lambda \leq (I-F)$.

(d) For $(I - F) > \lambda > 0$, $\alpha > 0$ and $H > I$, we have $\frac{\partial q^m}{\partial \alpha} < 0$ ▩

The intuition of Proposition 3 is straightforward. For $\lambda > 0$, and $\alpha = 0$, the manager implements the very conservative investment policy [1], of investing in the riskless project for all values of q. He is only worried about protecting his bonus λ and implements an investment policy which turns out to be in the interest of depositors. Of course, such an investment policy is suboptimal from an efficiency point of view and results in loss of bank value $V(\hat{q}) - I$. As managerial equity share α is increased from 0, the manager acts more and more like an equityholder, implementing riskier and riskier investment policies. However, for any α

[12]As mentioned above, the restriction that $\lambda \leq (I - F)$ in Proposition 3 is mainly for expositional convenience. Although the expression for q^m in (6) changes slightly, result (b) holds for all values of $\lambda < (H - F)$ and $q^m = q(F)$ for $\lambda \geq (H - F)$. $(H - F)$ is a natural upper bound for λ. Interestingly q^m is increasing in λ for $\lambda \leq (I - F)$ and then decreases towards $q(F)$ in the range $(I - F) \leq \lambda \leq (H - F)$. Note that $q(F)$ is the lower bound for q^m for all values of λ. Indeed, our focus on the restricted case $\lambda \leq (I - F)$ is without loss of generality. In Proposition 6, we show that an optimal compensation contract $\{S,\hat{\lambda},\hat{\alpha}\}$ exists such that $\hat{\lambda} \leq (I - F)$.

< 1, protecting the bonus makes him act in a more conservative fashion than the q(F), of Proposition 1, where his interests were fully aligned with those of equity holders. As λ gets larger, the bonus is more important and he becomes more conservative, i.e., q^m is larger. Thus, in general, α and λ have offsetting effects on managerial risk-taking incentives.

Corollary: (Management Incentives and FDIC Premia)

For any capital level corresponding to F, where $I > F > L$, and management compensation structure, $\{S, \lambda, \alpha\}$:

(a) when $\lambda = 0$ and $0 < \alpha \leq 1$, the manager is fully aligned with equityholders and implements the investment policy $q^m = q(F)$. The corresponding, fairly-priced, revenue-neutral FDIC premium is $\pi(F)$, as specified in equation (5).

(b) when $(I - F) > \lambda > 0$ and $\alpha = 0$ the manager is fully aligned with the depositors and implements the investment policy [1], i.e., for all $q \epsilon [0,1]$, he invests in the risk-less loan. The corresponding, fairly-priced, revenue-neutral FDIC premium is zero.

<u>**Proof**</u>:

(a) Substitute $\lambda = 0$ in equation (6) to obtain $q^m = \dfrac{\alpha(I - F)}{\alpha(H - F)} = q(F)$ from (4). Here the manager is fully aligned with equity-holders and the investment policy q(F) and the corresponding FDIC risk-premium, π(F) are as in Propositions 1 and 2, respectively.

(b) Substitute $\alpha = 0$ in equation (6) and $q^m = 1$. The investment policy [1] involves investing in the riskless loan for all $q \epsilon [0,1]$. The resulting output I is always sufficient to pay back the depositors, given $F < I$. The guarantor's liability is always zero, and the fairly-priced, revenue-neutral FDIC premium equals zero. ▩

Two insights follow from the above discussion for FDIC regulation. First, it is clear that the structure of management compensation, e.g., size of bonus (λ) relative to managerial equity share (α), may affect the riskiness of the bank's asset portfolio in a manner analogous to the level of capital (leverage) maintained. The corresponding FDIC premium can vary from 0 to $\pi(F)$. Hence, regulatory policy, and FDIC premiums, should potentially take into account the incentive features of management compensation. Second, since managerial bonus and the equity fraction have offsetting effects on a manager's risk-shifting incentives, a bank may be able to fine-tune these two incentive features so as to precommit to implementing a Pareto-optimal investment policy. We will discuss these two insights further below.

