

Buck, Florian

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Managerial Prudence under Banking Regulation

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Florian C. Buck¹

Abstract

This article provides a theoretical framework to analyze the impact of banking regulation on the risk-taking behavior of banks by incorporating the incentives of three risk-neutral agents - the welfaristic regulator, the shareholder and the manager. While shareholders are assumed to maximize the discounted flow of bank profits, bank managers maximize expected income choosing from a menu of portfolios with different risk-return profiles. We show under which conditions capital requirements intensify the agency conflict between shareholders and bank managers if complete contracts are impossible. As a result, a government interested in alleviating this divergence will incorporate capital requirements to curb risk-appetite only in those cases in which managerial myopia and the probability of default in the banking-sector are not substantial. Moreover, our model suggests that direct regulation of a manager's bonus system is a substitute for any form of capital requirements.

JEL Classification: G 28, G 21, G 01

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¹ Ludwig Maximilians University, Center for Economic Studies (CES),
Schackstr. 4, 80539 Munich, Germany,
email: florian.buck@lmu.de

1 Introduction

Today we are faced with a massive financial crisis mainly caused by excessive risk-taking of nearly the whole banking sector. Financial stability being a public good, politicians have to correct this form of market failure, and regulation will be required.

A common feature of all regulation concepts discussed in the political arena is the tightening of the equity-to-asset ratio for banks in order to tame moral hazard behavior. In particular, the major industrialized countries and emerging economies (G20) have resolved to put in place a common global framework for the world economy so that the current financial crisis is not repeated.² By 2011 banks will be required to build significantly higher capital reserves to cover high-risk products. The stricter regulations already in place in Europe will then also apply to US institutions.³ Furthermore, the role of bank managers attracts public interest. It has become popular to blame fund managers for triggering the financial crisis, because their bonus payments as the predominant industry practice are regarded as an invitation to gambling. In case of success the manager reaps high earnings, while the risk of bad outcomes remains largely with the investors. As a result the G20 decided that bonus payments for financial managers will in the future be linked to long-term financial performance, worldwide. The justification for this interference in private contracts is the belief that the banks' bonus structure has encouraged excessive risk in the banking sector and that shareholders were not able or not willing to prevent this behavior also known as moral hazard. Thus in December 2009, the UK administration announced that all banks in the U.K. awarding discretionary bonuses of more than 25,000 pounds (Euro 28,000) must pay a one-time levy of 50 percent. Shortly after this announcement, France considered a tax on 2009 banker bonuses exceeding 27,500 Euros, following the U.K. government's introduction of a similar levy.⁴

This article examines the conditions under which these two tools, capital requirements and the regulation of bonus systems, act as a disciplinary device against excessive risk-taking of banks. In addition, we discuss whether capital requirements may unsettle managers' relationships with their shareholders.

The effects of banking regulation on banks' behavior have been extensively discussed in the neoclassical framework of the firm abstracting from internal agency problems and disregarding the tension between executives and shareholder interests. Neoclassical models treat the bank as a black box, operating so as to maximize the banks' value. However, investment decisions are crucially influenced by agency problems due to diverging interests between shareholders and managers.⁵ Managers will choose actions with a bias towards their private benefit rather than to maximize the shareholder interest. For the regulator this results in a double moral hazard problem: the shareholder moral hazard due to limited liability and the managers' moral hazard due to imperfect control. The majority of the existing literature addresses the first kind of moral hazard but does not take into account the second kind of moral hazard. Therefore in this paper we develop a model that investigates the impacts of capital requirements and bonus regulation on the internal agency problems between shareholders and managers.

The paper relates to two streams of the literature. First, to the effects of capital requirements on a bank's investment behavior. Sinn (2003) pointed out that capital requirements force a profit-maximizing bank to have more of its own capital at risk so that it internalize the inefficiency of gambling (capital at risk-effect). Transforming the static investment problem to a dynamic one, Furlong and Keeley (1989) pointed out that minimum equity ratios can reduce the quality of banks' portfolios if risk weights in the required solvency ratio are proportional to the systematic risks of assets. However, Besanko and Kanatas (1993) and Boot *et al.* (1993) argue that capital rules also reduce monitoring incentives. More recently Blum (1999) and Hellman *et al.* (2000) have shown that capital

² The G20 is an informal forum which cooperates on issues relating to the international financial system. Together the G20 states account for 90 percent of worldwide economic power.

³ Moreover, accounting regulations will be harmonized at international level.

⁴ URL: <http://www.bloomberg.com/apps/news?pid=20601087&sid=aq.yXXceksVw>.

⁵ A crucial feature of the banking sector is the wide dispersion on small investors that limits their ability to monitor the activities of the bank.

requirements put conflicting pressures on risk-taking incentives.⁶ While higher capital requirements decrease the incentive to take risk by increasing the loss of shareholders if the bank defaults, they also decrease franchise value, *i.e.* the capitalized expected profits that accrue to a bank from its future operations. Thus it puts upward pressure on risk-taking incentives. To sum up, existing literature in this area does not reach a consensus.

The second area concerns the principal-agent problem of banks. In a seminal paper, Berle and Means (1932) argue that the separation of ownership and control has its darker sides. If not provided the right incentives, managers may do things to the detriment of the shareholders. Jensen and Meckling (1976) provide specific predictions on the behavior of managers under different circumstances, and Mirrlees (1971), Becker and Stigler (1974) provide guidelines for optimal compensation of the manager in a static setting. In this context Fama (1980) argues that the manager's outside option in the market for managers influences the optimal compensation strategy, since otherwise shareholders fail to attract talented managers. Regarding the investment strategies of banks, John *et al.* (2000) point out that managerial compensation schemes directly affect a bank's risk-taking behavior. They regard optimal regulatory schemes that maximize the bank's value, given assets that are ranked by second-order stochastic dominance - thus excluding higher risk, higher return assets. In contrast to our model, they do not take into account that there exist independent objective functions of the three agents involved in determining bank's risks, assuming congruence in the objectives of the owners of the bank and the regulators. Following Dewatripont and Tirole (1994) and more recently Jeitschko, Jeung (2005) and we keep the objectives of the three agents separate.

