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# The incentive to give incentives: on the relative seniority of debt claims and managerial compensation\*

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## Abstract

We show that the relative seniority of debt and managerial compensation has important implications for the design of remuneration contracts. Whereas the traditional literature assumes that debt is senior to remuneration, there are in reality many cases in which remuneration contracts are de facto senior to debt claims in financially distressed firms and in workouts. We theoretically show that risky debt changes the incentive to provide the manager with performance-related incentives (a “contract substitution” effect). In other words, the relative degree of seniority of managers’ claims and creditors’ claims in case a bankruptcy procedure starts is crucial to determine the optimal incentive contract ex-ante. If managerial compensation is more senior than debt, higher leverage leads to lower power incentive schemes (lower bonuses and option grants) and a higher base salary. In contrast, when compensation is junior, we expect more emphasis on pay-for-performance incentives in highly-levered firms.

**Keywords:** seniority of claims, remuneration contracts, financial distress, insolvency, leverage, managerial compensation, bankruptcy, capital structure.

JEL codes: G32, G33, G34, K12.

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## 1 Introduction

During the 1990s, the use of performance-related compensation packages increased dramatically (Murphy (1999)). Financial economists usually consider these forms of managerial compensation as the consequence of a rational attempt by shareholders to reduce the agency problems first illustrated by Jensen and Meckling (1976). The contemporaneous increase in the leverage of Anglo-American corporations has also stimulated the interest in the role of debt as a direct incentive device for the management to generate stronger corporate performance (Baker and Wruck (1989), Smith and Watts (1992)). This raises the question as to *how the various components of remuneration contracts and leverage relate*. Specifically, we examine whether debt and remuneration are complements in solving the agency conflicts between shareholders and managers. We show that including risky debt in the capital structure changes the "incentive to give incentives" by a principal in charge of managerial contracts. This principal is usually the compensation committee of the board of directors. Moreover, we show that the effect of debt on managerial remuneration depends on the relative priority with which the two claims are paid out if insolvency were to occur: the relative seniority of managerial and debtholders' claim when a firm enters a bankruptcy procedure at a later stage affects how the managerial contracts are designed ex-ante.

The relative seniority of debt and remuneration and its consequences is an important issue which has largely been ignored in the literature<sup>1</sup>. For example, Innes (1990), Hart and Moore (1995), Berkovitch, Israel and Spiegel (2000) recognize that only "hard" (that is, senior and non-postponable) debt plays an important role in reducing managerial discretion. If we have a closer look at the existing liquidation or reorganization procedures, it is not always the case that managerial remuneration is junior to debt claims. While such an assumption may be acceptable for countries with pure liquidation bankruptcy codes and with no room for claim renegotiations in workouts, it cannot be generalized. The bankruptcy procedures in countries like the US, UK, or Germany show that the seniority issue a complex problem. Even if the absolute priority rule (APR) is a principle in a liquidation code, Franks and Torous (1989), Weiss (1990), and Eberhart, Moore and Roenfeldt (1990) document that violations of the absolute priority rule are the rule rather than the exception. Hence, managerial compensation - even when it is based on junior claims (such as bonuses, stocks or stock options) - cannot be considered ex-ante as totally junior to debt claims<sup>2</sup>. Let us first illustrate this point using UK (and US) regulation.

When a UK firm is insolvent and will be liquidated, the number of claims with preferential status is limited to payroll taxes, VAT and arrears in wages. These last claims are confined to those held by employees (excluding directors), and to GBP 800 per person. Thus, top managers' claims based on salary and bonuses are theoretically not senior; they are part of

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<sup>1</sup>A notable exception is John and John (1993) who show that if shareholders negotiate managerial contracts before the capital structure is put in place, remuneration contracts can be used as commitment devices not to let managers expropriate the debtholders. However, this model takes the opposite view that salary has seniority over debt and it assumes that the interests of the manager and the ones of the principal-shareholder can be aligned without costs. In addition, the fact that remuneration contracts are signed before the capital structure is determined is not realistic given that managerial remuneration packages are frequently adjusted (Canyon and Murphy (2000)) whereas many firms hold on to a target capital structure.

<sup>2</sup>Lutgens (1991) surveys the regulation concerning managerial pensions in bankruptcy, showing that the payoffs to managers vary greatly from case to case. See also Edmans (2006) on this point about the seniority of pension plans.

the pool of unsecured claims and hence junior to all preferential debt (the floating and fixed debentures). The assumption in the theoretical literature that managerial remuneration is junior to all debt claims is not incongruent with the liquidation codes. However, there are many cases in which managerial remuneration claims are senior to leverage.

First, in case of insolvency, the holder of a floating charge (for a more detailed discussion of UK insolvency procedures, see Appendix B) can appoint a receiver who is to liquidate the firm's floating assets on his behalf. However, instead of liquidating the firm, the receiver can also exercise the following option: he can continue the business if the proceeds of continuation are expected to exceed those of a liquidation. If this were the case, the managerial remuneration contracts (and the arrears in remuneration and bonuses) retain their value. A continuation of the business (taken out of the corporate shell) or sale to a third party triggers the "Transfer of undertakings protection of employment" regulations of 1981 (TUPE), which stems from the European Acquired Rights directive. This regulation states that "all the [seller's] rights, powers, duties and liabilities under or in connection with [an employee's contract of employment], shall be transferred to the [buyer]." Furthermore, the buyer assumes the liability for "anything done before the transfer is completed by or in relation to the [seller] in respect of that contract or a person employed in that undertaking or part". TUPE states that such an act "shall be deemed to have been done by or in relation to the [buyer]."

Second, an alternative to the above creditor-oriented receivership is the debtor-oriented 'administration' procedure. In this case, the court supervises a formal workout (financial and/or asset restructuring) with the aim of corporate survival. If the incumbent management is essential to the firm and is maintained after the implementation of the reorganization plan, the claims of past remuneration may still retain their value. This happened, for example, in the collapse of Barings bank. Likewise, "E&Y, which was appointed as administrator for Railtrack in October 2001 [. . . ], took the decision to pay Richard Middleton £700,000 for six months' work to prevent him from leaving the troubled rail group. [. . . ] Mr Middleton was one of three directors responsible for the network's safety. E&Y feared that, without his expertise, the network could be plunged into chaos. The engineer, who was involved in the disastrous upgrade of the West Coast Main Line, received a pay rise that included a doubling of his salary of £168,000, a hefty retention bonus and a year's salary for loss of office" (The Times, 23 June 2003). As a US example, the Regus case<sup>3</sup> shows that in a formal workout, the employees' remuneration contracts (including bonuses) are preserved in spite of very poor past performance resulting in insolvency and Chapter 11 (the US equivalent to UK administration (Franks and Torous (2002))). This example is only one of the many cases of violations to the absolute priority rule that denies a claimholder a stake in the securities of the reorganized firm, until more senior claims have been totally satisfied. Franks and Torous

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<sup>3</sup>"Regus PLC which filed for Chapter 11 bankruptcy [. . . ], is asking a bankruptcy court to allow it to make retention and severance payments to keep selected employees on board while it reorganizes. The company said the value of its business "cannot be preserved and maximized for the creditors' benefit without the employees critical contribution to the operation of those businesses" [. . . ] The company is also seeking to establish a general pool of \$100,000 for discretionary bonuses to workers not initially covered under the plan. According to the motion, the plan would allow Regus to pay its four most senior U.S. corporate executives [. . . ] half their bonuses, equal to 20% of their base salaries [. . . ]. The remaining bonuses, also equal to 20% of salaries, would be paid by Jan. 31, 2004, subject to a performance review [. . . ]. The company would also assume the executives' current employment contracts, which call for potential bonuses of up to 40% of their salaries. Regus has also proposed to pay the executives one year's base salary as severance plus all deferred or unpaid benefits under the plan. (Dow Jones Corporate Filings Alert, 15 January 2003).

