THE EFFECTS OF THE BANK HOLDING EQUITY OF THE FIRM: FROM A MORAL HAZARD PERSPECTIVE

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Abstract

After the repeal of the Glass-Steagall Act in 1999, commercial banks are allowed to hold equity in firms. The current financial crisis also helps make banks universal in the US. This paper investigates the effects of the bank's equity holding of the firm from a moral hazard perspective. The bank's equity holding of the firm is shown to help mitigate the conflicts between the firm's shareholders and debtholders. However, it also creates another moral hazard problem, namely, the bank as an institutional shareholder can collude with the firm manager to pursue perks from project return. Without this moral hazard problem, the bank's optimal equity holding of the firm is shown to be at the point where its share of the firm's equity equals its share of the firm's debt. With this moral hazard problem being taken into consideration, the bank's optimal equity holding should be less than its debt share in the firm. Otherwise, the bank will force the firm to pursue overly risky projects. If asymmetric information is introduced into the model, the bank's equity holding becomes a signal to the outside debtholders, thus should be capped above by a certain level. Thus, the paper shows that regulations still need to be imposed on banks' equity holding in firms.

Keywords: Universal Banks, Moral Hazard, Regulations

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1. Introduction

The lessons learned from the great depression caused the US Congress to enact the Glass-Steagall Act (1933) and other regulations, which successfully separated investment banking from commercial banking and prevented commercial banks from providing other forms of finance than loans to industrial firms. Thus, commercial banks had been restricted from holding equity in firms in the US in most of the last century. The main argument for such a regulation is that the bank's equity holding of the firm will greatly increase portfolio risk of the bank, thus increase the probability of bank failure. Moreover, the bank is traditionally viewed as a delegated monitor of the firm [see, for instance, Diamond (1984) and Williamson (1987)], compared with other stakeholders (e.g., arms-length creditors). Some scholars worry that the bank's equity holding in the firm may produce severe moral hazard problem - the banker can collude with the firm manager to pursue private benefits at the expense of other stakeholders and, especially, the FDIC [see, for example, Boyd, Chang and Smith (1998)].

However, in other developed countries (the typical representatives of them are Germany and Japan), banks are free to hold equity in industrial firms. For example, in Germany the shareholdings of large banks are around 6% of the banks' total assets [Gorton and Winton (2002)]. Although empirical evidences are mixed in this field, some studies do find that bank equity holding improves firm performance [see, for example, Gorton and Schmid (2000) for the evidence from Germany]. Thus there are likely some social benefits related to banks' equity holding in firms.

Back to the US, the Congress repealed the Glass-Steagall Act (1933) in 1999 under the big trend of deregulation at the end of the last century. Furthermore, the current financial crisis is swiftly and dramatically reshaping the banking industry. During the last minute fire sales, Bear Sterns was acquired by JP Morgan Chase, and Merrill Lynch is to be acquired by Bank of America. Goldman Sachs and Morgan Stanley are allowed to attract direct deposits and do business in commercial banking. Universal banks (such as Citigroup, JP Morgan Chase and Bank of America) have been made in the US. How to regulate the new universal banking system immediately becomes a big concern to both the policy makers in Washington and the academia.

This paper tries to address the following issue: should the bank be allowed to hold equity in the firm? If yes, what should be the bank's optimal equity holding from a social welfare standpoint? Should there be regulations imposed on banks' equity holding in firms. There is some literature, both theoretical and empirical, which discusses the issue from different

perspectives. The studies closely related to this paper are Berlin, John and Saunders (1996), Boyd, Chang and Smith (1998), and Park (1999).

Berlin et al. (1996) show how the bank's equity holding in the firm can play a positive role in credibly subordinating the bank's claim to those of other stakeholders, thus prove that it cannot collude with a financially distressed firm to misrepresent the firm as healthy, at the expense of other stakeholders. They also show that in order to prove that the bank cannot collude with a financially healthy firm to misrepresent the firm as distressed, the bank's equity holding in the firm should be capped above. Boyd et al. (1998) show that allowing the bank to take equity in the firm will create an opportunity for the bank to collude with the firm manager to abscond investment fund and choose the riskier project, and pass all the costs to the FDIC. Thus moral hazard problems are exacerbated, and allowing the bank to hold equity in the firm is suboptimal. Park (1999) show that the bank's equity holding can improve the firm's investment efficiency, and that investment efficiency is maximized when the bank holds equal shares of the firm's debt and equity. However, since the bank's equity holding increases the monitoring need of uninformed creditors, the bank's optimal equity holding should be somewhere between zero and its debt share in the firm.