We begin our analysis from the perspective of the shareholders that maximizes the discounted flow of profits of a representative commercial bank. Our dynamic model is based on the theory of banks having a de-facto convex utility function due to limited liability. In this context we show that solely the liability regime distorts the investment decision of a bank, leading to a misallocation of risk. This misallocation is reinforced if we introduce the internal agency conflict between an earning-maximizing manager and a shareholder. Moreover, in the second part we discuss the impact of capital requirements and the direct regulation of managers' pay on the risk-allocation of banks. We argue that bank regulation via capital requirements has limited effectiveness, given a high degree of opaqueness of bank manager's investment behavior which results in internal moral-hazard.

The rest of the paper proceeds as follows. Section 2 introduces the framework in which we demonstrate our results formally. Section 3 examines the impact of regulatory tools on the investment behavior of banks. We suggest that the moral hazard problem may be more severe under capital requirements. Section 4 presents policy implications and Section 5 our conclusion.

2 The Framework

This section develops a dynamic model, in which a representative commercial bank is financed by equity and deposits. Shareholders of the bank are disperse and risk-neutral. The bank receives funds, denoted by F .⁷ After funds have been raised, the commercial bank issues loans to its customers. For the following analysis one may think of mortgages in the subprime sector as an example for these loans. By giving the mortgages to borrowers, the commercial bank chooses a target return $X - 1$, which describes the riskiness of the portfolio. Thus, the bank can affect the bank performance by determining the level of risk of the underlying portfolio. We assume the following two-point distribution of the gross rate of return R :

⁶ Blum (1999) shows in a two-period model that the value of equity in later periods is altered when risk-based capital requirements bind. Higher expected profits in the second period induce a unregulated bank to reduce risk in the first period in order to receive second-period profits. Higher capital requirements in the second period reduces that period's profits and induces risk-loving behavior in the first period.

⁷ The implications of risk-aversion on the investment behavior of banks is beyond the scope of this paper. For a seminal analysis of the relationship between overall safety of risk-taking behavior and the distribution of risk aversion across banks see Kahane (1977) and Koehn and Santomero (1980).

$$R = \begin{cases} X & \text{with probability } p[X], \\ 0 & \text{with probability } 1-p[X] \end{cases}$$

The probability of success is described by the function $p[X]$, where $p'[X] < 0$, and to avoid corner solutions with infinite risk, where $p''[X] \leq 0$. These assumptions imply that the expected returns $E[R | X] = p[X] \cdot X$ are strictly concave. The probability of default is equal to $1 - p[X]$ for every given X . Moreover, we assume that the risk of the mortgages is perfectly correlated.⁸ However, in a dynamic setting the bank implicitly determines its “life-expectancy” by choosing the level of risk. Therefore, in our setting the date of bankruptcy is a choice variable of the bank.

After each period, the bank has to pay an interest rate r to the depositors; there are no bankruptcy costs in our model: if the portfolio yields such a low return that the bank suffers a loss, available funds are shared among the depositors.

2.1 Regulator's choice

Before turning to the internal principal-agent problem between the shareholder and the manager, we derive the normative optimum that a risk-neutral welfaristic regulator would implement. Consequently the objective of the regulator coincides with the objective of a social planner. In the absence of limited liability the planner would choose that level of risk denoted by X^{Opt} that maximizes expected returns. Furthermore, to rule out supergames, we restrict our attention to Markov strategies. This implies that the regulator's problem is recursive and the bank chooses the same risk at any point in time. Dropping the time subscripts, the regulator's objective can be written as

$$\max_X V^{soz} = \int_0^\infty e^{-\rho t} \cdot e^{-\delta[X] \cdot t} ((p[X] \cdot X) \cdot F) dt, \quad (1)$$

where $p[X]$ is the probability of survival at time t . The future profits are discounted twice: ρ is a time preference rate from the regulator. Taking into regard the existence of positive interest rates in the capital market, the regulator discounts future bank profits at a rate ρ .⁹

Secondly, the “survival probability” in a given period depends on the prior “survival probability”. This reflects the intuition that there is persistence in a bank's risk behavior. Thus δ represents a second time-varying discount factor. It captures the weighting of the “survival probability” of the bank representing an endogenously determined devaluation of the bank due to an increasing probability of default. With this transition function $\frac{1}{p[X]} - 1 \equiv \delta[X]$ (1) can be rewritten as

$$V^{soz} = \frac{(p[X] \cdot X) \cdot F}{\rho + \delta[X]}. \quad (2)$$

Thus the optimal risk-allocation fulfils the following condition:

$$\underbrace{(\rho + \delta[X])}_{>0} \cdot \underbrace{(p'[X] \cdot X + p[X])}_{\text{static optimum}} = \underbrace{\delta'[X] \cdot (p[X] \cdot X)}_{>0}, \quad (3)$$

which implies that the optimal level of risk is strictly positive.¹⁰ Accordingly, for given rates of return, the regulator with a stronger preference for the present (a higher ρ) prefers riskier portfolios. Note, that in a dynamic setting

⁸ As the subprime crisis has shown, this assumption turned out not to be unrealistic. In the US subprime market the risk was linked to the house prices. As long as the house prices were rising, no borrower was about to default, but then, when prices began to fall an avalanche was set off.

⁹ As long as interest rates are positive, zero discounting would imply an impoverishment of the current generation. The lower the discount rate, the more future consumption matters, and hence more savings and investment should take place in the current generation's time period. Thus, while lowering the discount rate appears to take account of the well-being of future generations, it implies bigger and bigger sacrifices of current well-being.

