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Bank Bonuses and Bail-out Guarantees

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Abstract

This paper analyzes how a bank shareholder optimally designs the compensation scheme of a bank manager if there are agency problems between the shareholder and the manager, and how this design changes in reaction to anticipated bail-outs. If there is a problem of excessive risk-taking, bail-out guarantees lead to steeper compensation schemes and even more risk-taking. If there is an effort problem, the compensation scheme becomes flatter and effort decreases. If both types of agency problems are present, a sufficiently large increase in bail-out perceptions will make it optimal for a welfare-maximizing regulator to impose ceilings on bank bonuses.

Keywords: Bonus payments; bail-out guarantees; bank manager compensation.

JEL-Classification: G21, G28, M52, J33.

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1 Introduction

In recent months, bonuses of bank managers have come under fire. After banks had suffered unprecedented losses and had to be bailed out by the state, bonus payments were larger than expected (and desired) by the public and the state. We present a simple model that is able to explain why compensation schemes may become steeper precisely after widespread bank bail-outs. We also argue that such bail-outs may yield a rationale for imposing ceilings on bank bonuses.

The argument is simple: In a risk-shifting setup, bank shareholders with limited liability have an incentive to design compensation schemes that induce managers to take excessive risks. Bonus schemes are well suited to achieve this goal. Market discipline by (uninsured) lenders can counteract such incentives. In contrast, bank bail-outs raise expected bail-out probabilities and thereby destroy market discipline. Therefore, shareholders will react to an increase in bail-out expectations by designing steeper compensation (bonus) schemes to induce managers to take higher risk. In such a setup, ceilings on bonus payments can be welfare-increasing, especially if bail-outs are expected with a high probability.

If instead there is an effort problem between the shareholder and the manager, steep compensation schemes can be used to induce higher effort by the bank manager. The anticipation of a bail-out then makes it optimal for the shareholder to offer a flatter compensation scheme, lowering the manager's effort (which is again inefficient). In such a setup, ceilings on bonus payments are harmful or ineffective.

In reality, both types of agency problems are likely to be present. We show that, in such a setup, a ceiling on bank bonuses may raise welfare. This is particularly true in the presence of (anticipated) bail-outs. We show that a sufficiently large increase in bail-out perceptions will make it optimal for a welfare-maximizing regulator to impose ceilings on bank bonuses. This justifies recent advances by leading politicians to curb bank bonuses.

While there exists a broad literature on the corporate governance of non-financial firms,¹ the literature on the corporate governance of banks is still relatively scarce. Caprio and

¹See Shleifer and Vishny (1997), Prendergast (1999), and Becht, Bolton, and Röell (2003) for excellent surveys.

Levine (2002) were the first to systematically analyze the corporate governance of banks. They stress two differences between banks and non-financial firms that are important for corporate governance: the greater opaqueness of banks, which exacerbates agency problems, and banking regulation, which affects the governance of banks in various ways, most importantly by increasing risk-shifting incentives. While the importance of the safety net for bank's risk-taking behavior is a recurrent theme in the literature on the role of market discipline in banking (see, e. g., Demirguc-Kunt and Huizinga, 2004), the relationship between the anticipation of bank bail-outs and bank manager compensation schemes has, to the best of our knowledge, not yet been analyzed.

Recent empirical work by Laeven and Levine (2009) suggests that the governance structure indeed matters for banks' risk-taking; importantly, the effect of banking regulation also appears to depend on corporate governance structures. Regarding bank manager compensation, early evidence by Houston and James (1995) suggests that compensation schemes in banks differ from those in the non-financial sector; however, Houston and James do not find evidence that compensation schemes in the banking sector promoted risk-taking more than in other sectors. It will be interesting to see whether this will change after the current financial crisis.

The paper proceeds as follows. In Section 2, we introduce the basic setup of our model. In Section 3, we derive the optimal manager compensation scheme and the effect of anticipated bank bail-outs if the manager can determine the bank's risk. In Section 4, we analyze optimal compensation schemes if the manager faces an effort choice. Section 5 presents a general model including a risk and an effort choice and discusses the desirability of bank bonuses. Section 6 concludes.

2 Model Setup

Consider a bank with an asset volume $A = 1$, which is financed by (insured) deposits D , (uninsured) liabilities L , and equity E . Hence, the balance sheet identity is $A = D + L + E$. The deposit rate is r , the risk-free rate is r_f . Deposits are covered by deposit insurance at a fee τ . The bank's assets consist of a risky portfolio that returns Y_h with probability $p_h > 0$, Y_m with probability $p_m > 0$, and Y_l with probability $p_l = 1 - p_h - p_m > 0$. We assume that $Y_h > Y_m > Y_l = 0$. The bank is run by a manager whose compensation

Figure 1: Time Structure

- The bank manager writes a contract with the shareholder.
- The bank takes in deposits, D , and other liabilities, L .
- The manager chooses a (or e) and invests, incurring non-monetary costs $\alpha a^2/2$ (or $\eta e^2/2$).
- The bank portfolio returns Y_h , Y_m , and $Y_l = 0$ with probabilities $p_h(a)$, $p_m(a)$, and $p_l(a)$ (or $p_h(e)$, $p_m(e)$, and $p_l(e)$).

scheme (z_h, z_m, z_l) may depend on the realized state. The bank manager can influence the return structure of the bank portfolio by choosing an action that has an impact on the three probabilities (like in Biais and Casamatta, 1999).² The bank is owned by a single shareholder who is the residual claimant and is subject to limited liability. The shareholder determines the compensation scheme of the manager.