In this paper I investigate the issue from a moral hazard perspective. The simple model setting of the paper allows me to derive the main results of the three studies mentioned above in a single framework.

The main intuition of the paper is that the firm manager, who acts in the interest of shareholders, will choose overly risky project if given the opportunity to do so, thus transfer wealth from incumbent debtholders to shareholders and create the moral hazard problem. The bank, who is a debtholder and acts as a delegated monitor, can resolve this moral hazard problem. However, since the bank is a debtholder of the firm thus care only about the downside of the firm's project (it cannot share the upside), it will force the firm manager to choose overly safe project, thus transfer wealth to debtholders at the expense of shareholders, and reduce the firm's investment efficiency. The bank's equity holding in the firm will improve investment efficiency to the point where the bank holds equal shares of the firm's debt and equity[41]. However, since the bank now already has a substantial portion of its claim (its equity holding of the firm) subordinated to the other debtholders[42], as an institutional shareholder it will have an incentive to collude with the firm manager to choose overly risky project and enjoy perks from the project return, as long as the portion of perks the bank can enjoy is greater than its equity share in the firm (in fact, in my simple model the bank will have no incentive to collude if it can only enjoy a portion of perks equal to its equity share). Thus the second moral hazard problem arises.[43] The bank's optimal equity holding ('optimal' in the sense that dead weight loss is eliminated), due to this second moral hazard problem, should be below its debt share in the firm, and should be to the point where the portion of perks the bank enjoys equals its debt share. If asymmetric information is introduced into the model, the paper shows that the bank's equity holding becomes a signal to outside debtholders, thus should be capped above by a certain level.

The remainder of the paper proceeds as follows: the second section describes the model and derives the main results when only the first moral hazard problem is considered; the third section derives the bank's optimal equity holding when the second moral hazard problem is also taken into consideration; the fourth section extends the model into the asymmetric information cases; the fifth section concludes.

2. The Model and the Role of Bank Equity Holding in Improving Investment Efficiency

The model has a simple one-period static setting: a firm is set up at time 0 to invest in some one-period projects. At time 1 (when the project returns are realized) the firm has asset in place with market value A (assumed to be cash in hand), and has debt with value D and equity with value E in its capital structure (Obviously, A = D + E). At time 1 the firm manager faces a continuum of mutually exclusive one-period projects with identical initial investment A and return attributes as following.

Investment (Time1)	Return (Time 2)
A	R with probability P(R)
	0 with probability 1 - P(R)

Let us assume the success probability P(R) is a continuous, twice-differentiable function of R with

$$0 \le P(R) \le 1,\ \frac{dP}{dR} < 0,\ \frac{d^2P}{dR^2} < 0 \text{ for } 0 \le R \le \overline{R}$$

$$P(0) = 1,\ P(\overline{R}) = 0$$

The manager's project choice at time 1 and the realized state at time 2 are assumed to be observable but not verifiable (thus not contractible). The debtholders and shareholders of the firm face the alternative risk-free investment opportunity at time 1 with gross return $R_f = 1$ at time 2. The debtholders are promised a gross return R_D at time 2 (obviously, $R_D > 1$) by the firm. Both the debtholders and shareholders can choose to redeem their claims at time 1 and invest in the alternative risk-free opportunity. If either the

[41] This result is the same as that in Park (1999), and is proved under my simple model setting.

[42] Here I employ the argument from Berlin et al. (1996) that equity holding is a way for the bank to credibly subordinate its claim.

