

# Regulating Bank CEO Compensation and Active Boards\*

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We analyze the limits of regulating bank CEO compensation to reduce risk shifting in the presence of an active board that retains the right to approve new investment strategies. Compensation regulation prevents overinvestment in strategies that increase risk, but it is less effective in preventing underinvestment in strategies that reduce risk. The regulator optimally combines compensation and capital regulation. In contrast, if the board delegates the choice of strategy to the CEO, compensation regulation is sufficient to prevent both types of risk shifting. Compensation regulation increases shareholders' incentives to implement an active board, which reduces the effectiveness of compensation regulation.

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# 1. Introduction

We explore the regulation of bank CEO compensation to prevent risk shifting in the presence of an active board and its interaction with regulatory capital requirements. Compensation regulation can prevent overinvestment in risky strategies if it eliminates the CEO's incentives to propose excessively risky strategies. However, with an active board, compensation regulation is less effective in dealing with underinvestment in risk reducing strategies since the board can veto such strategies to prevent a reduction in shareholder value. Constraining leverage curtails the incentives of shareholders to take excessive risk. Optimal regulation in the presence of active boards combines compensation regulation and a leverage constraint. In contrast, with a passive board that delegates strategic decisions to the CEO, regulating CEO compensation can implement the socially optimal level of risk taking, and no leverage regulation is necessary. However, passive boards are generally not optimal when there are governance problems and the CEO might behave opportunistically. Introducing compensation regulation for the CEO can increase shareholders' incentives to implement an active board, which reduces the effectiveness of compensation regulation. Our results show that it is important to take the interaction between the board and CEO into account when considering the optimal structure of bank regulation, in particular, the effectiveness of regulating bank CEO compensation. A compensation contract that is linear in the bank's total payoff dominates a bonus cap, as introduced by the EU's new capital requirements directive (DIRECTIVE 2013/36/EU, 2013, Art. 94(g) and 94(m)), if the regulator's objective is to maximize social value.

We develop a model where a bank CEO searches for new strategies that can include new business models (e.g., fee business, trading desk), risk management tools, the use of risk transfer instruments, or the level of proprietary trading. The board, representing shareholders, employs the CEO, sets CEO compensation, and chooses the bank's target leverage ratio. An active board monitors the CEO to prevent mismanagement and rent

extraction. Moreover, an active board understands the bank's strategy and retains the right to approve changes to the current strategy. If the board does not approve a new strategy, the bank's current strategy remains in place. A new strategy can increase or decrease the bank's risk relative to the bank's current strategy. Upon finding a new strategy, the CEO decides whether to present it to the board, or not. The board provides the CEO with incentives to search for new strategies and propose them to the board. It is impossible to reward the CEO based on the effort he undertakes searching for a new strategy. We also assume that it is not verifiable whether the CEO found a new strategy or not, but it is possible to contract upon implementing a new strategy and the bank's realized payoff.

The bank is financed by a mix of equity and (insured) deposits, which gives shareholders an incentive to engage in risk shifting. Thus, the board provides the CEO with a compensation contract that reflects these incentives for risk taking in the absence of any compensation regulation. The board and the CEO will pursue strategies that involve excessively high risk and forgo risk reducing strategies that are socially optimal.

Regulating CEO compensation can eliminate the problem of overinvestment in risky strategies by requiring deferred compensation that is linear in the bank's total payoff. This compensation contract provides the CEO with incentives to maximize the total value of the bank. A bonus cap can also limit the CEO's incentive to engage in risk shifting, as a risky strategy is only worthwhile for the CEO if the compensation in the case of success is high enough. However, a bonus cap will either not fully prevent overinvestment in risky strategies or lead to inefficient underinvestment. A linear compensation contract does not involve such a trade-off. A linear contract is more effective than a bonus cap because it ties compensation to strategies' expected payoffs while bonus caps impose a uniform constraint on different strategies regardless of their expected payoffs.

Compensation regulation in the presence of an active board cannot eliminate under-

investment in socially efficient strategies that reduce risk. The reason is that reducing risk reduces the option value of default for shareholders. For this reason, the board will not approve such strategies. Compensation regulation is ineffective in this case because compensation contracts only directly affect how shareholder value and CEO compensation are shared, not the total amount available to shareholders and the CEO. Hence, a compensation contract cannot simultaneously provide incentives for the board to approve and for the CEO to present all efficient strategies that reduce risk.

The distinction between strategies that increase risk and strategies that reduce risk is important. Most papers that analyze risk shifting problems in the spirit of Jensen and Meckling (1976) focus on the former and consider only the option to increase risk. However, measures to reduce risk can be important for banks. For example, in the model by Diamond and Rajan (2011), risk shifting occurs when banks do not sell illiquid and distressed assets in a crisis. Selling the assets would reduce the probability of financial distress but primarily benefit debt holders, while holding on to the assets involves a gamble on the recovery of the economy that benefits shareholders.

With a passive board, compensation regulation can implement efficient risk taking in our model. However, active boards prevent the CEO from engaging in opportunistic behavior that destroys the value of the bank for shareholders as well as depositors (or the deposit insurance agency). Regulating CEO compensation provides incentives for a board to become informed and active. The reason is that, when the CEO's and the regulator's incentives are aligned, the board is less willing to delegate decisions to the CEO. The trade off between active and passive boards differs for shareholders and regulators. We discuss this trade off and relate it to recent proposals that concern the regulation of bank corporate governance (BCBS, 2014; PRA and FCA, 2014).

Capital regulation that limits bank leverage reduces the benefit of risk shifting for shareholders. Nevertheless, risk shifting incentives, albeit muted, prevail at any positive

level of leverage. To the extent that insured liquid deposits are valuable for households, it is not optimal for the regulator to eliminate deposit insurance. It is optimal for the regulator to combine compensation regulation and capital regulation. However, as the social and private incentives for investing in safe strategies differ at any positive level of leverage, even the optimal mix cannot implement the first best, because some socially efficient safe strategies will not get implemented if leverage is positive.

In our model, optimal compensation regulation will lead to an increase in CEO compensation because, with a linear wage the CEO also receives a positive wage when the bank does not change its strategy. Thus, the expected compensation for alternative strategies has to increase to provide incentives to search. This increase in CEO compensation is a transfer from shareholders that does not affect efficiency in the model as long as the board still provides the CEO with incentives to search for new strategies.

Our model has several features that are in line with recent empirical evidence on the link between board representation, CEO compensation and risk taking. For example, Bhagat and Bolton (2011), Fahlenbrach and Stulz (2011) and Hagedorff and Vallascas (2011) show that banks whose CEO's incentives were more aligned with shareholders took more risk and performed worse during the crisis of 2007-2009. Concerning the role of the board and corporate governance, the literature provides evidence that more shareholder friendly boards are also associated with higher risk taking and worse performance during the financial crises (e.g. Gropp and Köhler, 2010; Aebi et al., 2012; Beltratti and Stulz, 2012; Erkens et al., 2012; Peni and Vähämaa, 2012; Ellul and Yerramilli, 2013; Berger et al., 2014). Minton et al. (2014) find that banks with a higher representation of financial experts on their board performed slightly better before the financial crisis and slightly worse during the financial crisis. They argue that this evidence is consistent with higher risk taking in these banks.

A number of papers explore how the structure of CEO compensation can overcome

incentive problems between different claimants of a firm. One of the first papers is by John and John (1993) who show that combining a fixed wage that is only paid in case of solvency with an equity stake can provide CEOs with incentives to select the socially optimal set of investment projects. Several recent papers discuss the role of CEO compensation for bank risk taking: Edmans and Liu (2011) advocate to combine equity stakes with debt-like instruments such as uninsured pension schemes, Bolton et al. (2015) propose making CEO compensation a function of a bank's CDS spreads, and Hakenes and Schnabel (2014) discuss the role of a bonus cap to curb risk taking incentives.<sup>1</sup>

John et al. (2000) propose linking other regulatory tools to the structure of CEO compensation. They consider a fairly-priced deposit insurance premium that reflects the risk taking incentives implied by CEO compensation. This gives shareholders an incentive to choose the CEO compensation that maximizes the total value of the bank.<sup>2</sup> Hilscher et al. (2015) show that when the regulator can only imperfectly regulate bank risk taking and CEO compensation and it can be optimal to combine both regulatory tools.

Our model differs from the previous contributions by assuming that the board plays an active role in the choice of strategy. Hence, the CEO compensation does not uniquely determine the bank's investment strategy. In the literature above, where the CEO directly chooses the risk, it is sufficient to ensure that the CEO's incentives are set optimally. There is no role for an additional regulatory capital requirement. We show that the effectiveness of regulating CEO compensation is limited in the presence of an active board. Given this limit, capital regulation plays an important role in shaping shareholders' incentives to reduce risk.