(1989) conjecture that “shareholders obtain some share of the reorganized firm even when creditors’ claims have not been satisfied in full”. The same holds for managers who have been granted shares.

Third, there are numerous cases which show that management foresees insolvency and still manages to time the payment of substantial bonuses such that its remuneration is effectively senior to debt claims (by paying them out shortly before the corporate collapse). For instance, EuroTelecom collapsed in February 2001, eleven months after raising GBP 15 million through an AIM flotation<sup>4</sup>. Likewise, the UK management of Enron<sup>5</sup> and of NTL<sup>6</sup> cashed in their bonuses shortly before the collapse. Alternatively, in the wake of a corporate crash, top management can make the firm sign a new contract including generous severance payments (as in the Marconi case<sup>7</sup>). Not only does this evidence support the idea that debt is often "soft" compared to managerial compensation, but also that firms sometimes manage to keep parts of their subsidiary’s profits out of reach of creditors. For example in the case of the bankruptcy filing of the US utility Pacific Gas and Electric, it became clear that its profits were transferred to its subsidiary National Energy Group, allowing the management to enjoy performance bonuses even in a situation very close to financial distress of one subsidiary. “Pacific Gas and Electric transferred \$ 4.1 billion between 1997 and 1999. Most of this went to dividends and stock repurchases, but \$ 838 million was invested in other subsidiaries, primarily its National Energy Group unit. [ . . . ] ‘Executives of the companies say the transfers were proper. Audits have shown that “we followed the rules and didn’t do anything wrong” (‘While a Utility May Be Failing, Its Owner is Not’, The New York Times, 30 April 2001<sup>8</sup>).

These are only some of the numerous cases in which top management is able to safeguard their base salaries and bonuses by timing those payments well, by relating bonuses to the performance of subsidiaries where performance is amassed (at the expense of other subsidiaries) or by redesigning contracts (with substantial severance payments) even when the firm is close to insolvency. The research question as to *how the relative seniority structure of managerial compensation and debt contracts determines the managerial incentives*, constitutes a contribution to the theoretical literature as this has — to our knowledge — not been addressed.

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<sup>4</sup> “[The BDO accountants] disclose[s] that on November 6, 2000 three cheques of GBP 50,000 were made out and entered in the cash book as "directors’ bonuses in favour of" Mr Derry, Mr Linell and another director, Andy Krawchuk”. (The Guardian, 31 March 2001).

<sup>5</sup> “Senior executives at the London subsidiary of collapsed US energy trader Enron received at least GBP 500,000 in cash bonuses weeks before it went into administration.” (Scotland on Sunday, 24 March 2002).

<sup>6</sup> “Barclay Knapp, the chief executive of the troubled cable company NTL, was awarded a \$561,138 (£382,768) bonus for his work in 2001 as the company lurched towards bankruptcy” (The Independent, 31 May 2002).

<sup>7</sup> Lord Simpson of Dunkeld (CEO) managed to extract a severance pay of GBP 2.2 million. “It was hardly news, in August, that Marconi was in trouble. Simpson knew this when he entered into negotiations with those supine non-executives on the remuneration committee. So did they. But both parties signed.” (The Times, 29 September 2001).

<sup>8</sup> As another example, consider Global Crossing: “[T]he US telecoms giant’s board signed what must be among the most generous employment contracts of all time. On joining the company, Robert Annunziata, chief executive, was handed a \$10 million (Euro 12 million) signing bonus, options on two million shares with an exercise price \$10 below market value, and "guaranteed annual bonus" worth another \$500,000. His contract also specified the make and model of Mercedes the company would purchase for him, sanctioned the use of the corporate jet, and agreed to pay for first class air travel for his entire family, including his mother. Annunziata lasted 53 weeks in the job, but amassed no less than \$151m in pay. As it has now become clear, the board’s pay policy failed to buy performance” (The Financial News, 4 February 2002).

Therefore, in this paper we theoretically analyze the *effect of senior and junior debt, respectively*, on the choice of managerial incentive contracts (assuming the financing decision is taken prior to managerial contract negotiation). Specifically, we consider the degree of protection of managerial compensation in relation to debt contracts as given and commonly known by all parties before the remuneration contracts are written. We theoretically analyze two extreme cases: compensation is totally senior to debt, and the reverse case.

The main results from our model are the following. Pay-for-performance sensitivity (i.e. monetary bonus and option grants) decreases with leverage, while the base salary increases with leverage, provided that debt is considered to be junior to managerial compensation. With debt senior to compensation, the relations are opposite. These results are obtained from the following principles. First, at the moment of designing the compensation package, the existing capital structure determines the “incentive to give incentives” by the remuneration committee of the board of directors when it acts in the interest of the existing shareholders. Second, for a given level of leverage, the degree of protection of the managerial pay against creditors’ claims on corporate value changes the payment the manager would receive in the case of insolvency. Therefore, the seniority of debt relative to managerial compensation influences the management’s incentives to put effort into the firm.

When managerial remuneration is paid with priority over the debt claims in case of corporate insolvency, two important implications emerge. First, the base salary is partly paid by the debtholders whenever the firm is in financial distress: the shareholders do not suffer the entire cost of offering a high base salary to the management. Secondly, higher managerial effort decreases the likelihood the firm will be insolvent, thus increasing the value of debt claims. Why then should the shareholders, who enjoy positive profits only in good states of the world, give up a substantial part of these profits in the form of high incentive bonuses when part of the advantage of the higher effort will be cashed-in by the debtholders? The consequence of these two effects is that the shareholder-principal offers the agent-manager a lower performance-related bonus in highly levered firms.

In contrast, when the remuneration is subordinated to debtholders’ claims, leverage acts as a direct incentive device to enforce higher managerial effort, as Innes (1990), Dewatripont and Tirole (1994), and Hart and Moore (1995) point out (the so-called “incentive effect”). This is because managerial remuneration in low states of the world faces an upward boundary by the presence of senior debt, forcing her to put higher effort into the firm. This effort can be further stimulated through the payment of higher incentive bonuses. Still, under this regime, leverage reduces the resources free from debt service that can then be allocated to the management (Berkovitch, Israel and Spiegel (2000) call this the “cash-flow effect”). For some levels of debt the incentive effect prevails over the cash-flow effect, such that the principal has to reward the management with a greater bonus as leverage increases.

The remainder of the paper is organized as follows. Section 2 presents the general model. In Section 3, we study the choice of managerial remuneration contracts by the shareholders in the two different cases of seniority: (a) the managerial remuneration claims and (b) the debt claims are more senior. In Section 4 we discuss the previous results and provide some empirical implications of our theoretical model. Section 5 concludes. Appendix A collects the proofs while Appendix B details the UK bankruptcy procedures.

## 2 The model

Consider a firm operating in two periods  $t = 1, 2$ . At date  $t = 1$ , a principal  $P$  (typically the remuneration committee of the board of directors) offers a contract specifying a compensation scheme to a manager  $A$  and then delegates the business activity to him. As in the standard principal-agent model, the principal cannot monitor the manager's actions, but he can exactly observe the realization of the firm cash flows at  $t = 2$  and verify it through a legal procedure. Hence, the principal can write contracts on that realization of cash flows.  $P$  offers  $A$  a state-contingent, complete contract  $w(q)$  specifying the payment she will get at the final date  $t = 2$  for any realized cash flow  $\tilde{q}$ . We allow her to compensate the agent only through monetary payments (pay-for-performance bonus, or option and option plans), excluding any other form of remuneration (e.g. a promotion).

We will consider a risk-neutral principal and a risk averse agent. If the manager accepts the contract at  $t = 1$ , he then chooses a non-verifiable effort level,  $e$  in an interval  $\Lambda = [0, \bar{e}]$ , that affects the probability distribution of the final cash flows. We assume for simplicity that, at  $t = 2$ , the firm can only produce a high cash-flow  $q_1$  or a lower cash flow  $q_0$ <sup>9</sup> without any earnings maturing at time one. For the moment, we assume that the capital structure is given at the moment of the contract negotiation and that the manager cannot change this pre-existing capital structure anymore subsequently. Still, in Section 3, we discuss how the results change when this assumption is removed and the hired manager is able to change the capital structure at date  $t = 1$ .

