SUBJECTIVE AND OBJECTIVE PERFORMANCE EVALUATION*

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Abstract: We study executive compensation in an environment in which firms compete offering contingent contracts to managers with private information about their ability. We ask whether equilibrium executive compensation depends on subjective evaluations, i.e., on assessments made by the firm which are based on noncontractible information. We also allow for objective (i.e., contractible) performance measures and we depart from the rest of the literature on the topic by assuming that subjective evaluations are made before the uncertainty on the objective performance measures is resolved. We find that even in this case, equilibrium contracts ignore subjective evaluations regardless of their informativeness.

1 Introduction

Executive compensation is often based on performance measures which are imperfect for two fundamental reasons, noise and the distortion of incentives, (Baker, 2000). First, it is often difficult to know whether a good (bad) performance outcome was the result of high (low) effort and skill or simply the result of good (bad) luck. Second, distortion of incentives may result when managers can take actions that increase the performance measure without increasing firm value, e.g., "when firms reward for A while hoping for B".[1] In these situations several authors have advocated the use of subjective performance evaluation, i.e., compensation based on non-contractible measures, such as discretionary awards, to offset the dysfunctional incentives of objective performance measures, such as accounting earnings or stock prices.

According to Baker, Gibbons and Murphy (1994): "Many firms mitigate the effects of distortionary objective performance measures by augmenting objective measures with subjective assessments of performance. Investment bankers, for example, could be measured by several objective performance measures, such as the fees generated. Nonetheless, compensation at most investment banks relies heavily on subjective assessments of other factors"[2]. In a similar vein, Baiman and Rajan (1995) show that the use of contractible (objective) and non-contractible (subjective) information leads to Pareto improvements compared to a situation where only contractible information is used.

Similar ideas have also been very popular in the business community. Three McKinsey consultants, Axelrod, Handfield-Jones, and Michaels (2001) popularized the concept of "War for Talent", the idea that success requires the "talent mind-set": the "deep-seated belief that having better talent at all levels is how you outperform your competitors." The authors advocated finding the best and brightest and rewarding them in proportion to "talent" instead of their performance or seniority. As some critics have pointed out, however, Axelrod, Handfield-Jones, and Michaels (2001) did not define what should be understood by "talent", or how a company is to measure its employee's talent.[3]

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[1] Kerr (1975), page 769.

[2] Baker, Gibbons and Murphy (1994), page 1126.

[3] See for instance Gladwell (2002) and The Economist Global Executive (2003).

Empirical research also indicates that subjective evaluation is frequently used as a compensation tool. Murphy (1999) studied the performance measures used in the 177 annual incentive plans. He found that almost all companies (91%) rely on some measure of accounting profits. These measures (325 accounting-based measures) are either based on a single criterion (65%) or multiple criteria (35%). When performance measures are based on multiple criteria, discretionary awards are used in 60% of the cases. In other words, Murphy (1999) finds that subjective performance measures are mostly used as complement rather than as a substitute for objective performance measures. Ichniowski, Shaw and Prennushi (1995) find that in the steel industry the combination of explicit (group piece rates) and implicit (subjective bonus plan) contracts "produces substantially higher levels of productivity than do more "traditional" approaches"[4].

The goal of this paper is to study if and how compensation may be made dependent on subjective information, i.e., on information that, unlike objective performance measures, is nonverifiable by a third party and therefore noncontractible. We study an environment in which a manager has superior information about his ability to distinguish a profitable investment project from an unprofitable one. We start from a situation in which the manager's compensation can be made dependent on an objective but noisy performance measure and we ask how the picture is changed by a noisy signal on the manager's type that becomes exogenously and costlessly available after the manager has accepted employment, but before the final objective performance measure is available. We consider two different situations. One in which the noisy signal on the manager's ability is publicly observable (the case of contractible information) and one in which the signal is privately observed by the firm which then announces the signal it observed (the case of noncontractible information).

When the information on the manager's ability is contractible, the contract that the manager accepts in equilibrium gives him higher pay when the realization of the signal increases his relative likelihood of being good. When the information on the manager's ability is not contractible, his pay may be made dependent on the realization of the signal privately observed by the firm only if the firm has incentives to truthfully disclose its information. For this case we find that the contract that the manager accepts in equilibrium is independent of the realization of the signal and therefore that the information on the manager's type is ignored in equilibrium.

Our results clarify that it makes sense to base a manager's pay on information different from corporate performance measures, but also that it is important to distinguish between the case in which such information is verifiable and therefore contractible and the case in which it is nonverifiable and therefore noncontractible, because the establishment of incentives for the firm to disclose its information is incompatible with making an offer that makes an optimal use of information.

Our work starts from the observation that reneging on the part of the firm is an obvious problem when pay is based on subjective evaluations, i.e., on non-contractible information. The standard model of subjective performance evaluation studies situations in which a signal of performance is commonly observed by the contracting parties but is not verifiable by a third party and is therefore noncontractible. The existing literature has been mainly concerned with providing conditions under which an efficient use of this noncontractible information is made in the equilibrium of a repeated moral hazard relation.[5] Repeated interaction is used to ensure that the principal and the agent can credibly impose costs on each other when either of them deviates from the implicit contract. MacLeod (2003) analyzes a static model in which the agent receives a noisy signal of the performance measure privately observed by the principal. MacLeod's (2003) analysis starts from the observation that the literature on repeated moral hazard has clarified that it is possible to impose costs on parties who deviate from the equilibrium and therefore assumes that either party can impose costs on the other party. In other words MacLeod (2003) considers the possibility of inducing parties to reveal their private information by threatening costly conflicts if a deviation occurs.