We will distinguish between two different settings. In the first setting, discussed in Section 3, the manager chooses a , which is a measure of risk-taking. More specifically, an increase in a leads to a mean preserving spread, raising risk, but leaving the mean return unchanged. Hence, an increase in a results in a distribution that is second-order stochastically dominated. The manager incurs a non-monetary cost of risk-taking, $c(a) = \alpha a^2/2$. This cost can be interpreted as the cost of restructuring the portfolio (possibly also including potential consequences of bankruptcy for the manager). In the second setting, discussed in Section 4, the portfolio return depends on the manager's effort, which raises the bank's returns; effort is denoted by e . Hence, an increase in e entails a shift of the mean return and first-order stochastic dominance. Again the manager incurs a non-monetary cost, $c(e) = \eta e^2/2$. This cost can be interpreted as the cost of monitoring the (loan) portfolio.

The timing of the model is given in Figure 1.

²One advantage of this way of modeling is that all possible payoffs occur with positive probabilities. As a consequence, one cannot with certainty infer the chosen action by observing the return. A continuous version, as in Bester and Hellwig (1987), would not yield closed-form solutions in our framework.

3 Risk Choice

In the first setting, we assume that the manager's action a affects the risk of the bank's portfolio, but not its mean return. We first describe the bank's return structure. Then we derive the bank's optimal compensation scheme, the manager's effort choice, and the effects of anticipated bank bail-outs when the manager is subject to either limited or unlimited liability.

3.1 Return Structure of the Bank

In this version of the model, we assume that an increase in a shifts probability mass from the medium return to the two extreme returns. We parameterize this in the following way,

$$\begin{aligned} p_h(a) &= \frac{1}{3} + \frac{a}{Y_h(Y_h - Y_m)} > \frac{1}{3}, \\ p_m(a) &= \frac{1}{3} - \frac{a}{Y_m(Y_h - Y_m)} < \frac{1}{3}, \\ p_l(a) &= 1 - p_h(a) - p_m(a) = \frac{1}{3} + \frac{a}{Y_h Y_m} > \frac{1}{3}, \end{aligned} \quad (1)$$

with $a \in [0, Y_m(Y_h - Y_m)/3]$.³ An example of such a distribution function is plotted in Figure 2 for two different values of action a . An increase in a raises the probability of the highest and the lowest return, but it lowers the probability of the medium return. Moreover, the expected return does not depend on a ,

$$E[Y] = \frac{Y_h + Y_m}{3}, \quad (2)$$

whereas the variance increases in a ,

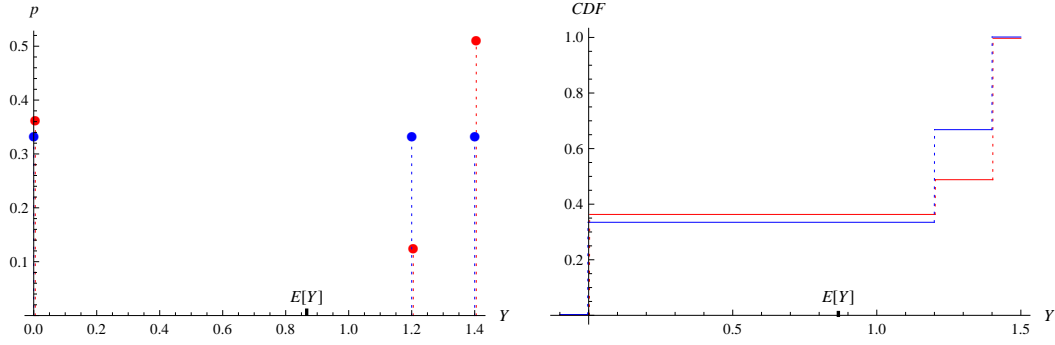
$$V[Y] = a + \frac{2}{9} (Y_h^2 - Y_h Y_m + Y_m^2). \quad (3)$$

Remark 1 *An increase in a induces a mean-preserving spread.*

The first-best choice of a maximizes $E[Y] - c(a)$. Given that the mean $E[Y]$ does not depend on a and that $c(a)$ strictly increases in a , the first-best choice is $a = 0$. Hence, any risk-taking is inefficient. We now analyze the manager's risk choice (depending on the compensation scheme set by the shareholder) in the presence of either limited (Section 3.2) or unlimited liability (Section 3.3) of the manager.

³For the extreme case of $a = Y_m(Y_h - Y_m)/3$, we have $Y_m(a) = 0$.

Figure 2: Return Distributions, Depending on Effort Choice



These pictures shows a possible distribution of returns with $Y_h = 1.4$, $Y_m = 1.2$, and $Y_l = 0$ for $a = 0$ (blue) and $a = 0.05$ (red). The “density function” is on the left, the cumulative distribution function is on the right.

3.2 Limited Liability of the Manager

Assume that the bank manager is subject to limited liability. Then all entries of the compensation scheme (z_h, z_m, z_l) must be non-negative, $z_h \geq 0$, $z_m \geq 0$, and $z_l \geq 0$.

Lemma 1 *The equilibrium contract has $z_h \geq 0$ and $z_m = z_l = 0$.*

Hence, the compensation scheme will look like (the extreme form of) a bonus contract. The manager receives a bonus if the project is very successful; in the two other states of the world, he does not receive any payment. The reason is that the shareholder, owning an equity stake in the bank, wants the manager to take risk. Because more risk moves probability mass away from the medium state, the shareholder will not reward the manager in the medium state. In the bad state, there are no payments to be distributed. Consequently, the manager receives payments only in the good state.