For any level of debt F, Proposition 3 implies that investment policy $[q^m]$ is safer than $[q(F)]$, for $\lambda > 0$. How much more conservative $[q^m]$ is in relation to $[q(F)]$ is determined by the management's compensation structure; specifically, by the relative importance of λ and α. Larger α's bring q^m closer to $q(F)$ and larger λ's take it closer to 1. By implication, regulatory actions in each of PCA's five zones of capitalization should take into account the incentive features of the management compensation schedule used by the bank. For example, a bonus which is lower for inadequate levels of bank earnings and by implication inadequate levels of bank capital, will induce *less* risk-shifting incentives by management.

Discretionary regulatory restrictions on the salary of officers (top-management) in significantly and critically undercapitalized banks -- included in the prompt corrective action (PCA) provisions of FDICIA -- seem to be somewhat similar in spirit to the results we have derived here -- although our results suggest that such regulatory restrictions should be *bank specific in nature*. We can also argue that the incentive features of the compensation structure in place should be considered more directly in setting appropriate FDIC insurance premia.

3.2 Pricing of Deposit Insurance and Management Compensation

In this section we will consider the effect of the pricing of deposit insurance on the optimal choice of management compensation structures by bank stockholders. We will consider two classes of deposit insurance pricing schemes. The first class of schemes do not explicitly incorporate incentive features of management compensation structures in the pricing of deposit insurance. As examples of this class of pricing schemes we will consider fixed premium deposit insurance pricing and a risk-based scheme based on a bank's capital adequacy. Together these two schemes are stylistic representations of the pre-1993 and post-1993 FDIC insurance pricing schemes.[13]

The second class of schemes proposed here will incorporate explicitly the observable features of management compensation structures in the setting of the deposit insurance premiums. The results below will show that when the regulator is using compensation-based deposit insurance pricing, it would be in the best interests of stockholders to select and implement a compensation structure for the bank manager which eliminates risk-shifting. On the other hand, deposit insurance pricing schemes of the first class, which do not incorporate the management's compensation features explicitly in deposit insurance pricing, will induce the bank stockholders to pick management compensation structures that align management's interests with shareholders and leave risk-shifting incentives intact.

Proposition 4: (FDIC Premium Schemes and Managerial Compensation Structures)

Consider a deposit insurance pricing regime; where:

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[13]Although it might be noted that the post-1993 pricing scheme also takes into account the bank's CAMEL supervisory rating. However, CAMEL ratings do not explicitly incorporate incentive features of management compensation.

(a) the premium π is fixed,

(b) the premium $\pi(F)$ is capital-based, i.e., $\pi(F) = kF$, where $0 \leq k \leq 1$, and F = the level of deposits.

Given the above pricing schemes, the bank's stockholders will optimally choose a compensation structure, (S, λ, α) where $\lambda = 0$, $\alpha > 0$, which preserves management's risk-shifting incentives.

<u>Proof</u>:

<u>Part (a) The Premium π is Fixed</u>: Given that π is independent of $F > 0$, and $\{S, \lambda, \alpha\}$, the bank stockholders will find it optimal to choose a compensation structure which will induce an investment policy that maximizes equity value. The investment policy which maximizes the value of equity is to invest in the risky project when q satisfies:

$$q\ [H - F]^{+} + (1 - q)\ [L - F]^{+} \geq [I - F]^{+}$$

(where a quantity y^{+} denotes max $\{0, y\}$). The corresponding investment policy is $[q(F)]$, where

$$q(F) = \frac{(I - F)}{(H - F)}$$

This investment policy will be induced by stockholders through choosing, for the management, a compensation contract $\{S, \lambda, \alpha\}$, with $\alpha > 0$, $\lambda = 0$, as shown in part(a) of the Corollary of Proposition 3. By the Corollary, the chosen compensation structure will preserve the management's risk-shifting incentives. ▩

<u>Part (b) The Premium $\pi(F)$ is Capital-Based</u>: Given that the deposit insurance regime $\pi(F)$ is independent of the compensation structure $\{S, \lambda, \alpha\}$, again the bank stockholders will pick the parameters of compensation structure to induce an investment policy $[q(F)]$ which is equity-value maximizing. As in part (a), this can be accomplished by setting $\alpha > 0$ and $\lambda = 0$ in the chosen

compensation contract, which again preserves management's risk-shifting incentives. ▩

Both of the above FDIC pricing schemes, (which do not incorporate management compensation features into FDIC pricing) lead to compensation choices by bank stockholders which induce an investment policy [q(F)] involving risk-shifting.