[43] This is similar to Boyd et al. (1998), with the main difference being that in their model the bank can only collude with the firm manager to abscond investment fund and enjoy a portion equal to its equity share, while in my simple model the bank can only collude with the manager to pursue perks from project return, and can enjoy a portion greater than its equity share.

debtholders or shareholders redeem their claims at time 1, the firm will be dismissed.[44] If not, the firm manager will choose a project (R, P(R)) to invest, and the firm will be dismissed after investment return is realized and claims are paid out at time 2. Assume that the firm manager acts in the interest of the shareholders.[45] For simplicity, also assume that all agents are risk neutral.

2.1. The First-Best Project Choice

Since the expected return of the firm's project,

$$E(R) = RP(R)$$

From the first-order condition, we have

$$\frac{dE(R)}{dR} = P(R) + R\frac{dP(R)}{dR} = 0 \qquad (1)$$

From the second-order condition, we have

$$\frac{d^2E(R)}{dR^2} = 2\frac{dp(R)}{dR} + R\frac{d^2P(R)}{dR^2} < 0 \qquad (2)$$

From (2) we know that the first-order derivative of the expected project return with regard to R is a monotonically decreasing function of R. Also we have

$$\frac{dE(R)}{dR}\Big|_{R=0} = 1 > 0 \text{ and } \frac{dE(R)}{dR}\Big|_{R=\overline{R}} < 0$$

Thus there is only a unique $R^* \in (0, \overline{R})$ which satisfies (1) and is also a maximizer of E(R). Let us further assume

$$R^*P(R^*) > 1$$

$$(AR^* - DR_D)P(R^*) > A - D \qquad \text{thus}$$

$$R^* > \frac{DR_D}{A}, \text{ and } R_D P(R^*) > 1$$

Thus (R^*, $P(R^*)$) is the mutually feasible solution for both the debtholders and shareholders, and is the first-best outcome, which serves as a benchmark in the model.

2.2. The First Moral Hazard Problem - Project Choice without Delegated Monitor

If the bank does not hold either debt or equity of the firm, and if the debtholders of the firm are all small arms-length debtholders (e.g., corporate bondholders) each possessing a negligible portion of the firm's total debt, the debtholders will not take time and other resources to monitor the firm, since they are subject to the free-riding problem. Thus we have the following proposition.

Proposition 1. *Given the opportunity, the firm manager who acts in the interest of shareholders will choose overly risky project to transfer wealth from debtholders to shareholders.*

Proof. The manager will choose the project which solves the following optimization problem.

$$\text{Max. } (AR - DR_D)P(R) \qquad (3)$$

$$\text{s.t. } DR_D P(R) \geq D$$

The first-order condition of (3) gives us

$$\frac{d(AR - DR_D)P(R)}{dR} = AP(R) + (AR - DR_D)P'(R) \qquad (4)$$

Evaluate (4) with the first-best project choice (R^*, $P(R^*)$), we get

$$\frac{d(AR - DR_D)P(R)}{dR}\Big|_{R=R^*} = -DR_D P'(R^*) > 0$$

Thus the manager will choose a riskier project with return R greater than (hence success probability P(R) less than) the first-best level.

The second-order condition of (3) gives us

$$\frac{d^2(AR - DR_D)P(R)}{dR^2} = 2AP'(R) + (AR - DR_D)P''(R) < 0 \qquad \text{for } R \geq R^*$$

Also we have

$$\frac{d(AR - DR_D)P(R)}{dR}\Big|_{R=\overline{R}} = (A\overline{R} - DR_D)P'(\overline{R}) < 0$$

Thus there is a unique $R' \in (R^*, \overline{R})$ which equates the first-order condition (4) to zero and is the maximizer of (3). Since the manager's project choice must also satisfy the constraint of the optimization problem, he will choose the project with return equal to $\min(R', P^{-1}(1/R_D))$, which is greater than R^*. **Q.E.D.**

Thus the manager's project choice will be $\min(R', P^{-1}(1/R_D)) > R^*$, and the deadweight loss will be $A[R^*P(R^*) - \min(R', P^{-1}(1/R_D)) * P(\min(R', P^{-1}(1/R_D)))]$.