We now consider the optimization of lenders, the shareholder, and the manager. Depositors are passive and do not have to be considered. Denote the total repayment to depositors (including principal and interest payments) plus the deposit insurance premium, by R_D , and the repayment to other lenders (again including principal and interest payments) by R_L . Given lemma (1), the expected profits of lenders (L), the shareholder (E), and the

manager (M) are⁴

$$\begin{aligned}\Pi_L &= (p_h(a) + p_m(a)) R_L, \\ \Pi_E &= p_h(a) (Y_h - R_D - R_L - z_h) + p_m(a) (Y_m - R_D - R_L) \quad \text{and} \\ \Pi_M &= p_h(a) z_h - \alpha a^2/2.\end{aligned}\tag{4}$$

The problem is solved by backward induction. The manager maximizes expected profits,

$$\Pi_M = \left(\frac{1}{3} + \frac{a}{Y_h (Y_h - Y_m)} \right) z_h - \alpha a^2/2,\tag{5}$$

which yields

$$a^* = \frac{z_h}{Y_h (Y_h - Y_m) \alpha}.\tag{6}$$

We see immediately that a higher bonus (high z_h) induces higher risk-taking.

In order to participate, (risk-neutral) lenders at least need to recover their opportunity costs. Hence, they solve

$$\begin{aligned}\Pi_L &= (p_h(a) + p_m(a)) R_L = (1 + r_f) L, \\ R_L &= (1 + r_f) L \cdot \frac{1}{p_h(a) + p_m(a)}.\end{aligned}\tag{7}$$

Hence, R_L increases in the bank's default probability $p_l(a) = 1 - p_h(a) - p_m(a)$. The shareholder maximizes

$$\begin{aligned}\Pi_E &= p_h(a) (Y_h - R_D - R_L - z_h) + p_m(a) (Y_m - R_D - R_L) \\ &= p_h(a^*) (Y_h - R_D - z_h) + p_m(a^*) (Y_m - R_D) - (1 + r_f) L,\end{aligned}\tag{8}$$

where a^* is defined by (6). Solving the first-order condition yields⁵

$$z_h^* = R_D \frac{Y_h - Y_m}{2 Y_m} - \alpha \frac{Y_h^2 (Y_h - Y_m)^2}{6}.\tag{9}$$

Some algebra shows that $z_h^* < Y_h$, so that the bonus can always be paid; it never exceeds the bank's capacities.

Plugging (9) into (6), we obtain the equilibrium value of a^* ,

$$a^* = \frac{R_D}{2 Y_h Y_m \alpha} - \frac{Y_h (Y_h - Y_m)}{6} > 0.\tag{10}$$

⁴Here we assume that $R_D + R_L < Y_m$. We discuss the case $Y_m < R_D + R_L < Y_h$ in the Appendix.

⁵For exposition, let us assume that parameters are such that we get interior solutions. Looking at (9) reveals, however, that z_h^* is non-negative only if α is not too large, namely $\alpha \leq 3 R_D / [Y_h^2 (Y_h - Y_m) Y_m]$.

Hence, the shareholder wants the manager to take excessive risk. This is due to the fact that the shareholder himself is subject to limited liability and that he can shift losses to the deposit insurance.⁶ If there were no insured depositors, there would be no incentives for excessive risk-taking.

The Impact of Bail-outs. So far we have assumed that there are no bail-outs. Assume now that lenders anticipate that banks will be bailed out. In the presence of bail-outs, lenders will become less sensitive to bank risk-taking. In the extreme case where the bank is bailed out completely with certainty, they will not react to bank risk-taking at all. In this model, they will then behave like depositors. As a result, anticipated bail-outs have the same effect as an increase of R_D to $(1 + r) D + (1 + r_f) L$ and a drop of R_L to zero.

Consequently, in order to find the effects of an anticipated bail-out on equilibrium contracting and behavior, we only need to consider derivatives with respect to R_D . We see immediately that $\partial z_h^* / \partial R_D > 0$ and $\partial a^* / \partial R_D > 0$. Hence, the bonus scheme becomes steeper and the manager takes higher risk. This translates into a higher default probability of the bank, $p_l(a)$. The manager benefits from the bail-out, $\partial \Pi_M / \partial R_D > 0$. The expected compensation of the manager, $p_h(a^*) z_h^*$, also increases. Finally, and not surprisingly, the shareholder's expected profits also increase. These results are summarized in the following proposition, and proven formally in the Appendix.

Proposition 1 (Impact of Bail-outs with Limited Liability) *If lenders anticipate a bank bail-out,*

1. *the bonus scheme becomes steeper (z_h^* increases),*
2. *the manager's risk-taking (a^*) increases, implying that the bank's probability of default $p_l(a^*)$ also increases,*
3. *the expected compensation and the expected profit of the manager increase,*
4. *the expected profit of the shareholder increases.*

⁶The deposit insurance does not react to bank managers' risk-taking in our model. Hence, in line with Dewatripont and Tirole (1994), the deposit insurance does not exert market discipline.

The intuition is simple: In the presence of bail-outs, market discipline is weakened and bank lenders will no longer “punish” their bank for higher (anticipated) risk-taking by demanding higher interest rates. This implies that the risk-shifting problem is exacerbated because the bank can now shift even more losses to other parties (the deposit insurance and the state). The shareholder hence wants to give the bank manager an incentive to take higher risks. This is done through a steeper bonus contract. Given that the manager is protected by limited liability, he will also benefit from the bail-out guarantee.

From a welfare perspective, risk-shifting ($a > 0$) is always suboptimal in this model. Since the mean of the return distribution is unchanged by risk-shifting, the welfare loss stems only from the costs $c(a)$. Welfare can be improved by regulating the manager’s compensation scheme. Specifically, a cap on bonus payments would lead to lower risk-shifting activities and, hence, to an increase in welfare.