¹⁰ A completely safe investment strategy, *i. e.* $X = r$, cannot be optimal. An increase in risk implies either a higher probability of default and a higher return given no default. Up to X^{Opt} the net effect on the expected profits is positive (see Blum 1999, p. 759).

the preferred risk level is below the optimal risk in a static world where the bank plays a one-shot game and where the efficient risk level is equivalent to $p'[X] \cdot X + p[X]$. The underlying intuition is straightforward: in case of bankruptcy the bank not only has a payoff of zero, but it also loses the future profits, the so-called franchise value. If these quasi-rents are high, it is optimal to reduce risk to increase the probability of getting these rents. Thus via the introduction of the bank's franchise value, risk-taking incentives are limited when the future is not heavily discounted, since the costs of the bankruptcy in form of lost bank value increase.

2.2 Shareholder's choice

Now consider the shareholder's maximization problem. A world without regulatory distortions being "Nirvana economics" (Demsetz, 1969), we assume the case where the representative commercial bank faces the requirement to hold a specific equity-to-asset ratio that is denoted by α . The bank must invest its equity capital at the safe rate $s - 1$.

Since banks enjoy limited liability, equity capital regulation affects the marginal return of risk taking as the expected profit distribution is truncated with regard to possible losses and the bank's equity capital defines the maximum costs in case of bankruptcy. The equity capital is insufficient to cover all liabilities to the depositors in the case of bank failure. In that case, from the bank's perspective, an implicit profit of the amount $(r - s \cdot \alpha) \equiv \omega$ arises for the bank, since r was promised but only $s \cdot \alpha$ can be distributed among the depositors. In other words ω describes the share of non-covered deposits in case of bankruptcy. Thus a shareholder maximizing his expected profits shows an asymmetric risk-behavior as he can externalize the adverse consequences of excessive risk-taking.

We assume that the shareholder will maximize the current value of the bank. Taking into account the recursive character of the maximization problem, the total expected profit of the commercial bank is described by the equation (4).

$$E\pi = \frac{(p[X] \cdot X - r) \cdot F + \omega \cdot F \cdot (1 - p[X])}{\rho + \delta[X]} \quad (4)$$

We now want to determine the impact of adequacy requirements on the risk-taking behavior of the commercial bank. In order to do this, we derive the marginal effect of a change in the risk-allocation X on the expected profits of the shareholder.

$$\frac{\partial E\pi}{\partial X} = \frac{(\rho + \delta[X]) \cdot (F \cdot (p'[X] \cdot X + p[X]) - p'[X] \cdot \omega \cdot F)}{(\rho + \delta[X])^2}$$

$$-\frac{\delta'[X] \cdot ((p[X] \cdot X - r) \cdot F + \omega(1 - p[X]) \cdot F)}{(\rho + \delta[X])^2} = 0$$

From this first-order condition we can derive a "more risk" condition in comparison to a situation without regulatory constraints:

$$\rho > \left(\frac{1}{\underbrace{p[X]}_{\delta}} - 1 \right)^2. \quad (5)$$

Accordingly, for a given discount rate ρ , the shareholder prefers more risk the higher the probability of success in the banking sector. Intuitively, the introduction of limited liability leads to a riskier portfolio when the banking system is relatively stable and $p[X]$ is near to 1. If $\rho = \delta^2$ the social optimal level of risk is chosen ($X^s = X^{Opt}$).

Note that (5) suggests that the shareholder may in some cases choose too little risk ($X^s < X^{Opt}$). The reason for this possibility is the fact that for given $p[X]$ in some cases the bank's franchise value, *i.e.* future profits may be so high, that the farsighted shareholder (ρ is pretty small) prefers a safer investment strategy to protect his bank's value. This finding implies that $\frac{\partial X}{\partial \alpha} > 0$ for all $\rho < \bar{\rho} \equiv (\delta)^2$.

Proposition 1. *When the shareholders are sufficiently myopic ($\bar{\rho} < \rho < 1$), the shareholder selects a level of risk that is strictly above the social optimal level.*

This result is quite intuitive: as long as the shareholder can externalize some costs in case of failure to the public he has incentives to increase the risk level of their portfolio. For given rates of return, this incentive will be stronger the stronger his preferences for the present. For the remainder of the paper, we will assume that shareholders of the bank are sufficiently myopic so that the “more risk” condition holds, where it is possible that the optimal capital requirement can be positive.

2.3 Manager's Choice

In reality, however, the ultimate decision makers within a company are not the shareholders, but the managers. Although being appointed by the shareholders, managers have some degrees of freedom in choosing the bank strategy as, for instance, their action cannot be supervised perfectly. Therefore, we assume in this section that the representative manager decides upon the riskiness of the chosen projects under the natural constraint of staying in office as long as the company makes profits and having to leave the bank when it defaults. Consequently he will no longer participate in the bank's earnings after his departure period T . In contrast to the shareholder, the risk decision of the manager is time-dependent. The objective of the shareholder in this context is to provide incentives for the manager to induce investment actions in the desired way by implementing an optimal incentive contract.

We assume that the compensation scheme of the manager can include fixed payments and variable payments, the latter being linked to the bank's profits.¹¹ Choosing a compensation scheme with profit participation enables the shareholder to direct the manager's effort to achieving high profits. Let the manager's compensation scheme, w , for a single period be as in equation (6) where L denotes the fixed payment to the manager, and $\theta \cdot \pi$ the profit participation with θ being the profit share of the manager. Keep in mind that the payment for the manager in period t depends on the current profits. But at the same time in our model the risk decision in t crucially influences the “survival probability” of the bank, thereby the future performance by the transition function. Therefore the manager's investment decision includes a hidden action that cannot be monitored by the shareholder. The manager has discretion in his choice of portfolio risk.

$$w = L + \theta \cdot E\pi^m = L + \theta \cdot ((p[X_t] \cdot X_t - r) \cdot F + \omega \cdot F \cdot (1 - p[X_t])), \quad (6)$$

Without loss of generality, the risk-neutral bank manager maximizes expected life-time income in the bank, which consists of his earnings from being manager at the bank.¹² As a result, the manager chooses the time paths of the portfolio risk such that the present value of the cash flow it generates is maximized.

$$\max_{X_t} \int_0^T e^{-\rho t} \cdot (s_t \cdot (L + \theta \cdot E\pi^m)) dt \quad (7)$$

s.t.

$$\dot{s}_t = s_t \cdot p[X_t] - s_t$$

$$s_0 = 1$$

¹¹ We are reluctant to drop the premise that the manager maximizes the expected value of his earnings. However, he will also attempt to increase the size and scope of his power and influence. To keep our model as simple as possible, we assume that the manager's utility of empire building is positively correlated with his earnings from the current profits of the bank θ .