2.3. The Project Choice with the Bank as a Debtholder and Delegated Monitor

Now let us consider the case that the bank is a debtholder of the firm with its share in the firm's debt value being β ($0 < \beta \leq 1$). Since the firm manager is assumed to act in the interest of the shareholders, following Boyd et al. (1998) I assume that as a debtholder (without any equity share in the firm) the bank cannot collude with the manager to pursue perks at the expense of other stakeholders of the firm.[46]

[44] Here I assume that if one party of the firm's financiers redeems its claim in the firm at time 1, the firm cannot get refinance from other parties due to capital constraint, regulation restriction, or diversification concern, and it is even more difficult for the firm to raise finance from somewhere else, thus it has to be dismissed at time 1.

[45] Since this paper focuses on the role of bank equity holding, I ignore the Jensen and Meckling (1976) type agency problem of the manager.

[46] Under the US legal doctrines such as equitable subordination and lender liability, if the bank as a creditor wants to collude with the manager to pursue private benefits at the expense of other creditors,

Thus the bank is acting as a delegated monitor (of the firm's other debtholders) to maximize the value of its claim thus the total debt value of the firm.[47] The bank will threat to redeem its debt claim from the firm at time 1, thus force the manager to maximize the debt value of the firm by choosing overly safe project (since debtholders only worry about the downside of a project) and transfer wealth from shareholders to debtholders of the firm, and will leave the shareholders indifferent between continue or dismiss the firm at time 1 (I assume the manager will choose to continue the firm given the shareholders are indifferent between these two choices). Thus we have the second proposition.

Proposition 2. *As a debtholder and delegated monitor, the bank will force the firm manager to choose overly safe project, thus transfer wealth from the shareholders to the debtholders.*

Proof. The bank will force the firm manager to choose the project which solves the following optimization problem.

$$\text{Max. } \beta DR_D P(R) \qquad (4)$$

$$\text{s.t. } (AR - DR_D)P(R) \geq A - D$$

The first order condition of (4) is

$$\beta DR_D P'(R) < 0$$

Thus without the constraint the bank's project choice will be the corner solution $R'' = DR_D / A$. To see the reason, we only need to verify that for any $R < DR_D / A$, the firm's debt value is $ARP(R)$. Since

$$\frac{dARP(R)}{dR} > 0 \text{ for } 0 \leq R < R^*$$

$$ARP(R) < A(DR_D / A)P(DR_D / A) = DR_D P(DR_D / A) \text{ for any } R < DR_D / A$$

Thus our focus is on the projects satisfying $R \geq DR_D / A$. From the proof of proposition 1 we know that

$$\frac{d(AR - DR_D)P(R)}{dR} > 0 \text{ for } 0 \leq R \leq R^*$$

We also have

$$(AR - DR_D)P(R)\Big|_{R=R^*} > A - D, \text{ and}$$

$$(AR - DR_D)P(R)\Big|_{R=DR_D/A} = 0 < A - D$$

Since the constraint of the optimization problem must be binding, the solution to the optimization problem (the bank's project choice) R'' must satisfy

$$DR_D / A < R'' < R^*$$

Q.E.D.

The shareholders will be indifferent between dismiss the firm at time 1 or invest in the project $(R'', P(R''))$, and the deadweight loss will be $A(R^* P(R^*) - R'' P(R''))$.

2.4. The Role of Bank Equity Holding in Improving Investment Efficiency

If the bank is allowed to hold both debt and equity of the firm, the firm's investment efficiency will be improved. Since the bank can now share the upside of the firm's project, it will have less incentive to (force the firm manager to) choose overly safe project. Consequently, the bank's equity holding of the firm will help mitigate the conflict between debtholders and shareholders. Temporarily ignoring the moral hazard problem mentioned in footnote 6, we have the following proposition.