Corollary 1 (Bonus Regulation) *A regulatory ceiling on bonus payments reduces risk-shifting and the bank’s probability of default, and it therefore increases welfare. The positive effect of a ceiling is even larger if bail-outs are anticipated by bank lenders.*

3.3 Unlimited Liability of the Manager

Assume now that the manager has unlimited liability, so that z_h , z_m , and z_l can be negative.

Lemma 2 *The equilibrium contract has $z_l = 0$.*

The intuition is as follows: z_l cannot be positive because the asset portfolio does not return anything, and the shareholder is protected by limited liability. z_l will not be negative because the shareholder wants to induce the manager to take risk (to increase a), and a $z_l < 0$ would discourage him from risk-taking. Hence, $z_l = 0$.

The problem is again solved by backward induction. The manager now maximizes

$$\Pi_M = \left(\frac{1}{3} + \frac{a}{Y_h(Y_h - Y_m)} \right) z_h + \left(\frac{1}{3} - \frac{a}{Y_m(Y_h - Y_m)} \right) z_m - \alpha a^2/2, \quad (11)$$

which yields

$$a^* = \frac{Y_m z_h - Y_h z_m}{Y_h Y_m (Y_h - Y_m) \alpha}. \quad (12)$$

A higher payment in the highest state (z_h) raises risk-taking, whereas a higher payment in the medium state (z_m) lowers risk-taking. The lenders again solve $\Pi_L = 0$, yielding the same expression for R_L as in (7). The shareholder now maximizes

$$\begin{aligned} \Pi_E &= p_h(a) (Y_h - R_D - R_L - z_h) + p_m(a) (Y_h - R_D - R_L - z_m) \\ &= p_h(a^*) (Y_h - R_D - z_h) + p_m(a^*) (Y_h - R_D - z_m) - (1 + r_f) L \end{aligned} \quad (13)$$

subject to the manager's participation constraint, $\Pi_M \geq 0$, and with a^* being given by (12). The participation constraint will be binding in equilibrium, yielding a relation between z_h and z_m . The first-order conditions yield

$$z_h^* = \frac{R_D}{Y_h + Y_m} \left(Y_h - Y_m - \frac{2 R_D}{3 \alpha Y_h Y_m^2} \right), \quad (14)$$

$$z_m^* = -\frac{R_D}{Y_h + Y_m} \left(Y_h - Y_m + \frac{2 R_D}{3 \alpha Y_h^2 Y_m} \right). \quad (15)$$

In an interior solution, z_m will be negative and z_h positive. Otherwise, if α is rather high, we get the corner solution $z_h = z_m = 0$ because delegation is too costly. Plugging (14) and (15) into (12), we obtain the equilibrium value of a^* ,

$$a^* = \frac{R_D}{\alpha Y_h Y_m} > 0. \quad (16)$$

Again there is excessive risk-taking ($a^* > 0$). In fact, equilibrium risk-taking is larger than with limited liability of the manager. The reason is that, under limited liability, the shareholder has to pay the manager a rent to make him take higher risk. With unlimited liability, the manager can be kept at his participation constraint, making it cheaper for the shareholder to induce the manager to take risk. Consequently, risk-shifting increases.

The Impact of Bail-outs. To analyze the effects of a bail-out, we again take the derivative with respect to R_D . We find that z_h^* increases and z_m^* decreases in R_D ; hence, the anticipation of a bail-out induces the shareholder to steepen the compensation scheme, as before. However, risk-taking will increase even more than with limited liability (which can be seen from the respective derivatives of a^* with respect to R_D). These results are summarized in the following proposition.

Proposition 2 (Impact of Bail-outs with Unlimited Liability) *If lenders anticipate a bank bail-out,*

- 1. the bonus scheme becomes steeper ($z_h^* > 0$ increases and $z_m^* < 0$ decreases),*
- 2. the manager's risk-taking (a^*) increases (even more than with limited liability), implying that the bank's probability of default $p_l(a^*)$ also increases (even more than with limited liability),*
- 3. the expected compensation and the expected profit of the manager increase,*
- 4. the expected profit of the shareholder increases.*

Hence, the negative effects of bail-outs are still reinforced by unlimited liability of the manager. This has important policy implications. Making the bank manager liable does not mitigate the problem of excessive risk-taking (but it rather exacerbates it) if the shareholder is free to design the compensation scheme of the manager. Unlimited liability leads to a redistribution of rents from the manager to the shareholder, and makes it even more attractive for the shareholder to offer steep compensation schemes.

In the public discussion, the typical argument is that bank managers will avoid risk-taking if their personal liability is increased. The comparison of Proposition 1 and 2 implies exactly the opposite. Since shareholders like risk and determine managers' compensation packages, and since managers' rents from risk-taking drop when they are made liable (which makes it cheaper for the shareholder to set incentives for risk-taking), managers will take more risk in equilibrium. The main reason is that shareholders will not make managers liable in the bad states of nature, but rather in the medium state. There are two possible ways out of this dilemma. First, instead of managers, *shareholders* could be made liable. This liability would then make shareholders refrain from implementing steep bonus schemes, which in turn would lead to lower risk choices by managers. Second, the managers could be made liable, but the details of this liability would have to be defined by the deposit insurance agency or by the state, rather than by shareholders. In this case, the state would directly have to intervene in bank governance.

3.4 Capital Regulation

Let us briefly analyze the role of capital regulation in this model. For this purpose, we first endogenize the capital structure of the bank.⁷ One way to do this is to assume that deposits are the cheapest way of refinance, but that the amount of deposits is limited. As a consequence, D is now endogenous, but fixed at the maximum amount of deposits that the bank can collect ($D = \bar{D}$). Furthermore, assume that the opportunity costs of equity exceed the refinancing costs through other liabilities. Then any capital requirement will be binding. For a given capital requirement \bar{E} , L can be determined by $L = A - \bar{D} - \bar{E}$.