¹² For simplicity we assume that all agents are risk-neutral. The introduction of risk-averse managers could avoid linearities in our model.

$$s_T \geq 0$$

with s_t as the "survival probability" of the bank in period t .

The current-value Hamiltonian of this problem is

$$H^C = s_t \cdot (L + \theta \cdot E\pi^m) + \mu_t \cdot (s_t \cdot p[X_t] - s_t), \quad (8)$$

where μ_t is the shadow price for one unit of s in period t . Applying Pontryagin's Maximum Principle, the first-order conditions

$$\frac{\partial H^C}{\partial X_t} = s_t \cdot \theta \cdot \frac{\partial E\pi^m}{\partial X_t} + \mu_t \cdot s_t \cdot p'[X_t] = 0 \quad (9)$$

and

$$\frac{\partial H^C}{\partial s_t} = (L + \theta \cdot E\pi^m) + \mu_t \cdot (p[X_t] - 1) + \rho \cdot \mu_t = -\dot{\mu}_t \quad (10)$$

and the transversality condition

$$\mu_T \cdot s_T = 0, \quad (11)$$

which implies that $\mu_T = 0$, since s_T cannot be zero, can be derived.

To analyze the impact of the internal principal-agent problem on the risk taking behavior of the bank, we rearrange the first-order conditions to get the optimality condition for the manager:

$$\underbrace{\theta \cdot F \cdot ((p[X_t] + X_t \cdot p'[X_t]) - \omega \cdot p'[X_t])}_{\text{marginal private rent of risk taking } MR_{today}} = - \underbrace{\int_t^T e^{-\rho(u-t)} \cdot (L + \theta \cdot E\pi^m[X_u^*]) du}_{\text{private loss of franchise value } MR_{tomorrow}}. \quad (12)$$

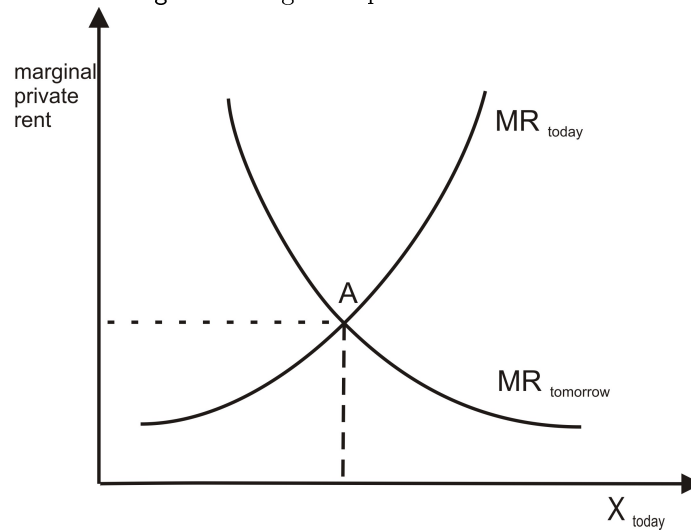
The above problem characterizes the optimal investment strategy of a representative self-interested manager. The manager considers a trade-off in selecting the optimal level of risk X^m . In general, an increase in risk is a double-edged sword. The first term in (12) represents the marginal return of increasing risk of the portfolio where the expression in brackets is the profit of the bank in the current period. Increasing risk implies a higher rate of return on the total amount of funds invested. Therefore the curve of the manager's marginal rent (MR_{today}) today in figure 1 is upward sloping.

The second term is the marginal cost of increasing risk tomorrow. This term represents the loss of managerial franchise value, since in case of bankruptcy the manager will loose all his future earnings. The higher the risk today the higher the probability of default and vis-à-vis the loss of franchise value, *e. g.* the lower the marginal rent of risk-taking tomorrow. That is why the curve of the marginal rent of risk-taking tomorrow ($MR_{tomorrow}$) in figure 1 is downward sloping. At the optimal level of risk X^m , marginal costs are equal to the marginal return, which can be rewritten as $F \cdot (p[X_t] + X \cdot p'[X_t]) = F \cdot \omega \cdot p'[X_t] - \frac{MR_t \cdot p'[X_t]}{\theta}$.

Comparing the FOCs of the shareholder and the manager it follows that the manager will invest in a riskier portfolio than the shareholder preferred level if and only if the relation of the profit-related bonus and the fixed payment exceeds the critical level of $\frac{\bar{\theta}}{L}$.

A lopsided emphasis on the market performance with $\frac{\theta}{L} > \frac{\bar{\theta}}{L}$ results in the manager taking actions that reduce the value of the bank as long as these actions increase the measurable outcome, *e.g.* boost current earnings. In such a situation the compensation contract is driven by the desire of the manager to increase the risk above the desired level of the shareholder. Since the shareholder rewards myopic risk-taking behavior, it is rational for managers to

Fig. 1: Managerial optimal level of risk



undervalue the occurrence of rare disruptive events if their bonus only depends on short-run performance indicators like current profits. In this context, blaming a manager for maximizing his earnings in spite of taking into regard the long-run dangers of the banking system sounds like blaming a cat for eating a mouse.

On the other hand, a compensation package with 100% salary fixed amount means to create incentives to privilege the long-term over the short-term profits. This package would implicate too little risk.