Proposition 3. *If the bank is allowed to hold both debt and equity in the firm with its share of the firm's equity being α and its share of the firm's debt being β, the first-best project choice $(R^*, P(R^*))$ can be achieved when α is equal to β; if α is less than (greater than) β, the bank will (force the firm manager to) choose the project with return R'' less than (greater than) R^*; the return of the chosen project R'' is everywhere non-decreasing with α.*

Proof. For the same reason mentioned in the proof of proposition 2, let us focus on the projects with return satisfying $R \geq DR_D / A$. The bank will force the firm manager to choose the project which solves the following optimization problem.

$$\text{Max. } \alpha(AR - DR_D)P(R) + \beta DR_D P(R) \qquad (5)$$

$$\text{s.t. } (AR - DR_D)P(R) \geq A - D \qquad (5.1)$$

$$DR_D P(R) \geq D \qquad (5.2)$$

Obviously, when α is equal to β, the first-best outcome $(R^*, P(R^*))$ is the unique maximizer of (5). Since $(R^*, P(R^*))$ also satisfies constraints (5.1) and (5.2), it is the unique solution to the optimization problem.

Let us consider the case where α is less than β. Rewrite (5) as

$$\alpha(AR - DR_D)P(R) + \beta DR_D P(R) = \alpha ARP(R) + (\beta - \alpha)DR_D P(R) \qquad (6)$$

The first-order derivative of (6) when R is equal to R^* is

$$(\beta - \alpha)DR_D P'(R^*) < 0$$

it will risk being sued by other creditors and its claim being subordinated to those of other creditors [Gorton and Winton (2001), Berlin and Mester (2001)]. However, if the bank is also a shareholder of the firm thus already has a substantial portion of its claim (its equity share of the firm) subordinated, it will have more incentive to collude with the manager in pursuing private benefits. I will discuss this moral hazard problem in section 3.

[47] For simplicity, I do not model the monitoring cost of the bank (or assume it to be sunk cost invested by the bank at time 0).

Thus the bank's optimal project choice R'' will be less than R^* in this case. If α is greater than β, the above first-order derivative is positive at R^*, and the bank will want to increase R'' beyond R^*.

Now consider the relationship between α and the chosen project return R''. Without constraints (5.1) and (5.2), the first-order condition of (6) should give us

$$\alpha[(AR'' - DR_D)P'(R'') + AP(R'')] + \beta DR_D P'(R'') = 0 \quad (7)$$

The total differentiation of (7) gives us

$$[(AR'' - DR_D)P'(R'') + AP(R'')]d\alpha + [\alpha(2AP'(R'') + AR''P''(R'')) + (\beta - \alpha)DR_D P''(R'')]dR'' = 0$$

Thus we get

$$\frac{dR''}{d\alpha} = -\frac{(AR'' - DR_D)P'(R'') + AP(R'')}{\alpha(2AP'(R'') + AR''P''(R'')) + (\beta - \alpha)DR_D P''(R'')} \quad (8)$$

From (7) we have

$$(AR'' - DR_D)P'(R'') + AP(R'') = -\beta DR_D P'(R'')/\alpha \quad (9)$$

Substitute (9) to (8), we get

$$\frac{dR''}{d\alpha} = \frac{\beta DR_D P'(R'')}{\alpha^2[2AP'(R'') + (AR'' - DR_D)P''(R'')] + \alpha\beta DR_D P''(R'')} > 0$$

Thus without constraints (5.1) and (5.2), R'' is strictly increasing with α. With the two constraints being in place, R'' is everywhere non-decreasing with α.

Q.E.D.

Proposition 3 says that if we ignore the moral hazard problem that the bank as an institutional shareholder can collude with the manager to pursue private benefits at the expense of other stakeholders of the firm, the bank's optimal equity holding of the firm should be to the point where its equity share (α) equals its debt share (β). In the following section I will include this moral hazard problem into consideration and discuss its effect on the bank's optimal equity holding of the firm.

3. The Second Moral Hazard Problem and Its Effect on the Bank's Optimal Equity Holding of the Firm

If the bank holds equity of the firm, the second moral hazard problem arises. Since the bank now has a substantial part of its claim (its equity holding of the firm) subordinated to the other debtholders, it will have a strong incentive to exert its influence power over the firm to pursue private benefits, at the expense of other stakeholders of the firm [Berlin, John and Saunders (1996), Boyd, Chang and Smith (1998), and Gorton and Winton (2002)]. Since the manager is assumed to act in the interest of the shareholders, we can (reasonably) further assume that the manager will submit to the influence of the bank (the only institutional shareholder of the firm in the model) and cooperate with it to pursue perks from project return.