At the last stage, the realized cash-flow of the firm  $(q_i)_{i=0,1}$  is distributed to the different claimholders (including the agent) according to their respective claims and following a pre-specified, law-enforced rule of priority. Even if the payoff generated by the firm is not sufficient to repay all the claims in their entirety, we assume that the contract signed at  $t = 1$  remains valid and is not renegotiated<sup>10</sup>.

**Assumption 1:** *The cash-flow of the firm at  $t = 2$  is a two-states random variable distributed according to  $p(e) = \Pr(q_1; e)$  where  $p(e)$  is assumed to be continuous in  $e$ , weakly increasing and weakly concave.*

Assuming that  $p(e)$  is weakly increasing and concave guarantees that both Monotone Likelihood Ratio Property (MLRP) and Cumulative Distribution Function Convexity (CDFC)<sup>11</sup> properties are verified<sup>12</sup>, so that we can be sure that the first-order condition of the agent problem only picks up global optima (Holmstrom (1979), Rogerson (1985)).

All the information about the firm returns and the contract with the agent is commonly known at time 1 by all individuals.

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<sup>9</sup>If the firm has liquid assets-in-place  $L$  at time zero, which can be turned into cash at  $t = 2$ , and whose market value at time 2 is independent of managerial effort, we include them in  $q$ . Hence,  $q$  is a composite measure of both the firm liquid assets-in-place and project cash-flows, with the difference that the  $t = 2$  value of the latter is affected by the effort the manager chooses previously.

<sup>10</sup>Since the firm is liquidated in any case at  $t = 2$ , there would be no incentives for both the principal and the agent to renegotiate the remuneration contract.

<sup>11</sup>The MLRP holds if the likelihood ratio  $\frac{p_i(e)}{p_i(e')}$  is non-decreasing in the state  $i$ , given any two actions  $e, e'$  in the set  $\Lambda$  and given that action  $e$  is more expensive to be implemented in first-best, i.e.  $C^{FB}(e') \leq C^{FB}(e)$ . The CDFC requires that the distribution function  $\Pr(q, e)$  is convex in the action  $e$ .

<sup>12</sup>See Result A in the Appendix for a formal proof of this statement.

We make the following assumption on the preferences of the agent:

**Assumption 2:** *The agent's utility function is separable in effort and compensation,  $U(e, w(q)) = (u(w_1)p(e) + u(w_0)(1 - p(e)) - c(e))$  where  $c(e)$  is increasing, twice continuously differentiable and strictly convex in  $e$ . Moreover,  $c' > 0$ ,  $c'' > 0$ ,  $c(0) = 0$ ,  $c'(0) = 0$ .*

The solution of the model involves two subsequent steps: at  $t = 1$  the choice of the optimal remuneration contract by the principal  $P$ ; and successively the optimal effort choice by the agent  $A$  once he has signed the contract. Since the individuals are perfectly rational and have complete knowledge of the model, we can analyze the sequence of the events by working recursively. We first describe the agent's choice of effort.

Given the state-contingent, complete contract  $(w_0, w_1)$ ,  $A$  solves the following problem:

$$\max_{e \in [0, \bar{e}]} u(w_1)p(e) + u(w_0)(1 - p(e)) - c(e) \quad (\text{A})$$

At time  $t = 1$ , the principal  $P$  (the remuneration committee) chooses the contract that maximizes the shareholders' value: in doing this she has to take as given the incentive compatibility constraint (IC) generated by the unobservable choice of effort by the agent.

Let  $D \geq 0$  be the face value of the existing debt in the capital structure of the firm with maturity  $t = 2$ . The problem of optimal-contract is

$$\begin{aligned} w_i^* \in \arg \max_{w_0, w_1} V_E & \quad (\text{P}) \\ \text{s.t. } p(e)u(w_1) + (1 - p(e))u(w_0) - c(e) \geq \bar{U} & \quad (\text{IR}) \\ e(w_i) \text{ is the solution to (A) given } w_i^* & \quad (\text{IC}) \end{aligned}$$

where, assuming no discount and risk-neutral shareholders, the value of equity is<sup>13</sup>:

$$V_E = p(e(w_0^*, w_1^*)) \max\{q_1 - w_1^* - D; 0\} + (1 - p(e(w_0^*, w_1^*))) \max\{q_0 - w_0^* - D; 0\}$$

and (IR) is the participation constraint for the agent.

## 2.1 Some properties of the principal-agent relationship

By assumption 1 on  $p(e)$ , we can substitute the incentive compatibility constraint (IC) with the first order condition in the effort choice whenever IC is binding<sup>14</sup> (Rogerson (1985)). Given the contract payments  $(w_0, w_1)$  the agent solves:

$$e \in \arg \max_{\hat{e} \in [0, \bar{e}]} p(\hat{e})u(w_1) + (1 - p(\hat{e}))u(w_0) - c(\hat{e})$$

<sup>13</sup>Given that the information is symmetrically distributed across all individuals, all the investors can anticipate rationally the decisions of  $P$  and  $A$  and can then correctly price their claims on the firm payoffs. With no discount and risk-neutrality all the claims are priced under the risk-neutral probability  $p(e)$ .

<sup>14</sup>In our framework IC is not binding for the implementation of  $e = 0$ : in that case  $P$  can fully insure  $A$  paying a fixed wage  $w^{fi}$  at which IR is binding (Grossman and Hart (1983)).

and the global maximum is characterized by:

$$p'(e) (u(w_1) - u(w_0)) = c'(e) \quad (1)$$

The characterization of the choice of effort by the agent allows us to determine some properties of the optimal contract problem.

**Assumption 3:**  $\bar{U} > \frac{c'(\bar{e})}{p'(\bar{e})}p(\bar{e}) - c(\bar{e}); q_0 - u^{-1}(\bar{U}) > 0;$   
 $q_1 - u^{-1}\left(\bar{U} + c(\bar{e}) + \frac{c'(\bar{e})}{p'(\bar{e})}(1 - p(\bar{e}))\right) > q_0.$

**Lemma 1:** *Under Assumption 1,2, and 3, for any  $e \in [0, \bar{e}]$ :*

(i) *IR is always binding, and each action can be induced with positive payments to the agent; moreover, the higher the agent's reservation price for action  $e$ , (in the sense of higher  $C^{FB}(e)$ ), the (weakly) higher  $w_1$ , and the (weakly) lower  $w_0$  necessary to implement such an action  $e$ .*

(ii) *for any given action  $e > 0$  implemented by  $P$ , a higher  $w_0$  requires a higher bonus  $b = w_1 - w_0$  that the principal has to pay to the agent in state  $q_1$ .*

**Proof:** See the Appendix.

**Corollary 2** *(co-monotonicity of payoffs of  $A$  and  $P$ ): a compensation scheme  $(w_0(e), w_1(e))$  satisfying IR and s.t.  $w_0(e) > w_1(e)$  is never optimal for  $P$  whenever  $q_1 - w_1(e) > q_0 - w_0(e)$ . Moreover, when  $w_1(e) > w_0(e)$  we have  $q_1 - w_1(e) > q_0 - w_0(e)$ .*

**Proof:** See Grossman and Hart (1983), Proposition 4.

Assumption 3 and Lemma 1 have two important consequences: first, they guarantee that adding a limited liability constraint on the agent does not change our results: for all actions  $e \in ]0, \bar{e}]$  the agent always receives a positive payment in both states; secondly, they allow us to order the set of payments the principal has to offer in order to induce any action  $e$ :

$$\begin{aligned} 0 &< q_0 - w_0(e) < q_0 - w_0^{\min} < q_0 \\ 0 &< q_1 - w_1^{\max} < q_1 - w_1(e) < q_1 \end{aligned}$$

## 2.2 The optimal contract in an all-equity firm

If no debt with maturity  $t = 2$  is present in the capital structure of the firm at the moment of the contract negotiation, the principal solves the following problem at  $t = 1$ :

$$\begin{aligned} e^0 \in \arg \max_e \quad & V_E = p(e(w_1, w_0)) (q_1 - w_1) + (1 - p(e(w_1, w_0))) (q_0 - w_0) \\ \text{s.t.} \quad & w_0(e) = h\left(\bar{U} + c(e) - \frac{c'(e)}{p'(e)}p(e)\right) \\ & w_1(e) = h\left(\bar{U} + c(e) + \frac{c'(e)}{p'(e)}(1 - p(e))\right) \end{aligned} \quad (2)$$

where the function  $h$  denotes  $u^{-1}$ .