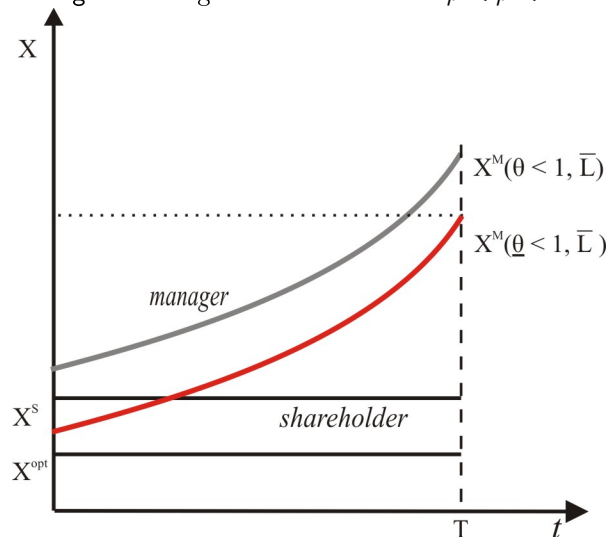
Fig. 2: Divergence in interests for $\bar{\rho} < \rho < 1$ 

Figure 2 illustrates the essence of our model displaying the risk path of the manager in comparison to the preferred level of the shareholder. First note that for $\bar{\rho} < \rho < 1$ the shareholder will select a portfolio above the level of risk that would be implemented without limited liability. The extent of non-covered deposits determines the magnitude of the additional risk. Secondly, the risk chosen by the manager for a given T will increase with time, since an increase in risk is associated with a higher probability of default. Thus the expected "lifetime" of the bank will also decrease. This works equal to a shortfall of expected future profits. As a consequence, the manager will act in a less risky fashion when he anticipates a large remaining time being in office because his future earnings crucially depend on the bank's value and the "probability of survival". Reaching risk maximum at T , he will engage in greater excessive risk-taking, the shorter the planning horizon. In the last period the manager is nearly insulated from the consequences that losses could impose on the bank in the future.¹³

¹³ Note that even for $T \rightarrow \infty$ the manager's payoff is not fully aligned with that of the shareholder, as long as there is $L > 0$.

Thirdly, in our model a manager's smaller stake of the bank ($\underline{\theta} < \theta$) results in an inward shift of the risk-curve and decreases the chosen level of risk, since the fixed wage in the manager's objective function gains importance. Due to a high franchise value, the manager initially chooses too little risk in the first periods and too much risk in the last periods.¹⁴

In this respect we can say that the equilibrium risk chosen by managers rises the shorter the planning horizon and the higher θ vis-à-vis the lower L . Thus the bottom line is that the bank's bonus structure encourages or discourages risky behavior.

Proposition 2. *If the manager's compensation package consists of a profit-related share $\frac{\theta}{L} > \frac{\tilde{\theta}}{L}$, then the manager's most preferred risk is above the preferred level of the shareholder, vice versa.*

2.4 Solving the internal agency problem

However, Proposition 2 provides the grounds for the argument that we can define an optimal contract that overcomes the divergence of interests between the shareholder and the manager. Pay packages have to be designed in which, there is congruence between the desired level of risks between the two agents - the intersection of X^S with the optimal risk path of the manager X^m in figure 2. In other words the shareholders have to constrain the feasible set of investment strategies by giving incentives via the composition of the pay package.

So far we have taken the bonus component of the manager's compensation package as fixed for all periods. However in the remainder of this section we want to stress this assumption and introduce a simple extension of the model that allows us to change the θ of the manager over time in order to distort the managerial *ex-ante* incentives to invest in high risk portfolios.

By equating (11) and (5) we can derive a profit-related bonus that induces managers to internalize the owners' interests:

$$\theta[t] = \frac{-p'[X] \cdot \int_t^T e^{-\rho(u-t)} \cdot L \, du}{\underbrace{\delta'[X] \cdot \left(E\pi^{soz} + \frac{\omega \cdot F \cdot (1 - p[X])}{\rho + \delta[X]} \right)}_{\equiv B} + p'[X] \cdot \int_t^T e^{-\rho(u-t)} \cdot E\pi^m[X^*] \, du} \quad (13)$$

Furthermore, it can be shown that the bonus in the optimal contract that solves the agency's problems declines in time:

$$\frac{d\theta[t]}{dt} = \dot{\theta}[t] = p'[X] \cdot \frac{B \cdot e^{\rho(t-T)} \cdot L \cdot \rho^2}{(B \cdot \rho - (e^{\rho(t-T)} - 1) \cdot E\pi^m[X^*] \cdot p'[X])^2} < 0. \quad (14)$$

This result is quite intuitive. For $L > 0, \theta = 0$, the manager implements conservative portfolios. He is only worried about protecting his fixed payment and implements a policy which is in the interest of depositors. As we have seen in figure 2, due to a high franchise value, the manager initially acts too risk-averse and the risk allocation is suboptimal. As managerial profit share θ is increased from 0, the manager acts more and more like a shareholder, implementing riskier strategies. But with $\theta > \tilde{\theta}$ the bonus makes him act in a more risk-favoring fashion than the shareholder prefer. Only with a compensation package with a time varying bonus system the shareholder is able to discipline the manager.

Proposition 3. *For any level of equity capital α and management compensation structure $\{L, \theta\}$, the bank shareholder will optimally choose a compensation structure that induces a portfolio risk X^S where the payment parameters satisfy the relation $\frac{-p'[X] \cdot \int_t^T e^{-\rho(u-t)} \cdot L \, du}{B + p'[X] \cdot \int_t^T e^{-\rho(u-t)} \cdot E\pi^m[X^*] \, du}$.*

¹⁴ This theoretical result is in line with the recent empirical findings that managers will use "riskier" strategies with higher incentive fees (Kouwenberg and Ziemba, 2007 or Massa and Patgiri, 2007). However Gehrig *et al.* (2009) found little evidence of bonus-induced risk-taking in a questionnaire of fund managers in US, Germany and Switzerland.