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<sup>1</sup>A different strand of the literature focuses on the inefficiencies that arise in the labor market for bank CEOs (Thanassoulis, 2012; Bannier et al., 2013; Archarya et al., 2014). In these models, labor market imperfections lead to risk taking incentives that are excessive from the firm's perspective, which provides a rationale for regulation.

<sup>2</sup>Eufinger and Gill (2013) show that this can also be achieved with capital requirements that depend on CEO compensation. While not discussed in their paper, their model gives shareholders an incentive to choose a CEO compensation where the optimal capital requirements will not be binding.

Several papers have looked at possible detrimental effects of regulating CEO compensation in a multi-task agency setting. Hakenes and Schnabel (2014) show that restricting bonuses to avoid risk taking can result in suboptimal effort provision. Inderst and Pfeil (2013) and Hoffmann et al. (2014) show that mandating deferred compensation or longer deferral periods can reduce the screening of new loans. The reason is that deferred compensation makes it more costly to provide loan officers with screening incentives. Our main contribution is to show that in the presence of an active board there is an important limit to what regulating CEO compensation can achieve even when looking only at the risk shifting problem. Introducing additional tasks such as the search for new strategies can further limit the effectiveness of CEO compensation.

## 2. The Model

### 2.1. Bank Strategy

We consider a bank with a board of directors and a CEO. The board represents shareholders; the CEO maximizes his own utility. The board and the CEO are risk neutral, the outside option yields zero utility. In a changing economic and competitive environment, the CEO is responsible for searching for new opportunities to increase the value of the bank, which constitutes the bank's strategy. In a broad sense, a bank's strategy could comprise its business model (interest or fee business), its risk management and lending standards, the use of risk transfer instruments, level of proprietary trading etc.

The level of total assets (investment)  $I$  is fixed and there are two states of nature, success and failure. The bank's current strategy yields a payoff  $\hat{H}$  with probability  $\hat{p}$  and a payoff of zero in the case of failure. If the CEO exerts effort, he uncovers an alternative strategy with probability  $\phi$ . A possible new strategy yield a payoff  $H \in [0, \bar{H}]$  with probability  $p \in [0, 1]$  and zero in the case of failure. Thus, strategies are fully characterized

by their probability of success  $p$  and the payoff in the case of success,  $H$ . Conditional on finding a strategy, its characteristics are drawn from a joint distribution  $f(H, p)$  over the set of strategies  $[0, \bar{H}] \times [0, 1]$ . The distribution  $f(H, p)$  and the characteristics of the current strategy  $(\hat{H}, \hat{p})$  are common knowledge. After exerting effort, the CEO learns whether a new strategy is available and if so, its characteristics  $(H, p)$ . The new strategy may or may not be associated with a higher expected payoff than the current strategy. Searching for new alternative strategies involves a personal cost  $c$  for the CEO and is not observable.

If the CEO presents a strategy to the board, an active board understands the characteristics of a new strategy,  $(H, p)$ . However, the CEO can strategically withhold information and claim that he found no new strategy. The board provides the CEO with incentives to search for new strategies that are profitable for shareholders and to present them to the board. The board retains the right to approve a new strategy. Thus, the CEO's power stems from access to information that he can withhold, while the board's power stems from its formal authority to oppose a new strategy.

The CEO can mismanage the bank and extract a private benefit at the expense of decreasing the bank's expected payoff. An active board that monitors the CEO can prevent mismanagement. We assume that the expected cost of mismanagement is so high that it is socially efficient and optimal for the board to be active. We endogenize the decision of the board to become active and formalize mismanagement in Section 8.

## 2.2. CEO Compensation

A wage contract can consist of an initial wage  $w_i$  and a deferred compensation  $w_d(H)$ . The CEO receives the initial wage independently of whether the bank fails or not.<sup>3</sup> In contrast, the CEO receives the deferred wage only if the bank does not default. Moreover,

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<sup>3</sup>In order to pay an initial wage the bank has to raise capital as will be explained in section 2.3.



the deferred compensation can depend on the bank's realized payoff,  $H$ .

The CEO's search effort, a strategy's success probability, or the pure availability of a new strategy are not contractible. However, the wage structure can depend on whether the CEO implements a new strategy. We denote the initial wage and the deferred compensation that the CEO receives with the current strategy by  $\hat{w}_i$  and  $\hat{w}_d$  respectively. The initial wage and deferred compensation with a new strategy are  $w_i$  and  $w_d(H)$ . Although the initial wage is not dependent on the bank's future payoff, it can still change (and thus be variable) if the board approves a new strategy and  $w_i \neq \hat{w}_i$ . The CEO is protected by limited liability so that the total wage payment cannot be negative. With a claw back arrangement, the CEO could lose the initial wage  $w_i$  if the bank fails. However, any wage structure with  $w'_i > 0$ ,  $w'_d(H)$ , and  $w'_d(0) = -k$  (with  $k \leq w'_i$  because of limited liability) yields the same payoff for the CEO as a wage structure where  $w_i = w'_i - k$ ,  $w_d(H) = w'_d(H) + k$ , and  $w_i = w_d(0) = 0$ . Thus, we restrict our analysis to the case without claw back and assume  $w_d(0) \geq 0$ . The wage contract  $\omega$  contains  $w_i$ ,  $\hat{w}_i$ ,  $w_d(H)$ , and  $\hat{w}_d$ .

We assume that the board cannot fire the CEO after he has presented a new strategy to save the wages that the board promised as incentives to search for a new strategy. (For example, a very high severance pay would prevent this.) However, we allow for renegotiation of the wage contract if both the CEO and the board agree to change the contract. Renegotiation takes the following form.

1. The CEO decides whether to propose a new strategy or not.
2. The board decides whether to offer the CEO a new wage after observing the new strategy's characteristics  $(H, p)$ . For example, it can offer an initial wage  $w'_i = \hat{w}_i + \hat{p}\hat{w}_d$ , which makes the CEO indifferent between the old and the new strategy.
3. The CEO decides whether to accept or reject the new offer. If the CEO rejects,

the old contract stays in place.

4. The board decides whether to implement the new strategy or not.

Renegotiation avoids the situation where the board rejects strategies with low expected payoff because of high CEO compensation. The flexibility of renegotiation is also important with compensation regulation to avoid detrimental effects from CEO compensation on the implementation of safe strategies. There exists no renegotiation proof compensation contract that implements the same strategies as renegotiation. The reason is that the compensation contract cannot explicitly depend on a strategy's success probability. In contrast, compensation after renegotiation depends on the strategy's success probability since the board observes the characteristics of the strategy that the CEO proposes.

### 2.3. Bank Leverage

The bank is financed with equity  $E$  and deposits  $D$ . Depositors are fully insured by deposit insurance and demand the risk-free rate of return, which we normalize to 0. We assume that banks do not have to pay a risk-sensitive premium for deposit insurance, which we also normalize to zero. Laeven (2002) and Demirgüç-Kunt and Kane (2002) find that deposit insurance pricing is, if at all, only weakly related to loan portfolio riskiness. Because of deposit insurance, depositors fail to charge the bank for the risk that it incurs and shareholders prefer debt financing to equity financing. Other reasons why debt might be cheaper than equity include, for example, implicit guarantees, tax benefits of debt financing, and possible frictional cost of equity.

The bank cannot increase its book leverage above 100% (i.e.,  $D/I \leq 1$ ), even in the absence of regulation. Moreover, we assume that the current strategy's payoff  $\hat{H}$  is sufficiently high so that the bank will not default on CEO compensation or depositors in the success state with the current strategy. The assumptions imply that the bank cannot transfer wealth to shareholders by financing dividends with debt and that, given optimal

behavior, CEO compensation does not cause default for any of the strategies that the CEO implements.

## 2.4. Regulatory Tools

We focus on two regulatory tools. First, the regulator can impose a capital requirement, which limits the amount of deposits raised to a maximum level of  $D$ . Second, the regulator can constrain the structure of CEO compensation. Since a bank's success probability is not contractible, regulation that is directly linked to a bank's risk is not feasible, which precludes, for example, a risk-based deposit insurance premium, risk-based capital requirements, or a direct limit on a bank's risk.