**Assumption 4** *The utility function of the agent and the probability  $p(e)$  are such that  $-p(e)h(\bar{U} + c(e) + \frac{c'(e)}{p'(e)}(1 - p(e)))$  is concave in  $e \in [0, \bar{e}]$ .*

Under Assumption 1-4 this problem is a concave problem (Laffont and Martimort (1999)) of which the first order condition is:

$$p'(e^0)(q_1 - q_0) = \frac{\partial C^{SB}(e)}{\partial e} \quad (3)$$

where  $C^{SB}(e)$  is the cost for the principal to implement action  $e$  under moral hazard (second-best cost):  $C^{SB}(e) = p(e)w_1(e) + (1 - p(e))w_0(e)$ .

**Proposition 1:** *The optimal contract under full-equity financing induces the effort  $e^0$  such that  $q_0 - w_0(e^0) \leq q_1 - w_1(e^0)$  and it is characterized by the following equality:*

$$p'(e^0)(q_1 - q_0) = p'(e^0)(w_1(e^0) - w_0(e^0)) + p(e^0)(1 - p(e^0)) \frac{c''(e^0)p'(e^0) - c'(e^0)p''(e^0)}{(p'(e^0))^2} (h'(\bar{u}) - h'(\underline{u}))$$

**Proof:** See the Appendix.

Proposition 1 allows us to fix the benchmark solution of the optimal contract in the case of full-equity financing of the firm. We now move to check how the presence of debt in the capital structure affects the choice of contract by the principal.

### 3 The seniority of compensation relative to debt

Since the equity claims are junior to both debt and to managerial monetary compensation, the equityholders receive a positive payment only in case the firm payoff  $q_i$  exceeds  $w_i + D$ , regardless of the relative seniority of debt and remuneration. It is easy to see that the Principal's objective function in (P) changes in a non-linear way with  $D$ , the debt due at  $t = 2$ <sup>15</sup>. Therefore, it is clear that the optimal contract ( $w_i^*$ ) chosen by P will depend on  $D$ . We call this effect of capital structure on the managerial compensation the “*contract substitution*” effect.

In this section, we show that the relation between the optimal remuneration contract and leverage depends on the relative degree of law-enforced seniority of the compensation versus debt. In many existing papers on managerial compensation (Innes (1990), Dewatripont and Tirole (1994), Robe (1999), Berkovitch, Israel and Spiegel (2000)), the management remuneration is considered junior to the debt claims. Such an assumption does not completely tie in with reality as we discussed in the introduction.

Our objective is to demonstrate that the relative seniority of  $w_0$  versus  $D$  in case an insolvency procedure starts is the all-important variable to understand the effect of leverage on compensation. Our argument is the following: we assume that the contracting parties anticipate what will be the *effective* priority rule of managers' pay versus creditors' claims in case of default. Notice that whether this degree of protection is due to the prespecified law regime (which ex-post is always enforced), or to any violations to the rules is not important for our purposes, as long as it is anticipated by the parties (we will discuss this point more thoroughly in Section 4.2).

<sup>15</sup>With a continuum set of states higher leverage reduces the states in which equity value is positive, making the function  $(q_i - w_i^* - D)$  convex in the states  $i$ .

### 3.1 Debt is subordinated to managerial remuneration

With managerial remuneration being senior to debt, the agent's problem (A) is not affected by  $D$ : the f.o.c. (1) holds for any  $D > 0$  as well. What matters for the choice of the optimal contract is only the change in the payoff function for the principal.

Suppose that in the pre-existing capital structure of the firm there is debt  $D > 0$  that has to be repaid at  $t = 2$ . The payoff function of  $P$  at  $t = 1$  becomes:

$$\begin{aligned} & p(e) \max\{q_1 - w_1 - D; 0\} + (1 - p(e)) \max\{q_0 - w_0 - D; 0\} \\ = & Ben(e; D) - C^{SB}(e) \end{aligned}$$

where

$$\begin{aligned} Ben(e; D) &= p(e) \max\{q_1 - D; w_1\} + (1 - p(e)) \max\{q_0 - D; w_0\} \\ C^{SB}(e) &= p(e)w_1 + (1 - p(e))w_0 \end{aligned}$$

$Ben(e; D)$  is the benefit for the principal when action  $e$  is induced, while  $C^{SB}(e)$  is the second-best cost for implementing such action. The fact that the agent's problem is invariant to  $D$  has an important consequence: a positive  $D$  does not create any direct incentive effect on the agent's effort. However, our purpose is to characterize how the solution of the following problem changes with  $D > 0$ :

$$\begin{aligned} & \max_e Ben(e; D) - C^{SB}(e) \tag{4} \\ s.t. & \quad w_0(e) = u^{-1} \left( \bar{U} + c(e) - \frac{c'(e)}{p'(e)} p(e) \right) \\ & \quad w_1(e) = u^{-1} \left( \bar{U} + c(e) + \frac{c'(e)}{p'(e)} (1 - p(e)) \right) \end{aligned}$$

**Proposition 2:** *If the agent's compensation is due with priority over the debt service in time 2 and if the solution of problem (2) is  $e^0 > 0$ , then, for  $D > q_0 - w_0$  the solution of (4) is  $e^D < e^0$ ,  $w_0^D > w_0^0$ , and the bonus paid in presence of debt  $w_1^D - w_0^D = b^D < w_1^0 - w_0^0 = b^0$ .*

When risky debt is issued, the relative payoff of shareholders changes across states. They end up not paying the agent's compensation entirely in the low state as the fixed part,  $w_0$ , is partly paid by the debtholders in the case of insolvency. Proposition 2 suggests that the shareholder-principal transfers part of the cost of the remuneration contract to the debtholders through a higher base salary  $w_0$  and a lower bonus. The cost of such a bonus accrues entirely to the shareholders but it produces benefits that they cannot fully internalize, since they are partly cashed-in by the debtholders. Furthermore, an increase of  $w_0$  has a negative effect on the managerial effort (Lemma 1). Hence, if the management's compensation is protected against the debtors' claims, a principal  $P$  acting in the interest of existing shareholders will choose a lower pay-to-performance sensitivity contract, since the marginal cost of the bonus is now higher for that principal. Implicitly, he offers an insurance to agent  $A$  (the manager) at the expense of the debtholders.

According to Proposition 2, we should observe low-powered incentive contracts under this regime in firms with risky debt. Smith and Watts (1992) confirm this prediction in firms using traditional, monetary compensation packages.

Finally, note that the result of Proposition 2 does not change when we allow the manager to change the capital structure at time 1. The intuition of this result is simple: when the

managerial remuneration is totally senior to debt, any variation of the capital structure posterior to the contract negotiation has no effect on the utility the agent-manager gets at the optimum, making her indifferent towards the debt level.

### 3.2 Managerial remuneration is subordinated to debt

In the present model, the firm is insolvent if at time  $t = 2$  the debt service and the managers' compensation exceed the generated cash flows. This is the case if the bad contingent state occurs and hence the cash flow is below the payments due ( $q_0 < D + w_0$ ). The debtholders can now start a bankruptcy procedure that leads to the liquidation of the firms' assets. If the existing law does not give a preferential status to the managers' pay in case the firm is liquidated, we can assume that the remuneration of the manager cannot exceed the amount  $q_0 - D$ <sup>16</sup>.