However, in reality the enforceability of such an optimal contract can be called into question for two reasons:

- The idea of the implementation of the optimal contract crucially depends on the assumption of a monopsony market for managers and consequently neglects the existence of a binding participation constraint. If we observe some market power for managers, the implemented contract will be supply-driven. To illustrate this point let us consider two types of contract offers that depend on the median shareholder. (1) An aggressive contract offered by short-term shareholders where the bank's risk is high, thus proving the manager with a large amount of bonuses and (2) a "conservative" contract that is preferred by the long-term shareholders (*e. g.* a bank with a high reputation, valuable brand, etc.) with a high salary. Due to managerial short-termism, income-maximizing managers have a systematic incentive to go to the banks with an aggressive compensation scheme. Given this reality, the best bankers, traders, dealmakers, etc. will work for companies that are able to provide the most attractive compensation packages. As a result the competition for rare managerial experts in the financial sector may lead to a bias towards inefficient high bonus components.
- Secondly, the value of the bank must be observable for outsiders with the same precision as for the manager. If it is not, managers may take costly actions to change the shareholders' perception, or simply try to hide the truth for as long as possible. By definition in our model the risk of the bank's portfolio, thereby the induced "life-expectancy" implemented by the decision of the bank manager, is not common knowledge. Due to imperfect monitoring possibilities - especially if there is huge dispersion on small investors - the consequences of a risky investment strategy may only be observable with time-lags. The shareholders are in a dilemma to punish bad investment strategies. This creates moral-hazard in the form of excessive risk-taking by the manager and is the Achilles' heel of any form of compensation structures in banking. Thus the dysfunctional corporate governance structure in banks limits the implementation of the optimal contract.

In this section we developed a model to show that a double moral hazard problem can rationalize why has occurred risk-favoring behavior in the banking sector compared to a world with unlimited liability. Since the shareholder can expect to capture the full upside, but only part of the downside, the shareholder's interests would be served by more risk-taking than would be in the interest of the benevolent regulator. Moreover the compensation package matters. Standard pay arrangements reward the manager for short-term results even when these come at the expense of long-term value or at the risk of an implosion later on. That is why our model suggests that a large bonus fraction in the first period and a small one in the last period can curb the additional moral hazard problem created by corporate governance.

However, in the aftermath of the financial crisis of 2008, there are concerns that the compensation structure of financial firms has provided such incentives. Market imperfections limit the implementation of an optimal contract. As a result, to address these short-term distortions regulators around the world are moving toward setting standards for pay structures in banks. In the next section we focus on the effects of such regulation.

3 Regulatory tools and the risk-allocation

Three agents affect the bank's risk allocation. First, the manager who makes the investment decision and has private interests that influence his choice. Second, the shareholder who wants to maximize the bank's value and influence investment decisions through corporate governance structures. And third, the regulator, who is interested in minimizing the cost of bank failures and uses regulatory provisions in order to affect the investment decision.

In this section we study the effects of two policy instruments on the commercial bank's investment behavior: an increase in capital requirements and an direct regulation of the manager's compensation package.

3.1 Does stricter regulation necessarily implement prudent investments?

First, note that the shareholder will reduce his preferred risk as a result of increasing capital requirements as mentioned in section 2.2. A marginal increase in α induces more risk-constraining incentives for the shareholder, since $\frac{\partial X}{\partial \alpha} < 0$ for all $\bar{\rho} < \rho < 1$.

In order to look at the impact of a tighter capital regulation concerning the principal-agent problem we zoom into the selection of the managerial preferred portfolio. Here, an increase of capital requirements α increases the volume of equity indeed, but the impact on the risk allocation is ambiguous.

First, obviously any increase in capital requirements augments the amount of liable equity capital. Thereby stricter regulation drives down expected profits in any remaining period by reducing the marginal advantage of the bank from enjoying limited liability. Graphically this implies a downward shift of the path of MR_{today} to the red line as illustrated in figure 3.

But the beneficial effect of capital requirements on moral hazard may be more than offset by the franchise value effect that is induced because equity capital is costly.¹⁵ If the opportunity cost of equity capital is large enough, higher values of α , by reducing bank's leverage, limit risk-taking incentives in the one-shot game, they also reduce the value of the bank and thus the incentives to behave more prudently, when the future is not too heavily discounted. The path of the future MR also shifts downward. It then turns out that for large opportunity costs (larger costs of capital) the franchise value effect may dominate the former effect resulting in an X^m that is above the initial level (like in figure 3). For example, under specific circumstances it can be profitable for the manager to abandon on the last periods in its "lifetime" by increasing risk since the cost to defaulting in the form of losing "expected lifetime" may be smaller than the expected profit increase in all other periods. So the manager accepts higher probabilities of default. This result implies that there exists a switchpoint where the manager changes his risk-allocation in favor of higher risk, if banks experience large enough negative shocks to franchise value due to increased capital requirements. Formally we derive the following more-risk-condition due to an increase in capital requirements:

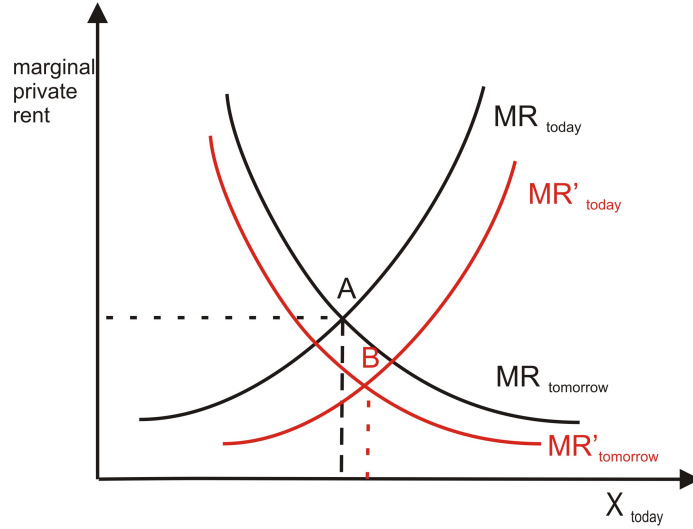
$$\theta \cdot s \cdot F > - \int_t^T e^{-\rho(u-t)} \cdot (-\theta \cdot s \cdot F \cdot (1 - p[X_u^*])) du. \quad (15)$$

Thus, we point out that the risk decision does not only depend on current regulation, but crucially on the foresight of the manager and the design of the compensation package. Only if the shareholders are able to implement the optimal contract derived in section 2, the regulation of equity capital will lead to the specific reduction of risk that the shareholders prefer.