The regulator maximizes total expected social value. We assume that depositors (households) associate a positive value with publicly insured liquid deposits, which provide money-like claims. Stein (2012), for example, provides a model that explicitly introduces the value of guaranteed deposits into households' utility function. Let  $\gamma(D)$  be the monetary equivalent value of households' utility from insured deposits. For tractability, we assume that  $\gamma(D)$  is an increasing and weakly concave function and that  $\lim_{D \rightarrow 0} \gamma'(D) = \infty$  and  $\lim_{D \rightarrow I} \gamma'(D) = 0$  to rule out boundary solutions. Thus, it is not socially optimal to prohibit funding with insured deposits or to give up deposit insurance. Alternatively, following Diamond and Dybvig (1983), a large literature justifies the presence of deposit insurance with the social cost of bank runs.

## 2.5. Time-Line

We summarize the interaction between the board and the CEO in Figure 1. Taking the regulatory constraints as given, the board raises deposits and designs the CEO's compensation contract at  $t = 1$ . At  $t = 2$ , the CEO decides whether to search for a new strategy. If he discovers a new strategy, he learns about the strategy's characteristics

and decides whether to present the new strategy to the board. At  $t = 3$ , if the CEO presents a new strategy, the board learns the characteristics of this strategy and can make a take-it-or-leave-it offer to change the CEO's compensation contract, which the CEO either accepts or rejects. At  $t = 4$ , the board decides whether to approve a potential new strategy or stay with the current strategy. At  $t = 5$ , uncertainty is resolved and the bank's payoffs are realized.

### 3. Strategy Choice

#### 3.1. Strategy Approval and Renegotiation

The board will only approve a new strategy if it increases shareholder value:

$$p(H - D - w_d(H)) - w_i \geq \hat{p}(\hat{H} - D - \hat{w}_d) - \hat{w}_i. \quad (1)$$

If (1) is not satisfied, the board can renegotiate the CEO's compensation contract. The CEO knows that in this case the board will not approve the new strategy without renegotiation anyway and thus accepts any new wage contract that guarantees at least the same expected wage as the initial contract. If (1) is satisfied for the initial contract, the board cannot renegotiate the contract because the board cannot make a credible threat not to implement the new strategy.

Given renegotiation with symmetric information, the board and the CEO will always implement a strategy that maximizes the sum of shareholder value and CEO compensation:

$$\begin{aligned} p(H - D - w_d(H)) - w_i + pw_d(H) &\geq \hat{p}(\hat{H} - D - \hat{w}_d) - \hat{w}_i + \hat{p}\hat{w}_d + \hat{w}_i \\ &\Leftrightarrow p(H - D) \geq \hat{p}(\hat{H} - D) \quad (2) \end{aligned}$$

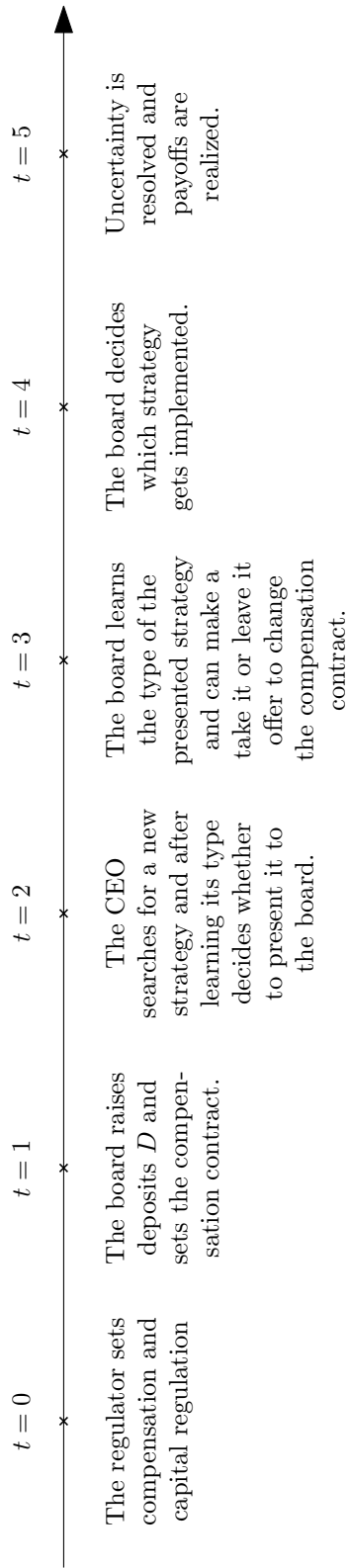


Figure 1: Time-line of events

We define the set of privately optimal new strategies that increases the sum of shareholder value and expected CEO compensation as  $\mathbb{P} = \{(H, p) \mid p(H - D) \geq \hat{p}(\hat{H} - D)\}$ . This discussion allows us to state the following Lemma.

**Lemma 1.** *The board will eventually approve any new strategy that the CEO presents and that increases the sum of shareholder value and expected CEO compensation.*

### 3.2. Search and Proposal of a New Strategy

The CEO is willing to present a new strategy to the board if his expected compensation with the new strategy is not lower than the expected compensation with the current strategy:

$$w_i + pw_d(H) \geq \hat{w}_i + \hat{p}\hat{w}_d. \quad (3)$$

The CEO also presents strategies to the board that involve renegotiation because he is never worse off after renegotiation than with the current strategy.

The CEO receives a reward for search only when the board approves a new strategy without renegotiation, which occurs whenever (1) is satisfied. We define the set of privately optimal new strategies that the board approves without renegotiation as  $\mathbb{P}_0 = \{(H, p) \mid p(H - D - w_d(H)) - w_i \geq \hat{p}(\hat{H} - D - \hat{w}_d) - \hat{w}_i\}$ .

The CEO's expected compensation with search is

$$\pi_M = \hat{w}_i + \hat{p}\hat{w}_d + \phi \int_{\mathbb{P}_0} \max\{w_i + pw_d(H) - \hat{w}_i - \hat{p}\hat{w}_d, 0\} dF(H, p),$$

The maximum inside the integrals follows from the fact that the CEO will only present strategies that do not decrease his expected compensation.

The CEO searches for a new strategy if the expected increase in his compensation

exceeds his search cost. The CEO's incentive constraint is

$$\pi_M - \hat{w}_i - \hat{p}\hat{w}_d \geq c$$

Given limited liability, the CEO's incentive constraint implies the CEO's participation constraint.

## 4. Privately Optimal Contract

Since the board approves a new strategy, it only needs to provide the CEO with incentives to search for new strategies and to present them. This objective can be achieved with a very simple contract that pays a bonus for implementing a new strategy, i.e.,  $w_i > 0$  and  $\hat{w} = \hat{w}_i = w_d(H) = 0$ . With such a contract, the CEO will present any new strategy that he finds and engage in search if

$$\phi \int_{\mathbb{P}_0} w_i dF(H, p) \geq c. \quad (4)$$

A simple bonus contract is sufficient if  $c$  is small relative to the expected value that a new strategy can potentially create. If (4) is satisfied with equality, the expected CEO compensation equals the search cost and the CEO does not earn any rent.

A simple bonus contract might not be sufficient to provide the CEO with incentives to search since the left-hand-side of (4) is not monotonically increasing in  $w_i$  as the likelihood of renegotiation increases in  $w_i$ . If  $c$  is large, a privately optimal compensation contract that provide the CEO with search incentives is more complicated, but the complication does not add to the understanding of our main arguments. Therefore, we assume that  $c$  is small enough such that (4) can be satisfied. This assumption implies that it is optimal for the board to provide the CEO with search incentives since the CEO

only receives a compensation when switching to a new strategy increases the shareholder value.

## 5. Risk Shifting

A new strategy is efficient (increases social value) if

$$pH \geq \hat{p}\hat{H}. \quad (5)$$

We define the sets of socially optimal new strategies that increase the bank's total payoff as  $\mathbb{S} \equiv \{(H, p) \mid pH \geq \hat{p}\hat{H}\}$ . Given the outstanding claims of depositors, the set of strategies that are optimal for shareholders  $\mathbb{P}$  does not coincide with the set of socially efficient strategies  $\mathbb{S}$ . Shareholders do not bear the consequences of their bank's strategy on the repayment of depositors as they do not have to repay depositors in the case of bankruptcy. This option value of bankruptcy increases in the probability of default, which, *ceteris paribus*, makes more risky strategies more profitable for shareholders. Hence, the board has an incentive to engage in risk shifting and the privately optimal contract derived in Section 4 implements this risk shifting.

Figure 2a depicts the set of possible strategies. The area to the north-east of the full line depicts the set of strategies that increase the social value relative to the current strategy. The area to the north-east of the dashed line depicts the set of strategies that increase shareholder value relative to the current strategy.