This legal regime implies that the wage the agent receives in state zero is directly affected by the amount of debt  $D$  because the principal is protected by limited liability. Thus, the principal cannot credibly offer a compensation  $w_0 > q_0 - D$  since the agent knows he will not be able to claim more than  $q_0 - D$  in case of liquidation.

The presence of risky debt<sup>17</sup> creates then two effects on the choice of contract (as pointed out by Berkovitch, Israel and Spiegel (2000)<sup>18</sup>):

1) an “incentive effect”: the debt  $D$  puts an upper bound on the wage the principal can (credibly) promise to the agent in a state with  $q_0 : w_0 \leq q_0 - D$ . Following from Lemma 1, the principal has to pay a higher  $w_1$  to make the agent accept the contract and induce high levels of effort;

2) a “cash-flow” effect: higher  $D$  reduces the cash-flow in  $s = 1$  available for compensation. As the maximum possible bonus  $b$  is now lower, the principal  $P$  will be less able to induce higher effort from the agent by means of bonus compensation.

As it is never optimal for  $P$  to implement an amount of effort  $e > 0$  that requires the payment of a bonus to the agent of  $w_1 - w_0 > q_1 - q_0$ , we find (Corollary 2) for any  $D \geq 0$  that  $q_1 - w_1 - D \geq q_0 - w_0 - D$ . This in turn implies that by increasing  $D$  we enter successively in the following regions:

(i)  $e^0$  is such that  $q_1 - w_1 - D \geq q_0 - w_0 - D \geq 0$ ;

(ii)  $e^0$  would require a payment  $w_0(e^0) > q_0 - D$  so that  $q_1 - w_1^0 - D \geq 0$  and  $q_0 - w_0^0 - D < 0$

(iii)  $e^0$  is such that  $D \geq q_1 - w_1^0$ ;

In the first case, the optimal contract for the principal does not change with  $D$ : the debt is riskless.

In case (ii), the action  $e^0$  is not implementable with any junior wage scheme because the principal cannot credibly offer the agent more than  $q_0 - D$  in state  $q_0$ . While the agent's

<sup>16</sup>Of course, the firm is also insolvent if  $D + w_1 > q_1$ . We will study the two cases separately.

<sup>17</sup>Risky debt is defined here as debt which cannot be entirely repaid when the state which yields  $q_0$  is realized:  $D > q_0$ .

<sup>18</sup>Our analysis is different from theirs since they only study the case of junior wage compensation along with the choice of optimal managerial turnover.

limited liability constraint<sup>19</sup> puts a lower bound on the compensation,  $D$  imposes an upper bound on  $w_0$ .

In case (iii), the principal cannot credibly pay more than  $q_1 - D$  in the good contingency, and this puts an upper bound on the maximum compensation  $w_1$ .

**Proposition 3.** *If the agent compensation is subordinated to the debt service at time 2 then  $e^D \geq e^{SB(0)}$  and  $w_1(e^D) - w_0(e^D) \geq w_1(e^0) - w_0(e^0)$  for  $D \in [q_0 - w_0(e^0), \min\{q_0, q_1 - w_1(e^0)\}]$ .*

If managerial compensation is not protected against the debtholders' claims, the optimal bonus is increasing in leverage. This occurs because debt acts as a direct incentive device (as in Innes (1990)), and the participation constraint of the agent forces the principal to pay him a higher bonus, even if this is suboptimal. Leverage and junior power-incentives are then complementary.

If we allow the agent to adjust the capital structure by issuing or retiring debt and equity after the contract has been signed (i.e. at  $t = 1$ ), the problem becomes more complex. Still, we can observe the following: once the contract has been signed, the manager  $A$  will try to postpone the debt repayment in order to increase the resources  $q_i - D$  available for his own compensation. Anticipating this, the principal can afford to offer the manager contracts requiring higher payments  $w_i$ . Still, the result in Proposition 3 will hold albeit with a caveat: the debt  $D$  represents the final debt service, net of the change of the capital structure the manager performs at  $t = 1$ .

## 4 Discussion

### 4.1 The timing of events and possible solutions to the "contract substitution" effect

In our model, we assume that the capital structure is fixed at the moment of the contract negotiation between the compensation board (acting in the interest of the existing shareholders) and the manager. The reason is that we want to highlight the effects of existing debt on the new remuneration contracts. This differentiates our model from John and John (1993), where at the moment of deciding the management contracts, the principal anticipates the consequence these will produce on the value of new debt that will be issued in the future<sup>20</sup>.

In both papers, the shareholders (or someone acting in their interests) have the power to write the managerial compensation contracts. If debt were issued before the contracting of a remuneration scheme with managers and still has not reached its maturity, then shareholders consistently maximize only the value of the equity claims when writing the contract. In other words, they could commit not to expropriate new debtholders (if in the future the firm issues new debt, as in John and John (1993)), but they still have the incentive to reduce the value of

<sup>19</sup>While we impose limited liability on the principal throughout our model, the condition of limited liability on the agent (no remuneration punishments) is always satisfied following assumption 3, in line with standard principal-agent models (Laffont and Martimort (1999)).

<sup>20</sup>Leary and Roberts (2005) provide evidence that active changes in capital structure are relatively infrequent. Managerial contracts are rediscussed at least every year, if not more frequently.

pre-existing debt: anticipating this, the cost of debt financing increases due to our "contract substitution" effect. In this sense, our paper is complementary to John and John (1993) since it studies the effect of existing debt as opposite of future debt.

However, it is important to check whether the shareholders and the debtholders can reach a Pareto-improvement renegotiating the old debt contracts that have not reached maturity, just before the new management contracts are drafted<sup>21</sup>. We do find that a Pareto-improvement is possible, and the reason is that in our model the debt pre-existing in the capital structure "overhangs" (in the sense of Myers (1977)) at the moment of deciding upon managerial contracts. More precisely, the shareholders (acting as the principal) prefer not to pay a high power-incentive contract to the manager since they bear all the cost of these incentives, while the debtholders enjoy part of the benefits. This part is proportional to the stake of debt which is at risk, i.e.  $D - (q_0 + w_0)$ . Thus, a renegotiation that reduces the face value  $D$  would alleviate this problem. However, notice that shareholders and debtholders cannot agree to renegotiate debt down to a level at which this is riskless: such a renegotiation would reduce the debt value, and hence would not be Pareto-improving<sup>22</sup>. As risky debt creates an incentive for shareholders to expropriate debtholders through the "contract substitution" effect illustrated above, allowing for debt contract renegotiation does not completely eliminate this incentive.

## 4.2 Anticipated versus unanticipated violations to the bankruptcy code

As we argued before, in the present model we assume that the contracting parties anticipate what will be the *effective* priority rule of managers' pay versus creditors' claims in case of default. In Section 1, we gave many reasons and examples that, even if the absolute priority rule states that remuneration is junior than debt, de facto remuneration is frequently senior to debt. Similar violations of the APR in favour of shareholders are extremely widespread, as documented by Franks and Torous (1989), Weiss (1990), and Eberhart, Moore, Roenfeldt (1990).

In the light of this observation, we can then reinterpret Proposition 2 and 3 as follows: if violations to the specified bankruptcy procedure can be expected regarding managers' compensation the effect of financing the firm with risky debt is different than when the parties anticipate<sup>23</sup> there will be no such violations<sup>24</sup>.

Let us illustrate this point with an example. Suppose that compensation  $w_0$  is considered to be junior to debt in line with the relevant bankruptcy procedures: at the moment of signing his contract, the agent would think he will get zero in state  $q_0$  if risky debt with face value  $D > q_0$  were raised. Suppose also that at the moment of deciding on his effort, the manager has no reason to believe there will be a deviation from the specified rule of seniority, so that his remuneration  $w_0$  will effectively be considered as junior to debt in case  $q_0$  is realized. He knows he will get zero in case of default ( $q_0$ ) and he will choose then action  $e$  accordingly. Our Proposition 3 predicts that, if the principal also anticipates no violations from the APR, she offers a higher bonus to the manager when risky debt is used to finance the firm.