In the absence of bail-outs, capital regulation is ineffective. For the case of limited liability, this can be seen directly in equations (9) or (10) where management compensation and risk-shifting are influenced by $R_D = (1 + r) \bar{D}$, but not by equity (the same is true with unlimited liability). The reason is that the market discipline through uninsured liabilities L works just as well as the discipline through more equity. As \bar{E} increases due to regulation, L is crowded out, and the effects cancel out. Given that equity is expensive, the regulator should not force the bank to hold equity in this situation.

If bail-outs are anticipated, we must substitute R_D by $(1 + r) \bar{D} + (1 + r_f) L$ in equations (9) or (10). Because L is determined by \bar{E} , capital requirements are now an effective policy tool because they reintroduce a disciplining effect. Hence, capital requirements can be useful if market discipline is hampered by the existence of bail-out guarantees.

4 Effort Choice

We now consider an alternative setting, in which the manager can exert effort in order to increase the mean return of the bank's portfolio. In Section 5, we will then combine the two models and consider the general case in which the manager can choose risk and effort. We start by describing the bank's return structure before analyzing compensation schemes, effort choices, and the effects of anticipated bank bail-outs with limited and unlimited liability of the manager.

⁷As an alternative to capital regulation, John, Saunders, and Senbet (2000) propose to modify the pricing schemes of deposit insurance to set appropriate incentives for bank managers.

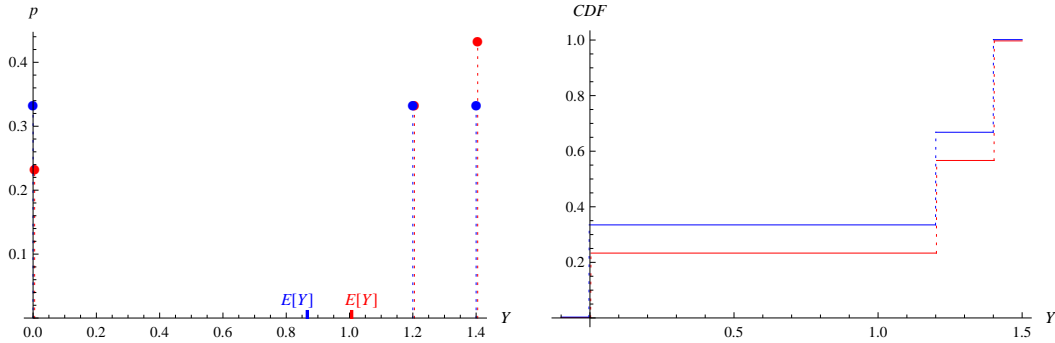
4.1 Return Structure of the Bank

Assume that managers can exert effort in order to increase the mean return of the bank (by moving probability mass from bad states to the better states). For concreteness, we assume the following return structure.⁸

$$\begin{aligned} p_h(e) &= \frac{1}{3} + e \geq \frac{1}{3}, \\ p_m(e) &= \frac{1}{3}, \\ p_l(e) &= 1 - p_h(e) - p_m(e) = \frac{1}{3} - e \leq \frac{1}{3}, \end{aligned} \tag{17}$$

for $e \in [0; 1/3]$. With this parameterization, an increase in effort e shifts probability mass from the worst to the best state, hence it leads to a new distribution that first-degree stochastically dominates the original distribution. Given the cost function $c(e) = \eta e^2/2$, the first-best level of effort is $e = \frac{Y_h}{\eta}$.

Figure 3: Return Distributions, Depending on Effort Choice



This picture shows a possible distribution of returns with $Y_h = 1.4$, $Y_m = 1.2$, and $Y_l = 0$ for $e = 0$ (blue) and $e = 0.1$ (red). The “density function” is on the left, the cumulative distribution function is on the right.

⁸Here the medium state is needed only to allow for a combination of this model with that from Section 3 in Section 5.

4.2 Limited Liability of the Manager

With limited liability of the manager, the shareholder will offer a bonus contract with $z_h > 0$ and $z_m = z_l = 0$. Using the same procedure as above, we derive z_h^* and e^* as⁹

$$z_h^* = \frac{Y_h - R_D}{2} - \frac{\eta}{6}, \quad (18)$$

$$e^* = \frac{Y_h - R_D}{2\eta} - \frac{1}{6}. \quad (19)$$

We see that the equilibrium effort will be below the first-best level. There are two reasons for this result. First, if the shareholder wants the manager to choose a higher effort level, he needs to pay a higher rent. The delegation is expensive, which leads the shareholder to implement too few incentives. Second, an increase in e partly benefits the bank's creditors. Therefore, the shareholder has insufficient incentives to implement a contract that entails an efficient level of effort.

The Impact of Bail-outs. Taking the derivative with respect to R_D , we find that the anticipation of bail-outs leads to a *flatter* compensation scheme, and hence to a lower effort choice, implying an increase in the bank's default probability, $p_l(e^*)$. The reason is the positive externality of effort on depositors' expected profits, which is not taken into account by shareholders when designing the compensation package. The resulting effort by the manager is too small. The higher R_D , the larger the externality on depositors, the flatter the compensation scheme, and the lower the effort choice.

Proposition 3 (Impact of Bail-outs with Limited Liability) *If lenders anticipate a bank bail-out,*

1. *the bonus scheme becomes flatter (z_h^* decreases),*
2. *the manager's effort (e^*) decreases, implying that the bank's probability of default $p_l(e^*)$ increases, and*
3. *the expected compensation and the expected profit of the manager decrease,*

⁹We must have $\eta \leq 3(Y_h - R_D)$, otherwise it does not pay for the shareholder to incentivize the manager, cf. footnote 5.