In Proposition 5 below, we characterize an FDIC insurance pricing scheme that incorporates the incentive features of bank management compensation, for any given compensation structure $\{S, \lambda, \alpha\}$. In the subsequent proposition (Propositions 6), we show that a compensation-based deposit insurance pricing scheme will lead bank stockholders to choose compensation structures that induce management to choose the optimal investment policy i.e., $q^m = \hat{q}$.

In Proposition 5, we derive the appropriate FDIC insurance premium, π^m, where the incentive effects of management compensation on asset risk choice are directly considered.

<u>Proposition</u> <u>5</u>: (Pricing FDIC Premia by Incorporating Managerial Compensation Features):

Given a level of bank capital corresponding to F, $F < H$, and a management compensation contract $\{S, \lambda, \alpha\}$ in place, a fairly priced, revenue-neutral, FDIC premium is specified as follows:

$$\pi^m = q^m(F - I)^+ + \tfrac{1}{2}\,(1 - q^m)^2\,(F - L)^+ \tag{7}$$

where q^m is specified in equation (6) of Proposition 3 (and a quantity y^+ denotes max $\{0, y\}$).

<u>Proof</u>: From Proposition 3, part (a), given the managerial compensation contract $\{S, \lambda, \alpha\}$, the manager implements an investment policy $[q^m]$, where q^m is as in equation (6). By

Lemma 1, such an investment policy produces the cashflow distribution L with probability ½ $(1 - q^m)^2$, I with probability q^m and H with probability ½$\{1 - (q^m)^2\}$, with corresponding payoffs from the guarantor to the depositors of $(F - L)^+$, $(F - I)^+$ and 0, respectively. The expected value of these payoffs, π^m in equation (7) is, therefore, a fairly priced, revenue-neutral FDIC premium. ▩

Note that π^m is specified in terms of F, the observable parameters of the management compensation structure, λ and α, and, as before, parameters of the bank's investment opportunity set {I, H, L}. In spite of moral hazard and incomplete contracting, we know that $[q^m]$ in equation (6) is the investment policy that bank managers will pursue in their own best interest, given the bank's capital and management compensation structure in place. Linking FDIC premia to the capital and compensation parameters enables the regulator to get at the correct risk choices that would be implemented by investment policy $[q^m]$.

3.3 An Optimal Management Compensation Structure

For any given level of F, and management compensation $\{S, \lambda, \alpha\}$ in place, the investment policy implemented will be $[q^m]$, where q^m is specified in (6). If the insurance premium π^m is correctly priced as in (7) (and correspondingly, depositors' claims are correctly priced) anticipating rationally the investment policy $[q^m]$, then the bank's equity holders suffer the loss in value, $V(\hat{q}) - V(q^m)$, due to the distorted investment policy $[q^m]$. This makes it in the best interests of the equity holders to choose, at $t=0$, capital and compensation structures which will induce managers to pick, (at $t=1$) an investment policy $[q^m]$, where $q^m = \hat{q}$, the Pareto-optimal investment policy.

Given the level of capital F, the management compensation parameters λ and α can be chosen by the equity holders to induce the investment policy [$\hat{q}$]. In fact, for any level of F, an optimal compensation structure can be chosen by owners such that the Pareto-optimal investment policy is implemented.

Proposition 6: (Optimal Compensation Features):

(a) Under the deposit insurance pricing scheme given in Proposition 5, the bank stockholders will optimally choose a compensation structure which induces an investment policy [$\hat{q}$].

(b) A compensation structure {$S\ \hat{\lambda}\ \hat{\alpha}$} which induces the investment policy [$\hat{q}$] has its parameters satisfying the relation:

$$\hat{\lambda} = \frac{\hat{\alpha}}{(1 - \hat{\alpha})} (F - L) \qquad (8)$$

Proof:

(a) For any compensation structure (S, λ, α), the investment policy picked by the management satisfies [q^m] in equation (6) and the resulting total value is V(q^m) as specified in equation (1), but substituting $q = q^m$. If the deposits and deposit insurance (and any other outstanding claims) are priced correctly (as zero net-present-value transactions), the residual claimants' wealth equals V(q^m). Any deviations $q^m \neq \hat{q}$ from the optimal investment $\hat{q}$ in equation (2) results in a wealth loss V($\hat{q}$) - V(q^m) to the bank's stockowners. The stockowners will optimally pick a compensation structure which will induce the management to pursue an investment policy [$\hat{q}$] which minimizes V($\hat{q}$) - V(q^m).