There are two types of risk shifting, which are important to distinguish. First, the board has an incentive to overinvest in risky strategies that increase the failure probability. These strategies are depicted by the shaded area to the north-west of the current strategy in Figure 2b, which consists of strategies that increase shareholder value but decrease the social value. Second, the board has an incentive to underinvest in (forgo) safer



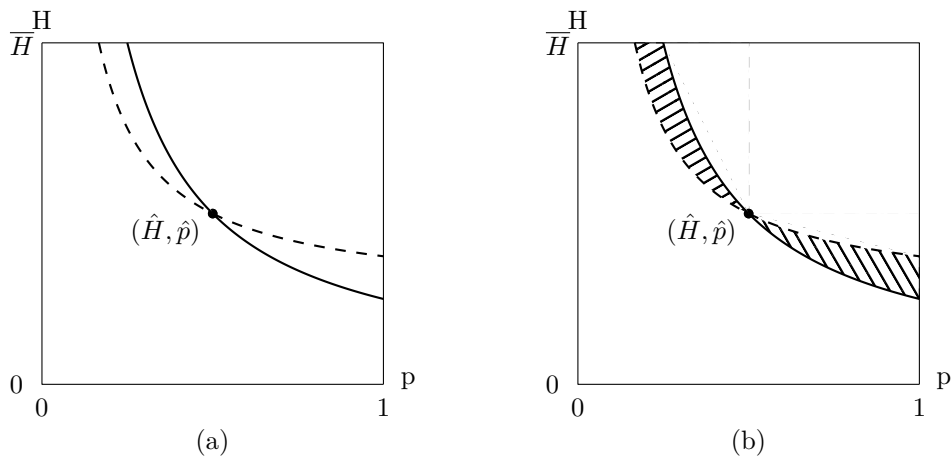


Figure 2: Risk shifting

strategies that decrease the failure probability. These strategies lie in the shaded area to the south-east of the current strategy in Figure 2b, which consists of strategies that decrease shareholder value but increase the social value. While standard risk shifting models typically focus on the case of overinvestment in risky strategies (active risk shifting), reluctance to reduce risk (passive risk shifting) is also important for banks. The distinction between the two types of risk shifting is crucial for understanding the effectiveness of regulating CEO compensation in the presence of active boards, which retain the ultimate decision about the bank's investment strategy.

The extent of risk shifting depends on the bank's leverage. Given deposit insurance, debt is preferred to equity because it increases the deposit insurance subsidy. Hence, an unregulated bank will maximize the amount of deposits which maximizes risk shifting incentives.

## 6. Compensation Regulation

### 6.1. Reducing Risk Shifting

Regulating CEO compensation can limit excessive risk taking by making it optimal for the CEO not to present high-risk strategies to the board. If the CEO's compensation from a new risky strategy is lower than the expected compensation from the current strategy, the CEO will not present such a strategy to the board, which prevents overinvestment in risky strategies. A prerequisite for the CEO to present only socially efficient risky strategies is that he bears some of the risk. This can only be achieved with deferred compensation that is forgone if the bank fails. Without deferred compensation, the CEO will present either all new strategies or none at all. For example, with a fixed bonus for implementing a new strategy as in Section 4, the CEO has an incentive to present all new strategies.

**Proposition 1.** *For any compensation contract without deferred compensation, either all risky strategies that increase shareholder value or no new strategy will be implemented.*

*Proof.* For  $\hat{w}_d = w_d(H)\forall H$ , the CEO is either willing to present all new strategies ( $w_i \geq \hat{w}_i$ ) or no new strategies ( $w_i < \hat{w}_i$ ). If the CEO presents all new strategies, the board will approve all strategies that increase shareholder value.  $\square$

The latest EU capital requirements directive, known as CRD IV (DIRECTIVE 2013/36/EU, Art. 94(m)), introduced regulatory requirements to defer compensation in the European bank regulation framework. Compensation regulation proposals that do not require deferred compensation instead rely on forward looking risk measures such as CDS spreads to reduce risk shifting. In theory, this allows the contracting parties to condition contracts directly on the default probability as in Bolton et al. (2015). Obviously, the effectiveness of such regulation hinges on whether it is possible to observe

banks' risk. In what follows we will focus on the case where compensation regulation requires all pay to be deferred  $w_i = \hat{w}_i = 0$ .

## 6.2. Limits of Compensation Regulation

Compensation regulation has a limited effect in preventing passive risk shifting. The reason is that both the CEO and the board must find a new strategy profitable. Any compensation contract can only redistribute the shareholder value between shareholders and the CEO. If a strategy decreases the shareholder value, there exists no compensation contract such that the incentive constraints of the board (1) and the CEO (3) are both satisfied.

**Proposition 2.** *With an active board, there exists no compensation contract that prevents underinvestment in safe, socially efficient strategies, for  $D > 0$ .*

*Proof.* For any compensation contract, a strategy can only satisfy both (1) and (3) if (2) is satisfied. Hence, irrespective of compensation regulation, the board will not approve any strategy that decreases shareholder value.  $\square$

With an active board, it is not sufficient that a compensation contract aligns the incentives of the CEO with those of the regulator. The board will not approve a strategy that reduces risk at the expense of shareholders. Thus, there exists no compensation contract for the CEO that solves the underinvestment in safe strategies.

This result contrasts with the literature that addresses the role of regulating CEO compensation to reduce risk shifting incentives, where regulating CEO compensation can typically ensure efficient risk taking behavior. The main reason for this difference is that, in the literature, the bank manager (CEO) chooses the level of risk, while in our setting, risk taking is a result of decisions by both the CEO and the board. The limits of compensation regulation in our model stem from considering both an active board

and passive risk shifting (forgoing strategies that reduce risk). We discuss corporate governance structures that differ from our main model in Section 8.

### 6.3. Bonus Caps and Linear Compensation Contracts

#### 6.3.1. Bonus Caps

The EU's CRD IV introduces bonus caps that limit the amount of variable pay to a multiple of fixed compensation (DIRECTIVE 2013/36/EU, Art. 94(g)). By limiting the CEO's bonus, the regulator attempts to prevent the board from rewarding the CEO for high risk strategies.

We define fixed compensation as the minimum wage that the CEO receives if the bank is solvent,  $w_{fix} \equiv \min\{\hat{w}_d, \min_H w_d(H)\}$ , and variable compensation or bonus as any payment in excess of the fixed compensation,  $w_d(H) - w_{fix}$ . A bonus cap puts a limit on the maximum variable compensation relative to the fixed compensation. Formally, we define a bonus cap imposed by the regulators as a multiple  $b$ , such that the wage structure must satisfy  $w_d(H) - w_{fix} \leq (b - 1)w_{fix} \forall H$ , or, equivalently,  $w_d(H) \leq bw_{fix} \forall H$ .

A bonus cap  $w_d(H) \leq b\hat{w}_d$  constrains the maximum expected compensation that the CEO can obtain when switching to a new strategy to  $pb\hat{w}_d$ . It is not optimal for the CEO to present a strategy where  $pb\hat{w}_d < \hat{p}\hat{w}_d$ , which is equivalent to  $p < \hat{p}/b$ . Thus, a bonus cap allows the regulator to limit the maximum probability of default to  $(1 - \hat{p}/b)$  by de facto limiting the CEO's incentives to present more risky strategies to the board.

While a bonus cap reduces overinvestment in risky strategies, it also reduces the CEO's incentives to present some socially efficient strategies. Thus, the regulator faces a trade-off. Figure 3 depicts the effects of a bonus cap of  $\underline{b} = 1$  and  $\bar{b} = \bar{H}/\hat{H}$ : the CEO will never present a strategy that lies to the left of the respective dash-dotted line. For  $b = \underline{b}$ , the CEO never presents a strategy to the board that has a lower success probability than the current strategy, which eliminates all active risk shifting, but at the

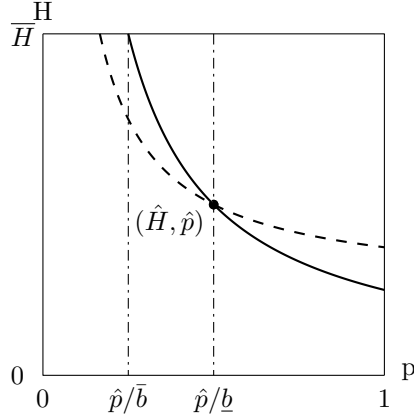


Figure 3: Bonus caps

same time also implies that the CEO does not propose efficient strategies with high risk to the board. Increasing  $b$  increases the set of efficient strategies that the CEO proposes (up to the point where  $b = \bar{b}$ ), but at the same time, it increases the set of strategies that involve risk shifting.