4. *the expected profit of the shareholder increases.*

In this context, the argument with respect to regulating management compensation is completely different from Section 3. Here, from a welfare perspective, the manager's effort choice is always suboptimal. A ceiling on bonus payments would worsen the manager's choice. But when a bail-out is anticipated, the bonus scheme becomes flatter. This implies that, potentially, the regulation becomes ineffective (is no longer binding). Hence, a cap on bonuses would be harmful or, at best, ineffective in this setting.

Corollary 2 (Bonus Regulation) *If the manager faces an effort choice, a ceiling on management compensation is detrimental. The negative effect is weakened if bail-outs are anticipated.*

4.3 Unlimited Liability of the Manager

With unlimited liability of the manager, we obtain

$$z_h^* = Y_h - R_D > 0, \quad (20)$$

$$z_m^* = -(Y_h - R_D) - \frac{3(Y_h - R_D)^2}{2\eta} < 0, \quad (21)$$

$$e^* = \frac{Y_h - R_D}{\eta}. \quad (22)$$

We find that the bonus scheme is steeper than with limited liability; z_h^* increases and z_m^* becomes negative. The reason is that it is now cheaper for the shareholder to induce the manager to exert effort. Hence, the equilibrium level of effort (e^*) is also higher, and the bank's probability of default $p_l(e^*)$ drops. Nevertheless, effort will still be below the first-best level.

The Impact of Bail-outs. The anticipation of bail-outs again leads to a flatter compensation scheme, and hence to a lower effort choice, implying an increase in the bank's default probability $p_l(e^*)$, for the same reasons as above. However, the effect of an anticipated bail-out is again stronger (in fact, twice as strong) than with limited liability. With unlimited liability, the equilibrium effort will be reduced more.

Proposition 4 (Impact of Bail-outs with Unlimited Liability) *If lenders anticipate a bank bail-out,*

- 1. the bonus scheme becomes flatter (z_h^* decreases and z_m^* increases),*
- 2. the manager's effort (e^*) decreases (even more than with limited liability), such that the bank's probability of default $p_l(e^*)$ increases (even more than with limited liability),*
- 3. the expected compensation and the expected profit of the manager decrease,*
- 4. the expected profit of the shareholder increases.*

Hence, the unlimited liability of the manager mitigates the effort problem and thereby stabilizes banks. However, the anticipation of bail-outs is harmful even with unlimited liability.

Taken together with the results from the previous sections, these propositions have several policy implication. Most importantly, the public discussion suggests that increasing the managers' liability can prevent undesirable behavior. Our propositions show that this is true only if managers put too little effort in administering their portfolio (if they are thought to be "lazy"). However, if the problem is that managers take too much risk (and shareholders like them to do just that), an increase in the managers' liability backfires, managers take even more risk, and financial stability deteriorates. Therefore, the public debate may be misguided.

5 General Model with Risk and Effort Choices

In reality, managers choose risk and effort. Therefore, we now consider the generalization of Section 3 and Section 4, assuming that the manager can influence the return distribution by choosing risk *and* effort. Here we only consider the case of limited liability.

5.1 Return structure of the bank

We now assume that the manager can take more risk by raising a at a private cost $\alpha a^2/2$. Moreover, he can increase the mean return by exerting an effort e at a private cost $\eta e^2/2$. The return distribution is then given by

$$\begin{aligned} p_h(e, a) &= \frac{1}{3} + e + \frac{a}{Y_h(Y_h - Y_m)}, \\ p_m(e, a) &= \frac{1}{3} - \frac{a}{Y_m(Y_h - Y_m)}, \\ p_l(e, a) &= 1 - p_h(e, a) - p_m(e, a) = \frac{1}{3} - e + \frac{a}{Y_h Y_m}. \end{aligned} \quad (23)$$

With these distribution functions, the first-best parameter choices are $a = 0$ and $e = Y_h/\eta$.

5.2 Limited Liability of the Manager

Under limited liability, only z_h will be positive in equilibrium. This implies that the shareholder has only one instrument to influence the two choice parameters of the manager. When z_h goes up, the manager takes more risk a and increases the effort e . Following an analogous procedure as above, we find that the manager chooses

$$\begin{aligned} a^* &= \frac{z_h}{Y_h(Y_h - Y_m)\alpha}, \\ e^* &= \frac{z_h}{\eta}. \end{aligned} \quad (24)$$

Risk and effort are proportional to the bonus z_h . The maximization of the shareholder yields

$$z_h^* = \frac{1}{2} \frac{\frac{R_D}{Y_m(Y_h - Y_m)} \frac{\eta}{\alpha} + Y_h^2 (Y_h - R_D - \frac{\eta}{3})}{\frac{1}{(Y_h - Y_m)^2} \frac{\eta}{\alpha} + Y_h^2}. \quad (25)$$

Now the effect of anticipated bail-outs is no longer unambiguous. Taking the derivative with respect to R_D yields

$$\frac{dz_h^*}{dR_D} = \frac{1}{2} \left(\frac{Y_h}{Y_m (1 + Y_h^2 (Y_h - Y_m)^2 \alpha / \eta)} - 1 \right)^{-1}. \quad (26)$$

This derivative is positive if and only if

$$\frac{\eta}{\alpha} > Y_h^2 Y_m (Y_h - Y_m). \quad (27)$$

This result is quite intuitive. If R_D increases, the shareholder adjusts the contract for the manager. There are two countervailing effects. First, as in Section 3, an increase in risk becomes more attractive for the shareholder, so he wants to increase z_h . This channel is particularly strong if risk-taking is cheap, hence if α is small. Second, as in Section 4, a high effort e becomes less attractive for the shareholder, so he wants to reduce z_h . This channel is particularly strong if η is small. Which of the two effect dominates will hence depend on the relative size of η and α .