Instead, let us assume now that both the principal and the agent anticipate that the APR

<sup>21</sup>We thank an anonymous referee for suggesting us this possibility.

<sup>22</sup>A proof of this statement is available upon request.

<sup>23</sup>Of course we refer to an equilibrium situation in which expectations are fulfilled.

<sup>24</sup>We thank an anonymous referee for pointing out this argument to us.

rule will be violated. Then, the agent expects to receive a positive  $w_0$  at  $q_0$ : he (resp. the principal) takes this into account in choosing the action  $e$  (resp. the contract). Proposition 2 predicts then that the principal will offer the manager a contract with lower power incentives  $w_1 - w_0$ , than in the case without risky debt in the capital structure. Hence, an expected violation from the APR in favour of managers, changes the incentive contract offered to the agent by a shareholder-principal ex-ante.

Finally, if ex-post an *unexpected* deviation of the seniority rules occurs, there is no effect on efficiency (since the action  $e$  as well as the contract have already been chosen earlier). The unexpected deviation simply transfers wealth from debtholders to the manager. This discussion has shown that our model can capture various realistic cases and that ex-post deviations from the APR have repercussions on the ex-ante decisions taken by shareholders provided these deviations are anticipated<sup>25</sup>.

### 4.3 Empirical implications

Based on our Propositions 2 and 3, we expect that when managerial remuneration is more senior than debt, remuneration contracts should specify higher base salaries in firms with higher leverage. In contrast, contracts in levered firms offer lower base salaries in a context of managerial remuneration being more junior than debt. To test these predictions one should study the relation between leverage and remuneration in poorly performing or financially distressed firms, because in such firms remuneration may be de facto senior to debt (as demonstrated in Section 1), whereas the question about seniority between remuneration and debt in well and average performing firms is not a pressing issue in the short-run.

We have also demonstrated that when managerial remuneration is more senior than debt, the variable part of managerial compensation (bonus, grants of options or long-term incentive plans) is lower in highly levered firms than in firms with a low debt/equity ratio. This relation between leverage and remuneration goes the opposite way when the seniority between remuneration and leverage is reversed.

Finally, another consequence of our theoretical analysis is that debtholders rationally require a higher return if they anticipate they could be expropriated once a procedure of insolvency starts. More precisely, we predict that if in a specific legal system the relative priority of managerial compensation over debtholders' claims is not univocally determined by the bankruptcy code, the cost of debt is higher than in another legal system in which such a priority is clearly specified and enforced.

## 5 Conclusions

This paper studies the effect of debt financing on managerial remuneration contracts (assuming that the financing decision is taken at a point in time preceding the contract negotiation). While in previous theoretical research, the seniority of debt with regard to remuneration contracts in case of insolvency is a standard assumption, this paper contributes to the literature

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<sup>25</sup>Bebchuk (2001) also shows that only anticipated violations to APR have effects on the ex-ante decisions of corporate agents. However, none of these papers consider how the choice of managerial remuneration contracts by shareholders change with the degree of enforcement of the priority rule.

by questioning this assumption. We theoretically show that the effect of leverage on managerial compensation and effort is significantly influenced by the relative seniority of these two types of claims. In other words, the relative degree of seniority of managers' claims and creditors' claims ex-post (i.e. when they can be considered as managerial remuneration in arrears) is crucial to determine the optimal incentive contract ex-ante.

We show that changing the capital structure of the firm changes the incentive for a shareholder-principal to give incentives to the management (a “contract substitution” effect). In particular, our model predicts that pay-for-performance sensitivity is negatively related to leverage, while the fixed salary increases with leverage if managerial compensation has priority over the debt claims. The intuition of this result is that, whenever risky debt is issued, the principal does not completely internalize the benefits of a higher incentive bonus because these benefits are shared with the debtholders. This implies that in highly levered firms, we expect a much weaker pay-for-performance relation and hence lower bonuses, than in low-leverage firms. In contrast, when managerial remuneration is junior to debt claims, leverage has a direct incentive effect on the managerial effort, and is then complementary to an increase in the junior power-incentives, and to a reduction of the base salary. The reason is that an increase in senior debt financing triggers higher managerial effort, in turn requiring higher performance-related managerial compensation in good states of the world. Moreover, we argue that (risky) debt financing is more likely to be optimal when it is senior to the compensation claims. The intuition of this result is similar to Innes (1990) and Hart and Moore (1995) who claim that debt financing is a good instrument to enforce high effort by a residual-claimant entrepreneur subject to limited liability.

In practice, the relative seniority depends on the context in which workout or bankruptcy procedures take place. Specifically, we detail that there are several ways by which management can ensure that its monetary compensation is de facto senior to debt even when insolvency is likely within the framework of a creditor-oriented bankruptcy code. This is usually the case in financially distressed poor performers when bankruptcy regulation (c.q. administration in the UK or Chapter 11 in the US) formally institutionalizes a violation of absolute priority, or when managers are able to (re)write contracts in informal workouts making their pay senior to debt.

## 6 Appendix A (proofs)

**Result A:** *If  $p(a)$  is weakly increasing and weakly concave, then it satisfies (MLRP) and (CFDC).*

**Proof.** Order the actions in  $[0, \bar{e}]$  according to their reservation price  $C^{FB}(e)$ , higher effort requiring higher cost: for any couple  $e', e \in [0, \bar{e}]$ , let  $e > e' \Leftrightarrow C^{FB}(e) > C^{FB}(e')$ . By definition (see Grossman and Hart (1983)) such a cost is given by the minimum payment  $P$  has to guarantee to make  $A$  choosing the effort  $e$  when the effort choice is observable (first best):

$$C^{FB}(e) = u^{-1}(c(e) + \bar{U})$$

Restate (MLRP) for our two-states framework:  $\forall e, e' \in \Lambda$  if  $C^{FB}(e') \leq C^{FB}(e)$  then  $\frac{p_i(e')}{p_i(e)}$  is non increasing in the state  $i$  (weakly decreasing; the states  $i$  have been ordered

for increasing payoffs  $q_i$ ). In a simple 2-states framework this means that for any couple  $e', e \in [e_{\min}, e_{\max}]$ ,  $e > e'$  we have  $\frac{1-p(e')}{1-p(e)} \geq \frac{p(e')}{p(e)} \Rightarrow \frac{1-p(e)}{p(e)} \leq \frac{1-p(e')}{p(e')}$  that is verified for  $p(e)$  (weakly) increasing in  $e$ .

(CDFC) requires that the cumulative distribution function is convex in  $e$ . With only two-states, calling  $F(0; e) = \Pr(q_i = q_0; e) = 1 - p(e)$  and  $F(0; \lambda e + (1 - \lambda)e') = 1 - p(\lambda e + (1 - \lambda)e')$ , while  $\lambda F(0; e) + (1 - \lambda)F(0; e') = 1 - \lambda p(e) - (1 - \lambda)p(e')$ . Then (CDFC)  $\iff F(0; \lambda e + (1 - \lambda)e') \leq \lambda F(0; e) + (1 - \lambda)F(0; e') \iff \lambda p(e) + (1 - \lambda)p(e') \leq p(\lambda e + (1 - \lambda)e')$  that is guaranteed by (weak) concavity of  $p(e)$ . *Q.E.D*