Let us assume the bank can collude with the manager to abscond a portion θ as perks from the project return at time 2,[48] and that the share of perks the bank can enjoy is $T(\alpha)$,[49] which has the following properties.

$$T(\alpha) \geq \alpha \text{ with equality at } \alpha = 1;$$

$$T'(\alpha) > 0 \text{ and } T''(\alpha) < 0 \text{ for all } \alpha < 1$$

We then have the following proposition.

Proposition 4. *If the bank can collude with the firm manager to abscond a portion* θ as *perks from the project return and enjoy a share* $T(\alpha)$ *of perks, which is greater than its equity share* α *in the firm, it will force the manager to choose overly risky project even if its share of the firm's equity* α *is equal to its share of the firm's debt* β*; the first-best outcome* $(R^*, P(R^*))$ *can only be achieved when the bank's share of the firm's equity is* $T^{-1}(\beta)$*, which is less than* β.

Proof. The bank's choice of θ and $(R'', P(R''))$ in this case should solve the following constrained optimization problem.

Max.

$$\alpha[(1-\theta)AR - DR_D)]P(R) + \beta DR_D P(R) + T(\alpha)\theta ARP(R) \quad (10)$$

$$\text{s.t.}\ [(1-\theta)AR - DR_D)P(R) \geq A - D \quad (10.1)$$

$$DR_D P(R) \geq D \quad (10.2)$$

Since (10) can be rewritten as

Max.

$$\alpha ARP(R) + (T(\alpha) - \alpha)\theta ARP(R) + (\beta - \alpha)DR_D P(R) \quad (11)$$

Obviously for any given R in (11), the bank would like θ to be as large as possible, since $(T(\alpha) - \alpha)$ is greater than zero. But from constraint (10.1), we have

$$(1-\theta)AR \geq (A - D)/P(R) + DR_D,$$

thus

$$\theta \leq 1 - (A - D)/ARP(R) - DR_D/(AR) < 1$$

Therefore the bank's chosen level of perks θ must satisfy

[48] I assume that θ is also observable (though not verifiable) to all, and that the bank and the firm manager will leave the outside shareholders of the firm at time 2 at least as good as if they invested in the alternative risk-free opportunity at time 1. That is, if the outside shareholders of the firm are better off than if they invested in the alternative risk-free opportunity at time 1, the marginal cost (to the bank and the firm manager) of one unit increase in θ will be zero; otherwise, the marginal cost of one unit increase in θ will be dramatically increased and will outweigh the marginal benefit (e.g., the firm manager will lose his human capital and the bank will lose its reputation, and they will face collective lawsuits which they have to spend costly resources to deal with).

[49] The functional form of T(α) is assumed to be common knowledge.

$$\theta = 1-(A-D)/ARP(R)-DR_D/(AR) \quad (12)$$

Substitute (12) to (11), we get

$$\alpha ARP(R)+(T(\alpha)-\alpha)[1-(A-D)/ARP(R)-DR_D/(AR)]ARP(R)+(\beta-\alpha)DR_DP(R)$$

which can be simplified to

$$T(\alpha)ARP(R)+(\beta-T(\alpha))DR_DP(R)-(T(\alpha)-\alpha)(A-D) \quad (13)$$

The first-order derivative of (13) with regard to R gives us

$$T(\alpha)A\frac{dRP(R)}{dR}+(\beta-T(\alpha))DR_DP'(R) \quad (14)$$

If α is equal to β, i.e., the bank holds equal share of both the firm's debt and equity, and if we set R in (14) to be the first-best outcome R^*, (14) will be reduced to

$$(\beta-T(\beta))DR_DP'(R^*)>0$$

Thus the bank will increase its chosen project return beyond the first-best level R^*, i.e., the chosen project $(R'', P(R''))$ in this case will satisfy

$$R''>R^*$$

Of cause, $(R'', P(R''))$ should also satisfy constraint (10.2).

However, if the bank's equity holding in the firm satisfies

$T(\alpha)=\beta$, thus

$$\alpha = T^{-1}(\beta) < \beta \quad (15)$$

Substitute (15) to (14) the first-order condition becomes

$$T(\alpha)A\frac{dRP(R)}{dR}=0 \quad (16)$$

We already know that the first-best outcome R^* is the only solution to (16), and that the second-order condition for a maximizer is also satisfied. Thus $(R^*, P(R^*))$ is the optimal project which will be chosen by the bank in this case.