Proposition 5 (Impact of Bail-outs with Limited Liability) *If lenders anticipate a bank bail-out,*

1. *the bonus scheme becomes steeper (z_h^* increases) if and only if*

$$\eta/\alpha > Y_h^2 Y_m (Y_h - Y_m),$$

2. *the manager's effort (e^*) and risk choice (a^*) increase under the same condition, but the bank's probability of default $p_l(e^*)$ always increases,*
3. *the expected compensation and the expected profit of the manager increase under the same condition,*
4. *the expected profit of the shareholder always increases.*

Welfare Effects of Bank Bonus Regulation In Section 3, a ceiling on bank manager bonuses increased welfare. In Section 4, a ceiling was detrimental. In this general setup, both effects of the above models are present, so the welfare effect of a ceiling is ambiguous. On the one hand, a ceiling would enable the regulator to reduce banks' risk-taking; on the other hand, it would curb the bank manager's effort. Assume the regulator wants to maximize social welfare. Welfare is defined as the aggregate net present value, net of the manager's non-monetary costs,

$$W = p_h Y_h + p_m Y_m - (1 + r) D - (1 + r_f) L - \eta e^2/2 - \alpha a^2/2. \quad (28)$$

The parameters p_h , p_m , e and a depend on z_h . We can now calculate the welfare-maximizing bonus,

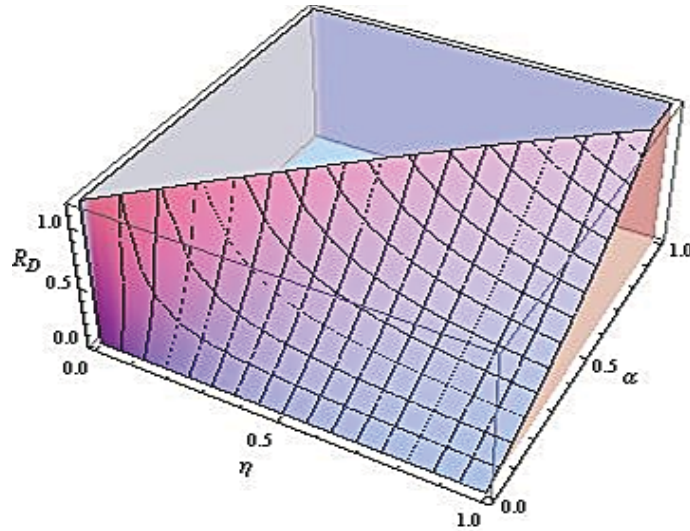
$$z_h^W = \frac{Y_h}{\frac{1}{Y_h^2 (Y_h - Y_m)^2} \frac{\eta}{\alpha} + 1}. \quad (29)$$

If z_h^W falls short of z_h^* of equation (25), a ceiling on bonus payments will improve welfare.¹⁰ If z_h^W exceeds z_h^* , then the bonus payment implemented by the shareholder is too small from a welfare perspective (because it induces too little effort, e), hence putting a ceiling on bonus payments is ineffective. Comparing (25) and (29) shows that $z_h^* > z_h^W$ if and only if

$$R_D \geq \frac{Y_h + \eta/3}{\frac{1}{Y_h^2 Y_m (Y_h - Y_m)} \frac{\eta}{\alpha} - 1}. \quad (30)$$

The condition is illustrated by Figure 4 for different combinations of η and α .

Figure 4: Condition for Welfare-Increasing Ceiling on Bonuses



This simulation is again based on the parameters $Y_h = 1.4$, $Y_m = 1.2$ and $Y_l = 0$. For parameters R_D , η and α below the plane, capping management bonuses is ineffective.

The Impact of Bail-outs. As discussed above, the effect of an anticipated bail-out is similar to the effect of an increase in R_D . The above figure shows that, even if one starts below the plane where ceilings on bonuses are welfare-decreasing, an increase in R_D can lead into the region where caps on bonus payments increase welfare.

Proposition 6 *If lenders anticipate a bank bail-out, the parameter space for which regulatory ceilings on bonus payments are optimal from a welfare perspective increases.*

¹⁰A tax on bonus payments would have the same effect.

Hence, the frequent calls for ceilings on bank bonuses during the current crisis may well be justified: Given the huge bail-out packages to many banks, expected bail-out probabilities increased across the board. This may render bonus ceilings optimal from the welfare perspective, even if this was not the case before.

5.3 Unlimited Liability of the Manager

For completeness, consider again a manager with unlimited liability. An interior solution satisfies

$$\begin{aligned} z_m^* &= \frac{Y_h - R_D}{2} - \frac{\eta}{6} \cdot \frac{Y_h + Y_m}{Y_h}, \\ z_h^* &= \frac{Y_m - R_D}{2} - \frac{\eta}{6} \cdot \frac{Y_h + Y_m}{Y_h} \cdot \frac{Y_m}{Y_h} - \frac{\alpha}{6} Y_m^2 (Y_h - Y_m)^2. \end{aligned} \quad (31)$$

The equilibrium choice variables of the manager are

$$\begin{aligned} a^* &= \frac{1}{6} (Y_h - Y_m) Y_m + \frac{R_D}{2 Y_h Y_m \alpha}, \\ e^* &= \frac{Y_h - R_D}{2 \eta} - \frac{Y_h + Y_m}{6 Y_h}. \end{aligned} \quad (32)$$

Again, unlimited liability makes the compensation scheme steeper. A comparison with the results of Section 5.2 shows that through unlimited liability, both a^* and e^* increase.