**Proof of Lemma 1:** (i) Order the set  $[0, \bar{e}]$  in the sense that the higher  $e$  has a higher  $C^{FB}(e)$ . We assume  $U(0) = 0$ . Grossman and Hart (1983) (see their Proposition 11) prove that in a two-outcomes moral hazard problem the participation constraint is binding for all  $e$ : hence, putting together (IR) and (1):

$$w_0 = u^{-1} \left( \bar{U} + c(e) - \frac{c'(e)}{p'(e)} p(e) \right) \quad (5)$$

$$w_1 = u^{-1} \left( \bar{U} + c(e) + \frac{c'(e)}{p'(e)} (1 - p(e)) \right) \quad (6)$$

and since

$$\frac{\partial w_0}{\partial e} = \frac{1}{u'} \frac{\partial \left( c(e) - \frac{c'(e)}{p'(e)} p(e) \right)}{\partial e} = \frac{1}{u'} \left( c' - c' - p \frac{c'' p' - c' p''}{p'^2} \right) = -\frac{p}{u'} \frac{c'' p' - c' p''}{p'^2} \leq 0$$

$$\frac{\partial w_1}{\partial e} = \frac{1}{u'} \frac{\partial \left( c(e) + \frac{c'(e)}{p'(e)} (1 - p(e)) \right)}{\partial e} = \frac{1}{u'} \left( c' - c' + (1 - p) \frac{c'' p' - c' p''}{p'^2} \right) = \frac{1-p}{u'} \frac{c'' p' - c' p''}{p'^2} \geq 0$$

if we require  $\bar{U} + c(\bar{e}) - \frac{c'(\bar{e})}{p'(\bar{e})} p(\bar{e}) > 0 \Rightarrow \bar{U} > \frac{c'(\bar{e})}{p'(\bar{e})} p(\bar{e}) - c(\bar{e})$  we have that the agent will always receive a strictly positive payment in state  $q_0$ . All lower actions require a base salary (weakly) higher than  $\bar{U} + c(\bar{e}) - \frac{c'(\bar{e})}{p'(\bar{e})} p(\bar{e})$ , since  $w_0$  is decreasing in  $e$ .

To induce  $e = 0$  a performance-independent salary is required ( $P$  provides full insurance to the agent):  $w_0(0) = w_1(0) = w^{fi} = u^{-1}(\bar{U} + c(0)) = u^{-1}(\bar{U})$ . This is the highest base salary (and the lowest  $w_1$ ) the agent can receive: imposing  $q_0 - w^{fi} > 0$  guarantees that the resources created by the firm in state 0 are enough to fully insure the agent.

Finally, since  $w_1$  weakly increases in  $e$ , the maximum payment the agent receives in state 1 corresponds to  $w_1^{\max} = u^{-1} \left( \bar{U} + c(\bar{e}) + \frac{c'(\bar{e})}{p'(\bar{e})} (1 - p(\bar{e})) \right)$ : letting  $q_1 - w_1^{\max} > 0$  guarantees that the principal can always afford to implement  $\bar{e}$ .

(ii) Consider again (1):  $\frac{c'(e)}{p'(e)}$  is increasing in  $e$  by Assumptions 1-2. Hence, the difference  $u(w_1) - u(w_0)$  required to implement any given  $e$  is increasing in  $e$ .

Given the concavity of  $u$ , for any  $w_1 - w_0$ ,  $u(w_1) - u(w_0)$  is higher the lower is  $w_0$ . For  $P$  it is always convenient to reduce  $w_0$  at the minimum level and then fix  $w_1$  such that  $u(w_1) - u(w_0) = \frac{c'(e)}{p'(e)}$ . Formally, if we denote with  $b = w_1 - w_0$  the performance bonus, from(1) we have:  $u(w_0 + b(w_0)) - u(w_0) = \frac{c'(e)}{p'(e)} = k(e)$  so that, keeping  $e$  constant and varying  $w_0$  we get that

$$\begin{aligned} u'(w_1) \left( 1 + \frac{\partial b}{\partial w_0} \right) - u'(w_0) &= 0 \\ \frac{\partial b}{\partial w_0} &= \frac{u'(w_0)}{u'(w_1)} - 1 > 0 \end{aligned}$$

by strict concavity of  $u(w)$ . *Q.E.D.*

**Proof of Proposition 1:** The result  $q_0 - w_0(e^0) \leq q_1 - w_1(e^0)$  derives directly from Corollary 2, noticing that, if  $e = 0$  is optimal for  $P$ , then  $w_0 = w_1 = w^{fi}$  while, for any  $e > 0$ ,  $w_1(e) > w_0(e)$  by Lemma 1. From Assumption 4, the f.o.c. (3) is necessary and sufficient to characterize the solution in  $e$ ; then computing explicitly  $\frac{\partial C^{SB}(e)}{\partial e}$ :

$$\begin{aligned} \frac{\partial C^{SB}(e)}{\partial e} &= p'w_1 + p\frac{\partial w_1}{\partial e} - p'w_0 + (1-p)\frac{\partial w_0}{\partial e} \\ &= p'(h(\bar{u}) - h(\underline{u})) + p\left(h'(\bar{u})(1-p)\frac{\partial \bar{u}}{\partial e} - h'(\underline{u})p\frac{\partial \underline{u}}{\partial e}\right) + h'(\underline{u})\frac{\partial \underline{u}}{\partial e} \\ &= p'(w_1 - w_0) + p\frac{c''(e)p'(e) - c'(e)p''(e)}{(p'(e))^2}\left(h'(\bar{u})(1-p) + h'(\underline{u})p\frac{\partial \underline{u}}{\partial e}\right) - ph'(\underline{u})\frac{c''(e)p'(e) - c'(e)p''(e)}{(p'(e))^2} \\ &= p'(w_1 - w_0) + p(1-p)\frac{c''(e)p'(e) - c'(e)p''(e)}{(p'(e))^2}(h'(\bar{u}) - h'(\underline{u})) \end{aligned}$$

where for brevity  $p = p(e)$ ,  $h(\bar{u}) = w_1$ ,  $h(\underline{u}) = w_0$  denoting with  $h = u^{-1}$  and  $\bar{u} \equiv \bar{U} + c(e) + \frac{c'(e)}{p'(e)}(1 - p(e))$ , and  $\underline{u} \equiv \bar{U} + c(e) - \frac{c'(e)}{p'(e)}p(e)$ . *Q.E.D.*

**Proof of Proposition 2:** For levels of debt  $D \leq q_0 - w_0(e^0)$  the solution of (4) coincides with the solution of (2) since  $Ben(e; D) = Ben(e; 0)$ . For  $D > q_0 - w_0(e^0)$  the objective function for the principal changes: shareholders get zero in state  $q_0$ . The objective for  $P$  when  $D \in [q_0 - w_0(e^0), q_1 - w_1(e^0)]$  becomes:

$$p(e)(q_1 - w_1(e) - D)$$

that, at  $e = e^0$  values  $p(e^0)(q_1 - w_1(e^0) - D)$ . Since both  $p(e)$  and  $w_1(e)$  are continuous and differentiable in  $e$ , check

$$\frac{\partial p(e^0)(q_1 - w_1(e^0) - D)}{\partial e} = p'(e^0)(q_1 - w_1(e^0) - D) - p(e^0)\frac{dw_1(e^0)}{de} \quad (7)$$

and by optimality of  $e^0$  we have (Proposition 1):

$$\begin{aligned} p'(e)(q_1 - q_0) &= p'(e^0)w_1(e^0) + p(e^0)\frac{dw_1(e^0)}{de} - p'(e^0)w_0(e^0) + (1 - p(e^0))\frac{dw_0(e^0)}{de} \\ p(e^0)\frac{dw_1(e^0)}{de} &= p'(e)(q_1 - q_0 - w_1(e^0)) + p'(e^0)w_0(e^0) - (1 - p(e^0))\frac{dw_0(e^0)}{de} \end{aligned}$$

and substituting into (7):

$$\frac{\partial p(e^0)(q_1 - w_1(e^0) - D)}{\partial e} = p'(e^0)(q_1 - D) - p'(e^0)w_0(e^0) + (1 - p(e^0))\frac{dw_0(e^0)}{de}$$

which is negative for  $D > q_0$  since, by Lemma 1,  $\frac{dw_0(e^0)}{de} < 0$ . Then, the profit function of  $P$  at  $e = e^0$  is decreasing, that ensures that the new solution  $e^D < e^0$ .