### 6.3.2. Linear Compensation

In contrast to a bonus cap, a CEO compensation that is linear in the bank's payoff  $H$  can fully align the CEO's incentives with those of the regulator. A compensation package that consists of both stock and debt-like claims that mimic the firm's financing structure implement a linear sharing rule.

**Proposition 3.** *Consider a compensation regulation that requires the compensation contract to be linear in the bank's payoff. Then, for any leverage,*

1. *the CEO will propose new strategies only if they are socially efficient, and the board approves all strategies that increase shareholder value.*
2. *there exists no other compensation contract where the board approves a larger set of efficient new strategies.*

*Proof.* Consider a compensation regulation that requires  $w_d(H) = \alpha H$  and  $\hat{w}_d = \alpha \hat{H}$

and allows the board to choose  $\alpha$ . Given this regulation, the CEO will only present strategies where  $p\alpha H \geq \hat{p}\alpha \hat{H}$ . This expression is equivalent to (5), which proves part 1 of the proposition.

Since renegotiation is possible, the board will implement any strategy that the CEO presents and that satisfies (2). Thus, the board approves all strategies that increase the sum of total shareholder value and CEO compensation, which implies part 2 of the proposition.

The CEO will engage in search if  $\alpha$  is chosen high enough to satisfy the incentive constraint and the board will choose a contract that satisfies the incentive constraint when  $c$  is small enough.  $\square$

The ability to renegotiate the linear contract is important. After renegotiating the compensation for safe strategies, the board is willing to implement all safe strategies that increase the sum of shareholder value and CEO compensation. In our setting, it would not be optimal for the regulator to prohibit renegotiation.

#### **6.4. Cost of CEO Compensation and Search Incentives**

The general press (Economist, 2013; Schäfer, 2013) voiced the concern that bonus caps will increase the size of bankers' fixed pay and their overall compensation package. This effect is present in our model. Compensation regulation can only be effective if the CEO receives a positive wage from the current strategy (i.e.,  $\hat{w}_d > 0$ ). Otherwise, the CEO will never lose anything when switching to a riskier strategy. A positive wage from the current strategy implies that the CEO earns a rent since the current strategy is always available. Thus, the expected wage costs of providing the CEO with incentives to search for a new strategy increase when the regulator imposes compensation regulation.

If the increase in CEO compensation is a pure transfer from shareholders to the CEO, it is of no concern for the regulator. However, the board might no longer provide the

CEO with incentives to search. First, the increase in CEO pay makes it more costly to provide the CEO with search incentives. Second, compensation regulation reduces the set of risky strategies that the CEO will propose to the board, which decreases the expected benefit of search for shareholders. Reduced incentives to search for a new strategy are socially optimal if, without compensation regulation, search was mainly valuable because of risk shifting. However, reduced incentives for search that stem from the higher rent that the CEO earns with compensation regulation, can be socially costly because the bank forgoes the option to find and implement new strategies that increase the social value.

## 7. Leverage Regulation

### 7.1. Privately Optimal Leverage

Shareholders have an incentive to maximize leverage as long as the incentive compatible CEO compensation does not involve a rent. If the regulator requires a linear compensation, an increase in leverage increases the CEO's rent. The reason is that the board will approve fewer strategies without renegotiation as leverage increases, which reduces the CEO's search incentives. To compensate for this effect, the CEO's payoff share  $\alpha$  must increase, which increases the CEO's rent  $\hat{w}_d = \alpha \hat{H}$ .

The CEO's incentive compatibility constraint with linear compensation is

$$\alpha \phi \int_{\mathbb{S} \cap \mathbb{P}_0} (pH - \hat{p}\hat{H}) dF(H, p) \geq c, \quad (6)$$

where  $\mathbb{S} \cap \mathbb{P}_0$  is the set of projects that the CEO implements without renegotiation. It follows that, when the search costs approach zero, the CEO's share  $\alpha$  goes to zero as well. Hence, changes in the value of the deposit insurance subsidy dominate changes of the CEO's rent for small  $c$ .

**Lemma 2.** *When compensation regulation requires a linear compensation, an active board chooses the maximum possible leverage for small  $c$ .*

*Proof.* see Appendix A.1. □

We focus on the case where  $c$  is small enough so that the board maximizes bank leverage, with and without compensation regulation.

## 7.2. Socially Optimal Leverage

The regulator maximizes the total value of the bank to its stakeholders, which is equivalent to the sum of payments to the bank's shareholders, the CEO, depositors and the depositor's utility from insured deposits. The payment from the deposit insurance corporation to depositors does not enter the objective, as it is a pure transfer. Thus, the regulator's objective function is

$$\hat{p}\hat{H} + \phi \int_{\mathbb{I}} (pH - \hat{p}\hat{H}) dF(H, p) - I - c + \gamma(D) \quad (7)$$

where  $\mathbb{I}$  denotes the set of new strategies that the CEO implements.

The combination of a leverage constraint and compensation regulation allows the regulator to achieve higher welfare than each measure in isolation. The reason is that with an active board there is always underinvestment in risk reducing strategies. Hence, optimal regulation must also target shareholders' risk taking incentives, which can be achieved by constraining leverage. The underinvestment in risk reducing strategies decreases as leverage decreases. Compensation regulation remains optimal for any level of positive leverage.

**Proposition 4.** *The optimal regulation constrains leverage and regulates compensation.*

*Proof.* See Appendix A.2. □



Even the combination of capital regulation and compensation regulation does not prevent underinvestment in safe strategies, though. For any  $D > 0$ , Proposition 2 shows that even with compensation regulation, there are safe, socially efficient strategies that will be rejected by the board. Because optimal capital regulation always entails  $D > 0$  when the social value of deposits is high enough, we obtain the following proposition.

**Proposition 5.** *The optimal regulation of leverage and CEO compensation cannot implement the first best.*

The Proposition shows that as long as the shareholders retain influence in the bank and their preferences are not aligned with those of the regulator, there will be resistance to reducing bank risk. Active risk shifting, on the other hand, can be prevented.

The introduction of compensation regulation lowers the socially optimal level of leverage. The reason is that compensation regulation curtails overinvestment in risky strategies independently of the leverage. This diminishes the marginal value of reducing leverage. The model does not suggest, however, that introducing regulation of CEO compensation justifies a reduction in the level of required regulatory capital that we observe in practice. Capital requirements in the past might have been too low so that increasing them can still be appropriate.

The regulator can reduce bank leverage using different instruments. For example, instead of a direct constraint on the bank's maximum leverage using capital regulation, the regulator could impose a tax on higher leverage. In our setting, it is also possible to constrain leverage indirectly through compensation regulation. If the regulator imposes a maximum level of  $\alpha$  for which the incentive constraint of the CEO is violated with maximum leverage, the board has to reduce leverage to satisfy the incentive constraint. Reducing  $D$  increases the CEO's expected compensation as it increases the set of risk reducing strategies that the board will approve.

## 8. Role and Regulation of Boards

### 8.1. Compensation Regulation with Passive Boards

The limit of compensation regulation in preventing risk shifting is due to the board's involvement in the selection of the bank's strategy. In contrast, the literature on regulating bank CEO compensation generally assumes that the CEO (manager) chooses the level of risk. In our setting, this corresponds to a situation where the board is passive and delegates the choice of strategy to the CEO (and where the CEO can extract no rent from mismanaging the bank in the presence of a passive board). With a passive board, compensation regulation is more effective since only the CEO's incentives influence whether he will implement a new strategy. Indeed, with delegation, compensation regulation can ensure that the CEO implements a new strategy if and only if it is socially optimal.

**Proposition 6.** *If the board is passive and delegates the choice of strategy to the CEO and compensation regulation requires the compensation contract to be linear in the bank's payoff, then the CEO implements the socially optimal set of strategies.*

*Proof.* See the following discussion. □

If the CEO receives a fixed fraction  $\alpha$  of the bank's total payoff it is optimal for the CEO to pursue only strategies that are socially efficient and maximize total bank value. Formally a new strategy increases the CEO's expected compensation with a linear contract if and only if

$$p\alpha H > \hat{p}\alpha \hat{H} \Leftrightarrow pH > \hat{p}\hat{H}.$$

i.e., the strategy increases social value. Because a passive board delegates the decision to implement new strategies to the CEO the bank will implement the socially optimal set of new strategies

Propositions 2 and 6 highlight the fact that the role of the board is important when it comes to the effectiveness of regulating CEO compensation. Regulating compensation is very effective if the ultimate decision about a strategy rests with the CEO. If the CEO has to get approval from the board, the effectiveness of regulating CEO compensation is limited.