Q.E.D.

From proposition 4 we can see that due to the second moral hazard problem, the bank's optimal equity holding of the firm should not be to the point where its share of the firm's equity is equal to its share of debt. The reason is that at this point the bank will have an incentive to choose the overly risky project, thus deadweight loss will occur. Rather, the bank's optimal equity holding in this case should be somewhere between zero and its share of the firm's debt, with the exact position $T^{-1}(\beta)$ determined by the function $T(.)$. The absolute distance from β (i.e., $\beta - T^{-1}(\beta)$) will be smaller when β approaches zero or one, and will be larger at the middle range (see figure 1 below).

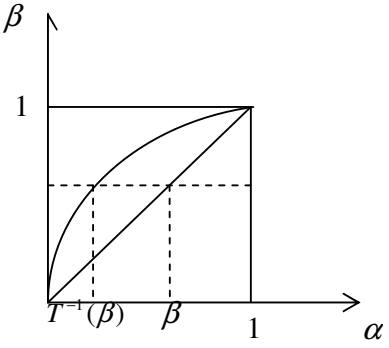

Figure 1

4. Extension

In the model presented above, I assume that the firm manager's project choice at time 1 and the realized state at time 2 are observable to all stakeholders of the firm, but not verifiable thus not contractible. This assumption allows me to mathematically derive the four propositions neatly. However, one may reasonably worry that the results are not robust to the case where there is asymmetric information. In this section I will extend the model to the case that only the firm manager and the bank know the project choice at time 1 and the realized state at time 2, and the other stakeholders of the firm (the outside shareholders and debtholders) cannot observe the project choice and realized state. Let us further assume that the set of all possible projects R and their success probabilities $P(R)$ are common knowledge to all stakeholders of the firm. The other assumptions of the model remain unchanged.

4.1. Proposition 1

Under the new assumption specified above, proposition 1 is still valid. The firm manager will choose the project $(R', P(R'))$ which satisfy

$$\frac{d(AR-DR_D)P(R)}{dR}=AP(R)+(AR-DR_D)P'(R)=0$$

However, if the R' which satisfies the above first-order condition is greater than $P^{-1}(1/R_D)$, the debtholders of the firm are better off to invest in the alternative risk-free opportunity, thus they will choose to redeem their claims at time 1. The deadweight loss becomes $A(R^*P(R^*)-1)$. If R' is less than or equal to $P^{-1}(1/R_D)$, the debtholders will not redeem their claims at time 1 and the firm continues

to time 2. The deadweight loss is $A(R^* P(R^*) - R' P(R'))$.

4.2. Proposition 2

Proposition 2 remains valid under the new assumption. Since the bank is an inside debtholder (thus can observe the manager's project choice) and delegated monitor, it will act to maximize the firm's total debt value, and leave the firm manager (who acts in the interest of the shareholders) indifferent about investing in the firm or investing in the alternative risk-free opportunity at time 1.

4.3. Proposition 3

Under the new assumption, proposition 3 is basically valid. Namely, the first-best outcome will be achieved when the bank's equity share α is equal to its debt share β; if α is less (greater) than β, the bank's chosen project R'' is less (greater) than R^*; R'' is non-decreasing with α. But now a new conclusion should be added to the proposition, i.e., α should be capped above by some $\overline{\alpha}$. To see the reason, notice that the bank will (force the manager) to choose the project R'' which satisfies the first-order condition

$$\alpha[(AR'' - DR_D)P'(R'') + AP(R'')] + \beta DR_D P'(R'') = 0$$

If α is greater than β, the solution R'' to the above equation is greater than the first-best level R^*. From the proof of proposition 3, we have

$$\frac{dR''}{d\alpha} = \frac{\beta DR_D P'(R'')}{\alpha^2[2AP'(R'') + (AR'' - DR_D)P''(R'')] + \alpha\beta DR_D P''(R'')} > 0$$

If α is large enough such that the solution R'' to the above first-order condition is greater than $P^{-1}(1/R_D)$, the outside debtholders will redeem their claims at time 1. Thus the outside debtholders will pick the bank's equity share of the firm - α, as a signal and will base their decision (redeem or not redeem at time 1) on it. To avoid the outside debtholders' redemption at time 1, the bank's equity share of the firm α should be less than a $\overline{\alpha}$, which equates R'' to $P^{-1}(1/R_D)$.