6 Conclusion

This paper has analyzed how a bank shareholder designs the compensation scheme of a manager in order to mitigate agency problems. We have considered two setups with different types of agency problems: a risk-shifting problem where the manager can choose the risk of the bank portfolio, and an effort problem where the manager can affect the mean return of the bank portfolio by exerting effort. We have shown that the shareholder will design a compensation scheme that induces the manager to choose excessive risk or a suboptimally low effort level in the respective setups.

We have then analyzed the effects of anticipated bail-outs. Such bail-outs weaken market discipline and induce the shareholder to steepen the bonus scheme in the risk-shifting setup, leading to even more risk-taking. In the effort choice setup, anticipated bail-outs tend to flatten the bonus scheme, reducing effort even further. Unlimited liability of the manager is counterproductive in the risk-shifting setup, while it helps to mitigate the effort problem. Ceilings on bonus payments are welfare-increasing in the risk-shifting setup, and detrimental in the effort setup.

We have then presented a general model combining the two agency problems. The anticipation of bail-outs may lead to steeper or flatter compensation schemes, depending on the curvature of the manager's cost functions for raising risk or effort. Under certain circumstances, ceilings on bonuses can be used to reduce risk-taking and raise welfare. For other parameter constellations, such ceilings are ineffective. The anticipation of bail-outs increases the parameter space for which bonus caps are welfare-increasing.

Hence, in the light of the increase in expected bail-out probabilities after the huge bank bail-outs during the current crisis, a ceiling on bank bonuses may well be justified. In fact, with permanently higher bail-out perceptions, such ceilings should not be lifted even after the crisis. It remains to be seen whether this will be politically feasible.

A Proofs

Proof of Remark 1: For the proof, consider Figure 2. a is higher for the red curve. Hence, the area under the red CDF should exceed that under the blue CDF for all Y . Formally, $\int_{-\infty}^Y F(Y') dY'$ should be larger for the red CDF for all Y . Now the area between the red and the blue CDF below Y_m is $Y_m [p_l(a_1) - p_l(a_2)] = (a_2 - a_1)/Y_h$, with $a_1 = 0$ and $a_2 = 0.05$. Between Y_m and Y_h , the area between the CDFs is $(Y_h - Y_m) [p_l(a_2) + p_m(a_2) - p_l(a_1) - p_m(a_2)] = (a_2 - a_1)/Y_h$. The areas are thus equal. Some more formalization would yield a proof. A higher a induces an MPS. ■

Proof of Proposition 1: The first two points are already in the main text. For the third point, the manager's expected (monetary) compensation, taking the optimal contract and the optimal action of the manager into account, is

$$p_h z_h = \frac{R_D^2}{4 Y_h^2 Y_m^2 \phi} - \frac{1}{36} Y_h^2 (Y_h - Y_m)^2 \phi. \quad (33)$$

The derivative with respect to R_D is clearly positive. The manager's expected profit (net of the non-monetary cost) is then¹¹

$$\Pi_M = \frac{1}{24 \alpha} \left(\frac{R_D}{Y_h Y_m} + \alpha Y_h (Y_h - Y_m) \right) \left(\frac{3 R_D}{Y_h Y_m} - \alpha Y_h (Y_h - Y_m) \right). \quad (34)$$

Again, $d\Pi_M/dR_D > 0$, which proves point 3. Finally, the shareholders' expected profit in equilibrium is

$$\begin{aligned} \Pi_E = & \frac{R_D^2}{4 Y_h^2 Y_m^2 \phi} + \frac{2 Y_m (Y_h - Y_m) - R_D (Y_h + 3 Y_m)}{6 Y_m} \\ & + \frac{Y_h^2 (Y_h - Y_m)^2 \phi}{36} - (1 + r_f) L. \end{aligned} \quad (35)$$

Here, the derivative with respect to R_D (when taking into account that the sum $D + L$ must remain constant) is

$$\frac{d\Pi_E}{dR_D} = \frac{R_D}{2 Y_h^2 Y_m^2 \alpha} - \frac{Y_h + 3 Y_m}{6 Y_m} + \frac{1 + r_f}{1 + r}. \quad (36)$$

Already for the limiting case (see footnote 5) of $\alpha = 3 R_D / [Y_h^2 (Y_h - Y_m) Y_m]$, this derivative becomes $-2/3 + (1 + r_f)/(1 + r)$, which is positive for $r \approx r_f$. For smaller α , it becomes even larger. Hence, the derivative is positive, which proves the final statement of the proposition. ■

¹¹Footnote 5 implies that this profit is positive.

Proof of Proposition 3: With the same argument as before Proposition 1, we see that an expected bailout has the same effect as an increase in R_D . From (18) and (19), it is obvious that $dz_h^*/dR_D < 0$ and $de^*/dR_D < 0$, which proves the first two statements. For the third statement, the manager's expected compensation is

$$p_h z_h = \frac{(Y_h - R_D)^2}{4\eta} - \frac{\eta}{36}, \quad (37)$$

which decreases as R_D increases. The manager's expected profit is

$$\Pi_M = \frac{(Y_h - R_D + \eta)(3Y_h - 3R_D - \eta)}{24\eta}, \quad (38)$$

which also decreases in η . Finally, the shareholder's expected profit is

$$\Pi_E = \frac{(3(Y_h - R_D) + \eta)^2}{36\eta} + \frac{Y_m - R_D}{3} - (1 + r)L. \quad (39)$$

This profit must increase if banks are expected to be bailed out, because even in the absence of the shareholder's reaction, this profit would increase. But the shareholder can adapt the contract, such that the manager reacts according to the shareholder's bidding. Due to this indirect effect, the expected profit increases even more. This completes the proof. ■

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