## 8.2. Social Value of Active Boards

We now formalize the assumption that an active board provides essential oversight to deter the CEO from engaging in opportunistic behavior that is harmful for both shareholder value and social value.<sup>4</sup> Suppose that, with probability  $\rho \in [0, 1]$ , the CEO has the opportunity to mismanage the bank and extract private benefits. We model the rent extraction as the possibility of the CEO transferring the bank's payoff  $H$  to himself, which results in certain failure of the bank, i.e., the payoff is zero in both states. However, rent extraction is inefficient as the CEO's utility increases by only  $\beta H$ , where  $\beta < 1$  measures the efficiency of rent extraction.

The CEO observes whether he can extract rent after signing the contract with the board, but before he engages in search. An active board that monitors the CEO can prevent mismanagement and rent extraction. A passive board, on the other hand, cannot observe whether the CEO can extract rent and can prevent rent extraction only by setting  $\hat{w}_d \geq \beta \hat{H}$  and  $w_d(H) \geq \beta H$  for all  $H$ . Alternatively, if the passive board chooses not to pay a wage to prevent rent extraction, the CEO will mismanage the bank if he has the opportunity to extract rent.

**Proposition 7.** *If  $\rho$  and  $\beta$  are sufficiently high, a bank is viable only if it has an active board. In this case, an active board is privately and socially optimal.*

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<sup>4</sup>Adams and Ferreira (2007) discuss the impact of more or less active boards on information sharing between the CEO and the board. While it can be optimal in their model not to fully align the board with shareholders interests, the board always monitors the CEO with positive probability.

*Proof.* see Appendix A.3. □

If  $\beta$  is high, it is too costly for the board to provide the CEO with incentives not to extract any rent. If, in addition, the probability of rent extraction  $\rho$  is sufficiently high, the bank's participation constraint is not satisfied and shareholders are not willing to finance banks with a passive board. Thus, it is socially optimal for the bank to have an active board because otherwise the entire social value of its operation is lost.

### 8.3. Banks' Choice between Active and Passive Boards

If it is costless to choose an active board, shareholders always prefer an active board. First, an active board prevents the CEO from extracting private benefits. Second, an active board ensures that the CEO implements only those strategies that are in the interest of shareholders. Delegating the choice of strategy to the CEO can be costly as it might increase expected wage costs and involve opportunity costs if the CEO does not implement the strategy that maximizes shareholder value.

We assume that  $\beta$  is so high that it is not optimal for a passive board to provide monetary incentives to prevent the CEO from extracting rent. Banks differ with respect to the probability that a CEO can extract private benefits  $\rho$  and the cost of implementing an active board  $\kappa \in [0, \bar{\kappa}]$ . We assume that  $\bar{\kappa} \leq \hat{p}\hat{H} - I$  so that a bank with an active board makes a positive expected profit. The board and the CEO know the bank's type  $(\rho, \kappa)$ , but the regulator cannot observe it. The joint density function of bank types has full support over  $[0, 1] \times [0, \bar{\kappa}]$ .

We define the expected bank payoff net of debt when the CEO does not extract private benefits as

$$R(\mathbb{I}) \equiv \hat{p}(\hat{H} - D) + \phi \int_{\mathbb{I}} (p \max\{0, H - D\} - \hat{p}(\hat{H} - D)) dF(H, p),$$

where  $\max\{0, H - D\}$  captures the possibility that a new strategy might be associated with a payoff  $H < D$ ;  $\hat{H} > D$  since the bank is solvent if the initial strategy is successful.

A passive board can choose a linear equity compensation contract for the CEO with  $w_d(H) = \alpha \max\{0, H - D\}$ ,  $\hat{w}_d = \alpha(\hat{H} - D)$ , and  $w_i = \hat{w}_i = 0$ . With this contract, if the CEO cannot extract any rent, he implements a new strategy if and only if it is optimal for shareholders and his incentive constraint to search for a new strategy is

$$\alpha\phi \int_{\mathbb{P}} (p(H - D) - \hat{p}(\hat{H} - D)) dF(H, p) \geq c$$

since a passive board never renegotiates the compensation contract and  $\alpha \max\{0, H - D\} = \alpha(H - D)$  for the privately optimal strategies that the CEO implements.<sup>5</sup>

The CEO's rent from this contract is  $\alpha\hat{H}$  and approaches zero as the cost of effort  $c$  goes to zero, analogously to Section 7.1. The linear equity contract is not the privately optimal contract. As the privately optimal contract yields a higher shareholder value than the linear equity compensation, the cost of delegating the choice of strategy to the CEO goes to zero as  $c \rightarrow 0$ . In this case, the shareholder value of a bank with a passive board is given by  $(1 - \rho)R(\mathbb{P})$ . With an active board, the CEO cannot extract rent and the shareholder value is  $R(\mathbb{P}) - \kappa$ . Shareholders trade off the expected loss from rent extraction  $\rho R(\mathbb{P})$  with a passive board and the cost of an active board,  $\kappa$ .

**Lemma 3.** *For  $c \rightarrow 0$ , without compensation regulation, shareholders will choose an active board if*

$$\kappa < \check{\kappa}_u(\rho) \equiv \rho R(\mathbb{P}). \quad (8)$$

The benefits of an active board increase with the probability that the CEO can extract

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<sup>5</sup> If the CEO can extract rent, he will choose the strategy that maximizes  $pH$ , which coincides with the socially optimal strategy. With a passive board, shareholders do not care about the choice of strategy if the CEO can extract rent, as they get zero in this case irrespective of the chosen strategy.

private benefits. All banks with  $\rho = 0$  choose a passive board and all banks with  $\rho = 1$  choose an active board.

If the regulator requires the compensation contract to be linear in the bank's total payoff, the CEO's rent still goes to zero as  $c \rightarrow 0$  for both passive and active boards. However, the interests of shareholders and the CEO are no longer aligned as the CEO implements the socially optimal strategy. Thus, the shareholder value of a bank with a passive board is now  $(1 - \rho)R(\mathbb{S})$ . An active board can prevent the board from implementing low risk strategies that reduce shareholder value, and the shareholder value of a bank with an active board is  $R(\mathbb{S} \cap \mathbb{P}) - \kappa$ . The difference in the sets of strategies that the CEO implements provides an additional incentive for shareholders to choose an active board.

**Lemma 4.** *For  $c \rightarrow 0$ , with compensation regulation, shareholders will choose an active board if*

$$\kappa < \check{\kappa}_l(\rho) \equiv \rho R(\mathbb{S}) + (R(\mathbb{S} \cap \mathbb{P}) - R(\mathbb{S})) \quad (9)$$

$R(\mathbb{S} \cap \mathbb{P}) - R(\mathbb{S}) > 0$  because the strategies in  $\mathbb{S} \setminus \mathbb{P}$  decrease the expected payoff to shareholders. Thus, the expected loss of shareholders from mismanagement by the CEO with compensation regulation  $\rho R(\mathbb{S})$  is lower than without compensation regulation  $\rho R(\mathbb{P})$  and shareholders have a lower incentive to prevent mismanagement with compensation regulation.

Figure 4 depicts the thresholds  $\check{\kappa}_u$  and  $\check{\kappa}_l$ , and  $(\dot{\rho}, \dot{\kappa})$  denotes the intersection of equations (8) and (9).<sup>6</sup> Linear compensation regulation increases the set of parameters for which shareholders choose active boards if  $\rho < \dot{\rho}$  (region *A*) and decreases it if  $\rho > \dot{\rho}$  (region *B*). Compensation regulation aligns the CEO's incentive with the incentives of the

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<sup>6</sup>The critical level  $\dot{\rho}$  is always between zero and one, which follows from

$$\check{\kappa}(0) - \check{\kappa}_l(0) < 0 \text{ and } \check{\kappa}(1) - \check{\kappa}_l(1) > 0.$$

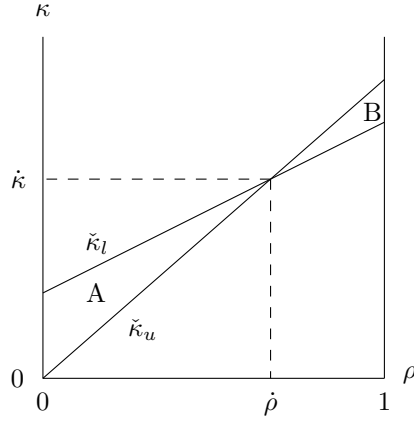


Figure 4: The choice between active and passive boards

regulator and delegating decisions to the CEO becomes less attractive for shareholders. However, preventing mismanagement becomes less important because the value at stake is lower. The relative importance of these two effects depends on the probability that the CEO can extract private benefits.