For  $D > q_1 - w_1(e^0)$  the principal gets an expected payoff of zero inducing effort  $e^0$ . He can improve upon it inducing an effort  $e^D$  s.t.  $q_1 - w_1(e^D) > D > q_1 - w_1(e^0)$ . Hence a contract with  $w_1(e^D) < w_1(e^0)$  is preferred by  $P$ . But this, by Lemma 1, implies  $e^D < e^0$ . *Q.E.D.*

**Proof of Proposition 3:** Suppose the optimal contract with all-equity  $(w_0^0, w_1^0)$  is s.t.  $w_0^0 > q_0 - D$ , but  $D < \min\{q_0, q_1 - w_1^0\}$ . Denote by  $e^0$  the optimal effort chosen by the agent who signs this contract when  $D = 0$ . If  $D > q_0 - w_0^0$  the agent knows that if  $q_0$  realizes, he will get only  $q_0 - D$  since the principal is protected by limited liability. His (IC) constraint becomes

$$u(w_1^0) - u(q_0 - D) = \frac{c'(e)}{p'(e)}$$

and since  $\frac{c'(e)}{p'(e)}$  is increasing in  $e$  (Lemma 1), the agent is pushed to optimally choose a higher effort  $e^* > e^0$  ("incentive effect"). However, at  $e^*$  his participation constraint is not satisfied with the payment  $w_1^0$ :

$$p(e^*)u(w_1^0) + (1 - p(e^*))u(q_0 - D) - c(e^*) < p(e^*)u(w_1^*) + (1 - p(e^*))u(q_0 - D) - c(e^*) = \bar{U}$$

since by Lemma 1 (ii), higher efforts require higher payments in state  $q_1$ , so  $w_1^* > w_1^0$ . The agent would then refuse the contract  $(w_0^0, w_1^0)$ .

By Lemma 1 (ii), we can order the set of efforts in a simple way: if  $e < e' \Rightarrow w_0(e) > w_0(e')$  and  $w_1(e) < w_1(e')$ : hence, all efforts which require a  $w_0 > q_0 - D$  are not feasible with senior debt  $D$ . The result  $e^D \geq e^0$  is then immediate.

Since the marginal benefit of any  $e$  for the principal reduces to  $p'(e)(q_1 - D) < p'(e)(q_1 - q_0)$  the principal will optimally choose to implement the lower feasible action: so, by Lemma 1 (ii)  $P$  will propose  $(q_0 - D, w_1^D)$  s.t. both (IC) and (IR) are satisfied:

$$\begin{aligned} u(w_1^D) - u(q_0 - D) &= \frac{c'(e^D)}{p'(e^D)} \\ p(e^D)u(w_1^D) + (1 - p(e^D))u(q_0 - D) - c(e^D) &= \bar{U} \end{aligned}$$

If  $D > \min\{q_0, q_1 - w_1^0\}$  the agent knows that at most he will get zero in state  $q_0$ : in fact  $q_1 - w_1 > q_0 - w_0$  for all  $e$  (Corollary 2): even if the principal would like to reward him with lower power-incentives, she has no resources to do this in  $q_0$ . Thus, only  $e = \bar{e}$  can be implemented since any lower effort requires a positive payment in state  $q_0$ . Hence, either  $w_1(\bar{e}) + D < q_1$  so the principal is constrained to offer the maximum power-incentive contract  $(0, w_1(\bar{e}))$  or there is simply no contract satisfying both (IR) and (IC).

*Q.E.D.*

## 7 Appendix B

In case a UK firm is insolvent, it may enter either receivership or administration. In the UK, the former procedure is creditor-oriented and in most cases leads to full or partial liquidation of the firm's assets. The latter procedure is debtor-oriented, resembles the US Chapter 11-procedure and formalizes a workout with the aim of corporate survival (Franks and Torous (2002) and Franks and Nyborg (1996))<sup>26</sup>. When a firm is in receivership (and is bankrupt),

<sup>26</sup>This concise description of seniority of remuneration and leverage in the UK bankruptcy process is based on schedule 6 of the Insolvency Act (1986) and has benefited from discussions with Mr. Ralph Paterson (who frequently acts as a receiver for a major audit firm), to Mr. Nigel Boobier (who is a bankruptcy lawyer for Osborne & Clark) and to Prof. Julian Franks (London Business School).

the following claims have preferential status: payroll taxes, VAT (from the period before the receivership) and the arrears in wages (including accrued holiday pay and occupational pension fund contributions). It should be noted that the preferential status of the arrears in wages is limited to the gross amount of GBP 800 per employee (excluding directors). This modest amount was never adjusted – not even for inflation - since the 1986 Company Act. All other unpaid remuneration is not preferential and unsecured and hence will be paid out on a pro-rata basis like all other unsecured creditors. Thus, under a liquidation code, the remuneration claims based on salary and bonuses in arrears are junior with regard to all secured debt and is put at the same seniority level of all other unsecured claims.

When a firm enters receivership, a receiver is appointed by the party holding a floating charge debenture. Essentially, a debenture is a claim over specific assets and, in case of corporate default, crystallizes into a fixed or floating charge. The former charge applies directly to a specific asset like a building or vital machinery. The latter applies to the category of ‘floating assets’ like e.g. inventory. The holder of a debenture is usually a bank, an asset financier, a private individual or a major supplier who advanced money against inventory or against plant, property or equipment (ppe) or who extended the credit period. The receiver (appointed by the holder of the floating charge) can liquidate the assets of the floating charge (e.g. the inventory) and the proceeds of the sale (including the potential surplus), net of costs, will go to the preferential creditors (c.q. debenture holder with floating charge)<sup>27</sup>. The remainder of the assets will be sold by a liquidator on behalf of the unsecured claimholders. In this category belong the arrears in remuneration of managers. There are many cases in which top management can still claim remuneration (including bonuses) which is in arrears. First, instead of selling the floating charge assets, the receiver can continue the business if the proceeds of continuation are expected to exceed those of a liquidation. If this were the case, he can take the business out of the corporate shell and, if he retains the management, the managerial remuneration contracts (and the arrears remuneration and bonuses) may remain intact. This is called the ‘Transfer of undertakings protection of employment’ regulation (TUPE). Second, receiver can sell one line of business, to pay the secured creditors off. At that point, the receiver ceases to act (he only works on behalf of the holders of the floating charge) and the company is again in the hands of the directors whose remuneration contracts remain valuable. Third, an alternative to the creditor-oriented receivership process is the debtor-oriented ‘administration’ procedure. The court supervises a formal workout (financial and asset reorganization) aiming at the survival of the restructured firm. If the incumbent management is essential for the firm and is maintained after the implementation of the reorganization plan, the employment contracts and hence the claims of past remuneration will be honoured. The recent changes in bankruptcy legislation<sup>28</sup> are moving the UK procedures closer to a US-style ‘debtor-in-possession’ concept<sup>29</sup>. Fourth, as documented in section 1, top management is frequently able to safeguard bonuses (even if ‘performance’-related) by

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<sup>27</sup>If it is possible that the party holding a fixed charge will also appoint a receiver whose only aim is to sell secured fixed assets (from plant, property and equipment).

<sup>28</sup>See the Enterprise Act (2002), applicable since September 2003. The changes in administration are in the first place geared towards the survival of the company and, failing that, towards the survival of the business. If these two objectives cannot be realised, the charged assets will be disposed off.

<sup>29</sup>For a discussion of the US bankruptcy procedures and a comparison with the UK and Germany: see Franks and Torous (2002). The recent changes in bankruptcy legislation (of September 2003) are more geared towards the survival of the company (rather than the business) moving the UK procedures closer to the ‘debtor-in-possession’ concept of US Chapter 11.

timing the payment well or by signing new contracts with substantial severance payments even when the firm is very close to insolvency.

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