(b) Substitute equation (8) in the expression for q^m in equation (6) and simplify to obtain

$q^m = \hat{q}$. This implies that a compensation structure $\{S,\hat{\lambda},\hat{\alpha}\}$ satisfying (8) is an optimal one.

Although the optimal pair $(\hat{\lambda},\hat{\alpha})$ are not uniquely specified, the relationships in equation (8) which imply larger $\hat{\alpha}$'s with larger $\hat{\lambda}$'s is intuitive. For a large value of the bonus λ and a small value of equity ownership α, the manager will invest too conservatively, i.e., $q^m > \hat{q}$. On the other hand, if λ is small and α is large, then the manager engages in risk-shifting, i.e., $q^m < \hat{q}$. The trade-off between λ and α produces the "middle-ground" optimal values given by equation (8).

<u>**Remark**</u>:

It is useful to contrast Proposition 6 with Proposition 4. As we know from equation 6, a given set of compensation parameters can be uniquely mapped into the investment policy [q^m], hence an insurance premium specifying the parameters of the compensation structure is tantamount to contracting on a specific investment policy [q^m]. In such a setting, it is optimal for the stockholders to pick the optimal compensation structure $\{S,\hat{\lambda},\hat{\alpha}\}$ and equivalently precommit to implementing the value-maximizing investment policy [$\hat{q}$]. On the other hand, in Proposition 4, since regulators currently use a deposit insurance pricing scheme that is insensitive to the compensation parameters $\{S,\lambda,\alpha\}$, it is tantamount to making [q^m] noncontractible. As is well-known, in such a setting, the choice of compensation structure (and equivalently the subsequent choice of the corresponding investment policy [q^m]) is made to maximize the value of equity. Even when the resulting investment policy [$q(F)$] is anticipated in the pricing of deposit insurance (as in equation (5)) the risk-shifting incentives remain as $q(F) < \hat{q}$.

The role of management compensation in controlling investment distortions has been previously considered in the literature. In particular, Dybvig and Zender (1991) show how the underinvestment problem à la Myers and Majluf (1984) can be solved by using optimal managerial compensation contracts. There are, however, important differences between our paper and Dybvig and Zender (1991). We model the incentive problems in a banking system with deposit insurance in place. In our paper, the rules of the game used by the regulator in pricing deposit insurance determine the choice of management compensation structures by the bank's stockholders. Whether or not the optimal compensation structure would be chosen by the bank's stockholders depends on the determinants of the deposit insurance pricing schedule set by the regulator, as we show in Propositions 4,5 and 6. This additional stage of interaction, between the deposit-insurance pricing scheme used by the regulator and the bank stockholders' choice of management compensation scheme, which is absent in Dybvig and Zender, plays a central role to our analysis.[14] We show that the correct pricing of deposit insurance premiums, based on compensation features in place, is crucial to providing the bank owners incentives to choose optimal compensation structures for its top management, which in turn induces the optimal investment policy by the bank management.

Another interesting observation is that in a regime where FDIC premiums are fairly priced, by linking premiums to both capitalization (i.e., F) and management compensation parameters (i.e., λ and α), equityholders are induced to pick the optimal compensation structure

[14]Other differences include the specific nature of information problem and the priority structure of the manager's claim. The investment distortion in Dybvig and Zender (1991) arises from asymmetric information, while in our framework, moral hazard and incomplete contracting induces risk-shifting incentives. Moreover, the explicit form of the optimal compensation differs from Dybvig and Zender. We adopt a priority structure for manager's claims consistent with current legal and regulatory policy (e.g., Depositor Preference Legislation, 1993).