If  $\bar{\kappa} \leq \kappa$ , then all banks with  $\rho \geq \hat{\rho}$  have active boards irrespective of compensation regulation (region  $B$  in Figure 4 is empty), while introducing linear compensation regulation increases the number of active boards for banks with  $\rho < \hat{\rho}$  (region  $A$ ).

**Proposition 8.** *Let  $c$  be sufficiently small and  $\bar{\kappa} < \kappa$ . Introducing linear compensation regulation increases the number of banks with active boards.*

Hence, board activism and the number of CEO decisions on which the board wants to have a say will increase as regulation of CEO compensation becomes more effective in constraining the privately optimal contract. The general economic mechanism behind the increase in board activism in response to compensation regulation is not only relevant for the interaction between the board and the CEO. Regulating bank manager compensation gives the bank incentives to change its decision processes in order to limit the impact of this regulation. For example, decisions might be shifted from those bank managers who are regulated (e.g., traders and loan officers) to managers in the back office. Internal control systems and greater reliance on hard information facilitate such a shift in decision

rights.

## 8.4. Implications for Compensation Regulation

The switch from a passive to an active board described in Proposition 8 has ambiguous implications for efficiency. Banks participation constraint with a passive board is

$$(1 - \rho)R(\mathbb{S}) \geq I - D. \quad (10)$$

For high  $\rho$ , a change to an active board can be necessary to satisfy the shareholders' participation constraint given the reduction in profits by the introduction of compensation regulation. If the bank will not operate with a passive board under compensation regulation, choosing an active board is efficient.

If (10) is satisfied, the social value of a bank with linear compensation regulation and a passive board is

$$(1 - \rho(1 - \beta))(\hat{p}\hat{H} + \phi \int_{\mathbb{S}} (pH - \hat{p}\hat{H}) dF(p, H)), \quad (11)$$

where  $\rho(1 - \beta)$  reflects the expected efficiency loss due to the CEO's rent extraction. The social value with an active board is

$$\hat{p}\hat{H} + \phi \int_{\mathbb{S} \cap \mathbb{P}} (pH - \hat{p}\hat{H}) dF(p, H) - \kappa. \quad (12)$$

Hence, a passive board is socially optimal when (11)  $\geq$  (12) and (10) is satisfied. Simple algebra thus yields the following Proposition.

**Proposition 9.** *Let  $c$  be sufficiently small and  $\bar{\kappa} < \kappa$ . The change of the board structure*



*in response to compensation regulation decreases efficiency when*

$$\rho \leq \min \left\{ 1 - \frac{I - D}{R(\mathbb{S})}, \frac{1}{(1 - \beta)} \frac{\phi \int_{\mathbb{S} \setminus \mathbb{P}} (pH - \hat{p}\hat{H}) dF(p, H) + \kappa}{\hat{p}\hat{H} + \phi \int_{\mathbb{S}} (pH - \hat{p}\hat{H}) dF(p, H)} \right\}.$$

An active board is socially valuable as it prevents inefficient rent extraction by the CEO. However, when  $\beta$  is sufficiently high, then rent extraction by the CEO is mostly a transfer and a passive board causes only small inefficiencies. Conversely, active boards decrease efficiency when the potential social surplus of new projects that decrease risk but are rejected by the active board,  $\phi \int_{\mathbb{S} \setminus \mathbb{P}} pH - \hat{p}\hat{H} dF(p, H)$ , is high. Thus, a passive board is more likely to be more efficient than an active board if the social loss from rent extraction is low and the loss from underinvestment in risk reducing strategies is high. When Proposition 9 holds, increases in board activism might be advertised as improved governance, but actually aim at countervailing the CEO's willingness to put the total bank value over the interest of shareholders.

Regulation could become more effective when it differentiates between active and passive boards. Implementing such a regulation is difficult. First, it is difficult to assess whether a board is active (monitors) or is passive as it requires detailed information about its conduct and the internal operation of corporate governance. Second, the incentives to choose passive boards must not prevent active boards when they are necessary for the profitable operation of banks. The regulator must thus ensure that choosing active boards remains sufficiently profitable, which limits the incentives that the regulator can provide for choosing a passive board. The regulator could implement a mechanism that gives banks incentives to reveal their type  $(\rho, \kappa)$ . However, in practice, banks' "types" are more complex than in our model and the regulator will not be able to elicit all the relevant information. This contrasts with the simple linear compensation regulation that can be applied uniformly to all banks and does not rely on the banks' characteristics.

## 8.5. Board Reform Proposals

Current bank corporate governance reform proposals (BCBS, 2014; PRA and FCA, 2014) include a number of provisions that concern boards. Several of these provisions attempt to increase the number and influence of independent directors. The literature commonly assumes that independent directors are more aligned with shareholders' interests than those of insider directors whose interests may be more aligned with those of the CEO. In our framework, this would tend to increase the underinvestment in safe strategies that is caused by directors maximizing shareholder value. In contrast, Adams (2012) argues that, in financial firms, independent directors are likely to have little or no experience in the finance industry and thus are less informed. An uninformed board makes compensation regulation more effective in our model, but may fail to prevent inefficient, opportunistic behavior by the CEO. Thus, increasing the number of independent directors may either not be effective in reducing a bank's risk shifting or reduce the board's ability to monitor the CEO.

Instead of adjusting the board's level of independence, another solution could be to ensure that the board composition represents all relevant groups of stakeholders. In this spirit, the recent guideline proposal of the Basel Committee on bank corporate governance states that "[...] the board should take into account the legitimate interests of depositors, shareholders and other relevant stakeholders." (BCBS, 2014, p. 8) In the UK, more concrete proposals (PRA and FCA, 2014) attempt to increase the individual responsibility and liability of senior management, including board members. Under these proposals, board members may be criminally liable in the case of bank failure. In addition, the regulator can fine individuals and suspend their regulatory approval, required to serve a senior management function. In principle, these measures might align the board's incentives more closely with the regulator's objective. However, the effect largely depends on their application and enforcement.

Another approach to change the board's incentives is to regulate their compensation, which is currently not pursued by regulators. One reason may be that board members have very heterogeneous objectives and levels of equity stakes in the bank, which makes it difficult to fully align the incentives of board members to maximize total bank value.

The proposals discussed by regulators also attempt to formalize banks' risk taking decisions and increase direct regulatory oversight. Banks are required to specify risk appetite frameworks (RAF) and risk assessment systems (RAS). Banks also have to create dedicated risk management functions such as chief risk officers (CROs) and risk committees at the executive and board level, respectively. To the extent that these measures make bank risk taking more transparent, they may enable the regulator to intervene more reliably and constrain risk taking. However, it is less likely that they will help to identify possibilities to reduce risk. Moreover, these measures may also increase the board's ability to evaluate the risk of certain strategies and give it the means to play a more active role, which might aggravate the risk shifting problem.

## **9. Discussion and Conclusion**

We have shown the limits of compensation regulation in the presence of an active, shareholder friendly board. Such a board retains the ultimate power to approve a new bank strategy that the CEO proposes. While the regulator can limit the CEO's willingness to propose high risk strategies to the board, compensation regulation does not affect the board's willingness to approve risk reduction strategies.

If a passive board delegates the choice of bank strategy to the CEO, regulating the pay of the CEO has more bite and can implement efficient risk taking by the CEO. The presence of an active board can be essential, however, to deter opportunistic behavior by the CEO that would be inefficient. Compensation regulation makes it more costly for shareholders to delegate the choice of strategy to the CEO. The reason is that

shareholders can no longer rely on compensation contracts to align the CEO's incentives with their own.

Reform proposals concerning banks' corporate governance generally face the tension between regulatory objectives and the objectives of shareholders. To reduce risk shifting, the regulator can constrain the compensation of CEOs and other bank managers. However, the governance structure is likely to adapt in order to preserve shareholders' interests. In our setting, boards might become more active when regulators constrain CEO compensation. As long as shareholders retain control of the bank, their interests will affect banks' decision-making process and hence specific corporate governance reforms will only provide a partial solution.

Another possibility to reduce risk shifting is to reduce shareholders' appetite for risk. This can be achieved by limiting a bank's leverage. We show that with an active board, combining regulation of bank capital and CEO compensation is more efficient than using any of the two tools in isolation. Requiring a CEO compensation that is linear in total bank value effectively curtails overinvestment in a risky strategy while capital regulation ensures that the board is more willing to accept strategies that reduce the bank's risk.