Otherwise, we can conclude a regulation paradox: capital requirements may create adverse effects on corporate governance by intensifying the divergence of interests between the shareholder and the manager. Even if the regulator chooses the optimal level of α , the investment decision of the banking sector, *e.g.* the manager, depends on the quality of the corporate governance. In other words, despite it would be possible to design a regulating system with capital requirements that provides the right incentives to achieve the socially preferred level of risk X^{Opt} , the same policy becomes suboptimal, when it is applied to banks with internal agency problems. Once again: the enforceability of the optimal contract becomes the Achilles' heel of any form of capital regulation. Optimal bank regulation in presence of internal moral hazard is partly offset by the managerial franchise value effect. This result is in line with the recent empirical findings of Laeven and Levine (2009), which show that the impact of bank regulations on bank risk critically depends on each bank's ownership structure. They pointed out that the effect of the same regulation on bank's risk taking can be positive or negative depending on the bank's corporate governance structure.

¹⁵ Because of tax-deductibility of interest costs, which give debt an advantage, deposit insurance and "too big to fail"- arguments in this context the Modigliani-Miller theorem is not binding.

Fig. 3: Impact of capital requirements on the risk allocation



3.2 Regulation of the Manager's Compensation Package

As an alternative instrument the regulator can also impose constraints on the management compensation. Unlike capital requirements, which have at best indirect effects on managerial incentives and thereby on manager's portfolio decisions, changing top-manager's compensation package for instance by implementing a relative wage cap to regulate the bonus-fix payment relationship or taxing the variable compensation above a certain threshold is a direct way of influencing managerial return and risk-taking incentives.¹⁶ Pay packages can be designed that there is congruence between the desired level of risk between the benevolent regulator and the risk path of the manager (X^{Opt} and X^m in figure 2). Then the contract-driven moral hazard of the manager is incorporated in the compensation structures. Given such a compensation package which we characterized in the previous section as a function of incentive parameters, we can induce the manager to undertake efficient portfolio decisions. With regard to section 2.4 we define an optimal contract from the perspective of a social planner that is equal to:

$$\theta^{Soz}[t] = - \frac{\left(\int_t^T e^{-\rho(u-t)} \cdot L \, du + \theta \cdot \int_t^T e^{-\rho(u-t)} \cdot E\pi^m[X^*] \, du \right) \cdot p'[X]}{\delta'[X] \cdot E\pi^{Soz} - F \cdot \omega \cdot p'[X_t]}. \quad (16)$$

One basic insight follows from the above discussion. It is clear that the structure of the management compensation, in our model the size of the fixed payments L relative to the managerial equity share θ , affect the riskiness of the portfolio. Hence regulatory policy could take into account the incentive effects of pay packages and can fine tune this incentive instrument in order to implement the efficient portfolio risk.

Although the optimal pair $\{L, \theta^{Soz}(t)\}$ is not uniquely specified, the relationships in Equation (16), which imply larger θ 's with larger planning horizon of the manager, are intuitive. For larger values of $(T - t)$, the manager will invest too conservatively, that is, $X^m < X^{Opt}$. On the other hand, if the planning horizon is small, then the manager engages in too risky strategies $X^m > X^{Opt}$. Note also, that the optimal values of θ depend on the specific ω of the bank. Accordingly, managers in banks with small equity buffers should have a smaller bonus fraction than those banks with high equity levels. Thus, linking the earning of managers either to job-specific and equity parameters enables the regulator to get the correct risk choice that would be implemented by the social planner X^{Opt} .

In fact both discussed policy instruments, capital requirements and the regulation of bonuses, can now be seen

¹⁶ The taxation of executive compensation above a certain threshold can be implemented as a gradual decline in the tax deductability of the compensation above the pre-specified level. Such a regulation of the banker's pay would provide the manager with an incentive to invest in less risky portfolios compared to a situation without any form of regulation.

as substitutes leading to the efficient risk allocation under the assumptions of perfect enforceability. This is the bottom line of our paper.

Proposition 4. *If the optimal contract is enforceable, capital requirements α^* and the regulation of bonuses with $\{L, \theta^{Soz}(t)\}$ are substitutes leading to the efficient risk allocation X^{Opt} .*

In the following section we discuss these necessary assumptions and argue that taxing the wage may be a more promising way to deal with the issue of moral hazard in banking.

4 Discussion and Policy Implications

As we have seen in the previous section the bank's investment decision depends on the corporate governance mechanism that coordinates the incentives, on the one hand by the bank's internal structure and on the other hand by the regulatory structure.

Capital requirements affect the shareholder's incentives to incur risk. But since bank risk is not observable, capital requirements cannot control precisely the level of risk implemented by myopic managers. Even if the shareholder's best response is a reduction of risk, the manager who is faced with an incomplete contract may have an incentive to play the moral hazard card.

Because the shareholders' interest favors incentives for risk-taking that is excessive from a social perspective, regulation of pay arrangements should become the objectives of banking regulation. The regulator's focus should be on the structure of compensation - not the amount - with the aim of discouraging the taking of excessive risk. Then the regulation of the manager's pay could reinforce the traditional regulation of the bank's activities via capital requirements.