$\{S, \hat{\lambda}, \hat{\alpha}\}$ at $t=0$ as a means of *precommitting* to the depositors and regulators that the optimal investment policy $[\hat{q}]$ will be implemented. Consequently, banks need only be charged the insurance premium $\pi^m(\hat{q})$ specified in (7). That is, the regulator does not have to *mandate* the exact details of the bank's managerial compensation as was initially implied under the original FDICIA proposal for poorly capitalized banks. Instead, equityholders, will in their own self-interest, put in place an optimal compensation structure at $t=0$. Since the effectiveness of the precommitment depends on the observability of the parameters of the compensation scheme, such as λ and α, the appropriate audit and regulatory processes must play a role in facilitating the precommitment aspect of the compensation structure. Moreover, recent SEC regulation, which requires mandatory disclosure of the details of management compensation structures, should be helpful in achieving the degree of transparency required. Finally, the disclosure costs for banks should also be quite small. That is, requiring (and monitoring) disclosure of bank compensation schemes should be a relatively low cost form of regulation, especially compared to seeking to monitor and control the asset/investment technologies of banks, as is current practice.

3.4 Implementation Issues: Compensation vs. Capital Regulation

There are two additional important issues related to implementation. Firstly, "what happens if bank owners shift the compensation schedule" after the insurance premium is set? It should be noted that this is no different from banks' reducing their capital-asset ratios after premiums are set. In both cases this can be addressed by either (i) a more frequent adjustment of insurance premiums, and/or (ii) a back-evaluation approach whereby banks are penalized by an additional (back-end) premium at the end of each premium-setting period, should actual compensation (capital) structures differ significantly from initial compensation (capital) structures.[15] If penalties are sufficiently high, there will be no incentive for bank owners to distort compensation (capital) structures in this fashion.

The second issue relates to the view that bank capital is potentially more observable (measurable) than bank compensation structures. However, as is well known, measuring the economic (market) rather than book value of bank capital can be extremely difficult, involving, among other things, the valuation of non-traded assets and liabilities (e.g., demand deposits) as well as valuing contingent (off-balance-sheet) assets and liabilities. By contrast, as noted above, bank compensation contracts may be relatively more transparent, especially in view of recent changes by the SEC requiring greater disclosure of managerial compensation.

4. Conclusions

We have examined the incentive structure of the post-FDICIA regulation of U.S. banks, particularly, the efficacy of bank capital requirements and restrictions on asset risk choice, in controlling banks' risk-shifting incentives. While demonstrating the limitations of capital and asset regulation, we argue for a more prominent role for management compensation structures in bank regulation and specifically in the pricing of FDIC insurance. We show that the effectiveness of capital regulation hinges on the characteristics of the underlying asset investment opportunity set facing a depository institution.

A principal aspect of our analysis is to consider, not only agency conflicts between the regulator and a bank, but also between a bank's management and the owners of the bank (see

[15]This type of "back-end" penalty scheme is to be implemented to support capital requirements for market risk that came into effect in 1998.

Section 3). This is particularly important, because investment risk choices are generally controlled by management whose risk-taking behavior depends on the structure of the compensation schedule specified by stockholders. In particular, we show how managerial compensation serves as a direct regulatory mechanism that induces optimal investment risk choice from the standpoint of the regulator.

Importantly, we show that Pareto-optimal investment risk choices by banks can be achieved without direct regulation of managerial compensation and/or equity capitalization. We show that, when a fairly priced insurance premium reflects the structure of managerial compensation, along with the level of bank capitalization, it pays bank equity-holders to pick optimal managerial compensation contracts that ensure first-best investment risk choices. That is, there is no need to regulate the details of managerial compensation contracts, so long as they are observable, since picking an optimal compensation scheme precommits equity holders to value-maximizing investment choices. The regulatory role of bank management compensation is particularly significant, given the limitations of capital and asset regulation.

Analogous to our results on capital regulation, there is a practical regulatory parallel regarding the role of bank management compensation. In particular, it is clear that regulatory action in the five zones of the PCA program should actively take account of the incentive effects of managerial compensation on bank risk-taking. While discretionary bank-specific restrictions on the pay of officers of critically undercapitalized banks, (as suggested in the PCA provisions of FDICIA), seem desirable in the context of our analysis, our results suggest that *no direct or mandatory regulation* of management compensation is required as long as the insurance premium incorporates parameters of the compensation structure in place, as well as level of bank capitalization.

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