4.4. Proposition 4

Proposition 4 will generally not hold. The reason is that since the outside stakeholders cannot observe the project choice and realized state (as well as θ - the perks level) under the new assumption, without further corporate governance mechanism to ensure that constraint (10.1) be satisfied, the bank will set θ to be 1 at time 2. If the outside stakeholders rationally anticipate this outcome ex-ante, they will redeem their claims at time1.

However, if we can impose further mechanisms (such as auditing, reputation concern etc.) to ensure that constraint (10.1) be satisfied, the conclusion of proposition 4 will still be valid. Namely, if α is equal to β, the bank has the incentive to increase R'' beyond the first-best level R^*; if α is equal to $T^{-1}(\beta)$, the first-best outcome can be achieved. But the same as in proposition 3, in this case the bank's equity share α should be capped above by some $\overline{\alpha}$. The reason is that from the proof of proposition 4 the bank's chosen project R'' should satisfy the first-order condition

$$T(\alpha)A\frac{dR''P(R'')}{dR} + (\beta - T(\alpha))DR_D P'(R'') = 0 \quad (17)$$

Reorganize the above equation, we get

$$\beta DR_D P'(R'')/T(\alpha) = DR_D P'(R'') - A\frac{dR''P'(R'')}{dR} \quad (18)$$

Total differentiate (17) with regard to α and R'', we get

$$\frac{dR''}{d\alpha} = \frac{T'(\alpha)(DR_D P'(R'') - A\frac{dR''P'(R'')}{dR})}{T(\alpha)(AR'' - DR_D)P''(R'') + 2T(\alpha)AP'(R'') + \beta DR_D P''(R'')} \quad (19)$$

Substitute (18) to (19), we get

$$\frac{dR''}{d\alpha} = \frac{T'(\alpha)\beta DR_D P'(R'')}{T(\alpha)^2(AR'' - DR_D)P''(R'') + 2T(\alpha)^2 AP'(R'') + T(\alpha)\beta DR_D P''(R'')} > 0$$

Thus R'' is increasing with α. If α is large enough such that R'' is greater than $P^{-1}(1/R_D)$, the outside debtholders will redeem their claims at time 1. Thus the bank's equity share of the firm α should be capped by a $\overline{\alpha}$, which equates R'' to $P^{-1}(1/R_D)$.

5. Conclusion

This paper investigates the effects of the bank's equity holding of the firm from a moral hazard perspective. Without a delegated monitor, the firm manager who acts in the interest of the shareholders has the incentive to choose overly risky project to transfer wealth from debtholders to equity holders, thus creates the first moral hazard problem. If the bank as a delegated monitor is only allowed to hold debt of the firm, it will force the firm to invest in overly safe projects, thus reduce investment efficiency. The bank's equity holding of the firm is shown to help mitigate the conflicts between the firm's shareholders and debtholders. However, it also creates the second moral hazard problem, namely, the bank as an institutional shareholder may collude with the firm manager to pursue perks from project return. Without this second moral hazard problem, the bank's optimal equity holding of the firm is shown to be at the point where its share of the firm's equity equals its share of the firm's debt. With the second moral hazard problem being taken into consideration, the

bank's optimal equity holding should be less than its debt share in the firm. If asymmetric information is introduced into the model, the bank's equity holding becomes a signal to outside debtholders, thus should be capped above by a certain level.

The policy implication of this paper is that allowing banks to hold equity in industrial firms may help improve social welfare. However, regulations still need to be imposed to set an upper limit for banks' equity holding in industrial firms. Otherwise, due to the moral hazard problems, banks can force industrial firms to pursue overly risky projects at the expenses of other stakeholders and the FDIC (thus the taxpayers).

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