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## A. Proofs

### A.1. Proof of Lemma 2

*Proof.* When compensation regulation takes the form of imposing a linear contract  $\alpha = \hat{w}_d/\hat{H}$ , the CEO implements strategies in  $\mathbb{S} \cap \mathbb{P}_0$  without renegotiating the compensation contract. Hence, we can write the CEO’s incentive constraint (6) as

$$\phi \int_{\underline{H}}^{\hat{H}} \int_{\underline{p}(H)}^1 (p(\hat{w}_d/\hat{H})H - \hat{p}\hat{w}_d) f(H, p) dp dH + \phi \int_{\hat{H}}^{\bar{H}} \int_{\hat{p}\frac{\hat{H}}{H}}^1 (p(\hat{w}_d/\hat{H})H - \hat{p}\hat{w}_d) f(H, p) dp dH = c$$



where  $\underline{H} = \hat{p}\hat{H} + (1 - \hat{p})(1 - \hat{w}_d/\hat{H})D$  and  $\underline{p}(H) = \hat{p}\frac{(1-\hat{w}_d/\hat{H})\hat{H}-D}{(1-\hat{w}_d/\hat{H})H-D}$ . Applying the implicit function theorem yields

$$\begin{aligned} \frac{\partial \hat{w}_d}{\partial D} = & \left[ \int_{\underline{H}}^{\hat{H}} \frac{\partial \underline{p}(H)}{\partial D} (\underline{p}(H)(\hat{w}_d/\hat{H})H - \hat{p}\hat{w}_d) f(H, \underline{p}(H)) dH \right. \\ & \left. + \frac{\partial \underline{H}}{\partial D} \int_{\underline{p}(\underline{H})}^1 (p(\hat{w}_d/\hat{H})\underline{H} - \hat{p}\hat{w}_d) f(\underline{H}, p) dp \right] \\ & \times \left[ \int_{\underline{H}}^{\hat{H}} \int_{\underline{p}(H)}^1 ((p/\hat{H})H - \hat{p}) f(H, p) dp - \frac{\partial \underline{p}(H)}{\partial \hat{w}_d} \underline{p}(\hat{w}_d/\hat{H})H - \hat{p}\hat{w}_d) f(H, \underline{p}(H)) dH \right. \\ & \left. - \frac{\partial \underline{H}}{\partial \hat{w}_d} \int_{\underline{p}(\underline{H})}^1 (p(\hat{w}_d/\hat{H})\underline{H} - \hat{p}\hat{w}_d) f(\underline{H}, p) dp + \int_{\hat{H}}^{\bar{H}} \int_{\hat{p}\frac{\hat{H}}{\bar{H}}}^1 ((p/\hat{H})H - \hat{p}) f(H, p) dp dH \right]^{-1} \end{aligned}$$

From the CEO's incentive constraint it follows that  $\lim_{c \rightarrow 0} \hat{w}_d = 0$ . Inspection of terms in the above expression then shows that  $\frac{\partial \hat{w}_d}{\partial D}$  approaches zero as  $c \rightarrow 0$ .

The CEO implements new strategies in  $\mathbb{S} \cap \mathbb{P}$ . Hence, we can write the shareholder value as

$$\begin{aligned} & \hat{p}(\hat{H} - D) + \phi \int_{\underline{H}}^{\hat{H}} \int_{\underline{p}(H)}^1 (p(H - D) - \hat{p}(\hat{H} - D)) f(H, p) dp dH \\ & + \phi \int_{\hat{H}}^{\bar{H}} \int_{\hat{p}\frac{\hat{H}}{\bar{H}}}^1 (p(H - D) - \hat{p}(\hat{H} - D)) f(H, p) dp dH - (I - D) - \hat{p}\hat{w}_d(D) - c \end{aligned}$$

where  $\underline{H} = \hat{p}\hat{H} + (1 - \hat{p})D$  and  $\underline{p}(H) = \hat{p}\frac{\hat{H}-D}{H-D}$ . The derivative with respect to leverage is given by

$$\begin{aligned} & (1 - \hat{p}) + \phi \int_{\underline{H}}^{\hat{H}} \int_{\underline{p}(H)}^1 (-p + \hat{p}) f(H, p) dp - \frac{\partial \underline{p}(H)}{\partial D} (\underline{p}(H - D) - \hat{p}(\hat{H} - D)) f(H, \underline{p}(H)) dH \\ & - \phi \frac{\partial \underline{H}}{\partial D} \int_{\underline{p}(\underline{H})}^1 (p(\underline{H} - D) - \hat{p}(\hat{H} - D)) f(\underline{H}, p) dp + \phi \int_{\hat{H}}^{\bar{H}} \int_{\hat{p}\frac{\hat{H}}{\bar{H}}}^1 (-p + \hat{p}) f(H, p) dp dH - \hat{p} \frac{\partial \hat{w}_d}{\partial D} \end{aligned}$$

The first term denotes the marginal increase in the deposit insurance subsidy when the current strategy gets implemented. The four middle terms account for the difference in

the deposit insurance subsidy when a new strategy gets implemented. The last term denotes the changes to the CEO's rent. The sum of these terms is positive, since the deposit insurance subsidy is increasing in leverage and the absolute value of  $\frac{\partial \hat{w}_d}{\partial D}$  is small for small search costs  $c$ . It follows that for small  $c$  the board always maximizes  $D$  with a linear compensation contract.  $\square$

## A.2. Proof of Proposition 4

*Proof.* With a linear compensation regulation, the CEO implements new strategies in  $\mathbb{S} \cap \mathbb{P}$ . Hence we can write the regulator's objective function (7) as

$$\hat{p}\hat{H} + \phi \int_{\underline{H}}^{\hat{H}} \int_{\underline{p}(H)}^1 (pH - \hat{p}\hat{H}) f(H, p) dp dH \\ \phi \int_{\hat{H}}^{\bar{H}} \int_{\hat{p}\frac{\hat{H}}{H}}^1 (pH - \hat{p}\hat{H}) f(H, p) dp dH - I - c + \gamma(D)$$

where  $\underline{H} = \hat{p}\hat{H} + (1 - \hat{p})D$  and  $\underline{p}(H) = \hat{p}\frac{\hat{H}-D}{H-D}$ . It follows that the regulator's first order condition for leverage is

$$\phi \int_{\underline{H}}^{\hat{H}} \frac{\partial \underline{p}(H)}{\partial D} (\underline{p}(H)H - \hat{p}\hat{H}) f(H, \underline{p}(H)) dH = \gamma'(D).^7$$

The left hand side is the expected forgone social value of strategies that the board refuses to approve as leverage increases. The right hand side is the marginal value of safe deposits for households. Given the assumptions on  $\gamma'(D)$ , the regulator optimally chooses an interior level of  $D \in (0, I)$ , which implies that it is optimal to constrain leverage.

Without compensation regulation, any  $D > 0$  results in overinvestment in risky strategies. Requiring a linear compensation contract can thus improve upon any regulation that relies exclusively on constraining bank leverage. Thus, combining compensation

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<sup>7</sup>Note that  $\phi \frac{\partial \underline{H}}{\partial D} \int_{\underline{p}(\underline{H})}^1 (p\underline{H} - \hat{p}\hat{H}) f(\underline{H}, p) dp = 0$  because  $\underline{p}(\underline{H}) = 1$ .

regulation with leverage constraints is socially optimal.  $\square$

### A.3. Proof of Proposition 7

*Proof.* First, assume that  $\rho > 1 - (I - D)/(\bar{H} - D)$ . With a passive board that does not prevent the CEO from extracting private benefits, the bank always fails when the CEO has the opportunity to extract private benefits. The expected shareholder payoff for a given strategy  $(p, H)$  and any compensation contract  $w_d(H) < \beta H$  is

$$(1 - \rho)p(H - D - w_d(H)) - w_i \leq (1 - \rho)(\bar{H} - D) < I - D$$

for all  $D < I$ , which implies that shareholders cannot recoup their investment.

Second, assume that  $\beta \in (1 - I/\bar{H}, 1)$ . With a passive board that pays a wage  $w_d(H) \geq \beta H$  to prevent the CEO from extracting rent, the shareholders also do not recoup their initial investment since the expected payoff to shareholders is

$$p(H - D - w_d(H)) - w_i \leq p((1 - \beta)H - D) \leq p(I\frac{H}{\bar{H}} - D) < I - D$$

for all  $D < I$  and strategies  $(p, H) \neq (1, \bar{H})$ , including the default strategy. (For high  $D$ ,  $p(I\frac{H}{\bar{H}} - D) < 0$  because the board would have to compensate the CEO for benefits he is exacting from debt holders.)

Thus,  $\rho > 1 - (I - D)/(\bar{H} - D)$  and  $\beta \in (1 - I/\bar{H}, 1)$  are sufficient conditions for a bank with a passive board to be not viable, which establishes the Proposition.  $\square$