Indeed, if pay structures are designed to discourage moral hazard, the indirect regulation with capital requirements could be less tight than it should otherwise be. The regulation of the managers' compensation package may be levelled more at the target than indirect minimum capital ratios where there is a higher degree of dilution-effects because of the collective-action problem between dispersed and uninformed shareholders within a bank. If there are asymmetric information and the long-term consequences of unsound investment decisions are not observable, the manager has huge degrees of freedom for hidden actions creating short-termism behavior. In addition, the regulation of bonus systems compared to capital requirements offers one crucial advantage. Holding equity capital is costly, thus an increase of capital requirements leads to a cost-disadvantage for banks. Due to deposit insurance, incomplete contracts, the irrelevance theorem of the financial structure of the bank (Modigliani-Miller, 1958) does not hold. As we have seen in (4) and (8), both the shareholder and the manager aim to minimize the amount of equity due to the positive externality in case of insolvency. The increase of capital requirements diminishes the bank's profits.

In accordance with Hellman *et al.* (2001) the income of the shareholder, the manager and the regulator can be defined as a function of the level of capital held by banks and whether the banks invest prudently. Then a Pareto outcome is defined by the set of outcomes such that no agent (shareholder, manager and the benevolent regulator) can made better off without some them becoming worse off. A compensation package control with $\theta^{Soz}[t]$ would yield the same returns to the regulator and higher profits to the bank, which would save banks the incremental capital costs of increasing capital requirements. Thus, when the regulator is sufficiently powerful to implement the optimal contract, any policy of capital requirements is a Pareto inferior policy. Under these circumstances the regulator would do best by direct monitoring and regulating the optimal contract.

Against pay regulation in the banking sector one could basically say four kinds of arguments: First one could argue that the regulator does not have a legitimacy to dictate bank shareholders how to spend their money. Choices of pay packages may belong to the area of private business decisions where regulators should not trespass. However this argument is not persuasive, since a safe banking sector is a public good.

Second, one could argue that regulators have an informational disadvantage when regulating pay arrangements. As we have seen self-interested managers use their informational advantages and discretion for any given corporate governance structure. In face with the complexities of modern finance and the limited information of regulators, the traditional regulation of bank's actions is "necessarily imperfect" (Bebchuk, 2009). Thus, when the manager has incentives to do so, he may be able to take risk beyond what is intended by the regulator who may often be one step behind the bank's manager. Following Bebchuk (2009) placing limits on compensation structures "that incentivize risk-taking would be no more demanding in terms of information than the regulator's direct intervention in investment, lending and capital decisions." Thus, the structure of pay arrangements should not be left to the unconstrained choice of informed players inside banks: these players do not have incentives to take into account the interests of stakeholders like bondholders, depositors and the government in setting the managers' pay.

Third, some economists (Kaplan, 2009) argue that pay regulation is likely to damage the financial sector by driving talent away and banks losing valuable employees. Greater pay regulation will drive more of the most talented away from regulated banks and towards hedge funds, private equity funds and other unregulated investment firms. In fact, this thesis of a potential talent drain can be denied in the context of our model. As we stresses before, regulation of pay arrangements should focus on pay structures and should not limit absolute pay levels.

Finally pay restrictions could open a Pandora's box of other restrictions. Pay regulation could provide regulators with increased power which they may abuse. Following Bebchuk (2009) one may argue that banks might respond by increasing their investments in political contributions and their efforts to curry favor with the political establishment. "Then the financial sector will move increasingly to a Fannie-Freddie style arrangement in which banks use their capital to advance pet projects and political fortunes of lawmakers' in exchange for lawmakers guaranteeing sympathetic regulatory treatment" (Kaplan 2009).

Nevertheless, the main message of this paper is not to make regulators more influential but rather encourage them to expand their toolkit and improve their possibilities to achieve more stability and trust in the banking sector. Curtailing moral hazard between the manager and the shareholder, which recent agreements of G20 seems to seek, cannot fully eliminate any risk-taking that is excessive from a social planner point of view. But a reform of corporate governance (in combination with capital requirements) can reduce the moral hazard problem by limiting bank manager's incentives to invest in too risky projects at lower costs.

5 Conclusion

This article provides a theoretical framework to analyze the impact of banking regulation on the risk-taking behavior of banks by incorporatig the incentives of three agents - the welfaristic regulator, the shareholder and the manager. While shareholders are assumed to maximize the discounted flow of bank profits, bank managers maximize expected income choosing from a menu of portfolios with different risk-return profiles.

We began our analysis from the perspective of a representative shareholder. In this context we showed that solely the liability regime distorts the investment decision of profit-maximizing banks, leading to a misallocation of risk. This misallocation is reinforced if we introduce the agency conflict between managers and shareholders. The management compensation scheme rewards myopic risk-taking behavior if it is rational for managers to undervalue the occurence of rare disruptive events since the bonus only depends on short-run performance indicators. In our model the manager's short-term bias is endogenous and is greater in those circumstances where the overall linkage between the manager's and shareholder's wealth via the variable compensation component is maximal. Then the income-maximizing manager is "trapped" into behaving myopically.

Moreover, the second part of our model suggests that increasing the minimum equity-to-asset ratio of banks does not in general lead to less risk-taking – as frequently assumed in the policy debate. This is a consequence of income-maximizing bank managers being compensated at least partly with profit related bonuses. There, they face

a trade-off between (1) current profits which are reduced due to stricter regulation and can be increased in the short-run by more risk-taking, and (2) the expected loss of profits in the distant future as the expected lifetime of the bank is reduced by increased risk. In particular, we point out that the risk reduction does not depend on the current regulation, *i.e.* the liability regime, but crucially on the foresight of the bank manager, the current risk-taking of the banking sector and the design of the manager's compensation package. From a shareholder perspective this problem does not exist and more equity capital leads to a risk reduction. But if the private opportunity costs to increase risk are large enough for the manager, an increase of capital requirements intensifies the agency conflict.

In addition, it is shown that there exists a social optimal contract that implements the efficient level of risk from a social planner's point of view. If we assume perfect enforceability of contracts the direct regulation of the banker's pay and traditional instruments like capital regulation are substitutes.

This conclusion certainly does not provide support for moving to an even more costly system of capital requirements. Our results do suggest, however, that the direct regulation of the bank manager's compensation package is a supporting tool in the regulator's arsenal to achieve stability in the financial sector. Furthermore, it is an important issue for future theoretical research in the banking arena.

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