Our work differs in a substantial way from the existing literature on subjective evaluation. The existing literature considers either situations in which subjective evaluation is the only source of information, or situations in which subjective evaluations are contemporaneous to the objective measures. This creates an obvious incentive for the principal to lie about its private information and announce the one that leads to the lowest wage payment.

Our paper starts from the observation that subjective evaluations are often obtained before objective

[4] Ichniowski, Shaw and Prennushi (1995), page 2.

[5] See Bull (1987), MacLeod and Malcomson (1989), Prendergast and Topel (1993), Pearce and Stacchetti (1998), and Levin (2004).

measure of performance become available. For instance, a board of directors of a corporation may develop an impression of the ability of its CEO, of his dedication, and of the suitability of his choices well before accounting or market valuation measures become available. When this is the case the problem of designing incentives for the principal to reveal its private information has a different structure, because announcing a signal does not to a sure payment to be made to the agent, but rather to the choice of a lottery of payments, with the final payment depending on the resolution of uncertainty on the objective performance measure.

Our paper is motivated by the belief that it is important to determine whether compensation may be made dependent on subjective evaluations made at such an interim stage. We do this by analyzing an adverse selection environment in which firms obtain noisy signals on the manager's likely type and we find that, even if the announcement of subjective evaluations are made before objective performance measures are available, subjective evaluations are ignored in equilibrium contracts. Our work, in other words, confirms the idea that subjective evaluations cannot be used unless the threat of appropriate conflicts or the threat of future punishments create incentives for firms to publicly reveal their private information.

Our work also relates to a strand of research that defends the idea that suppressing information on an agent's performance may enhance incentives and therefore output. In this line, Crémer (1995) studies a situation in which a principal receives a costless signal correlated with the agent's type after the latter has carried out production. Despite of the fact that the information is useful ex-post to screen the agent's type, Crémer shows that the principal finds it optimal to commit ex-ante to disregard this information, because this increases the incentives for the agent to exert high effort. Given that postcontractual information is used by the firm to unilaterally decide whether to retain or fire the agent, Cremer's (1995) result does not depend on whether the information is contractible or not. Our results are reminiscent of Cremer (1995) but our work differs because we consider a situation in which post-contractual information could be used to screen managers' types at the contracting stage and because we find that information is ignored in equilibrium only when it is noncontractible.

The paper is organized as follows. Section 2 presents the model and introduces the equilibrium concept used in the paper. In section 3 we propose two different benchmark situations in which (i) no post-contractual exogenous information on the manager is available or (ii) post-contractual exogenous information on the manager becomes available but is contractible. Section 4 turns to the analysis of the situation in which noncontractible postcontractual information on the manager becomes available and contains our main result that indicates that subjective evaluations are ignored in equilibrium. Section 5 concludes.

2 The Model

Two risk neutral firms compete for a single manager of unknown ability. If hired, a manager has to decide whether to invest in a unitary cost given project, I, or not, N. If investment is carried it leads to success (revenue equal to s) with probability p and failure (revenue equal to 0) with probability $1-p$. In case of success, therefore, profit (gross of executive pay) is $s-1>0$ and in case of failure it is -1. If the manager does not invest, the realization of profit is 0 with probability 1. Without loss of generality we assume that $ps-1>0$, i.e., that investing is the ex ante efficient decision.[6] The manager has an innate ability to forecast the realization of investment. For simplicity we assume that only two types of manager exist, good and bad, $\tau \in \{G, B\}$ and that the good manager that is employed by a firm is able to *perfectly forecast the realization of investment*, whereas a bad manager is unable to improve his forecast beyond the prior probability distributions. The manager knows his type but it is common knowledge that firms believe that he is good with probability μ and bad with probability $1-\mu$. The manager receives a signal $\rho \in \{V, L, H\}$ on decision I. The bad manager receives signal V, the void signal, with probability 1 and the good manager receives signals L or H, the low and the high signal, with probabilities $1-p$ and p. The probability of decision I having the high return ($s>0$) conditional on the received signal is

$$\Pr(r=s \mid \rho, I) = \begin{cases} p & \text{if } \rho = V \\ 0 & \text{if } \rho = L \\ 1 & \text{if } \rho = H \end{cases} .$$

In other words, while signals H and L ensure, respectively, the success or the failure of a given operating decision, the void signal, V, provides no additional information and the conditional probability of success

[6] Qualitatively similar results are obtained in the case in which $ps-1<0$.

is, therefore, equal to the prior. Notice that a talented manager is often thought as being able to generate higher expected returns, i.e., as being able to come up with better ideas. In contrast to this, we refer to managerial ability as the ability to forecast the realizations of different operating decisions. The distributions of returns of the different operating decisions do not depend on the ability of the manager but a good manager has a superior ability to forecast their realizations. The manager maximizes expected utility of wage payments. We denote the manager's Bernoulli utility function by $U(w)$. For the sake of simplicity we assume that $U(.)$ is twice continuously differentiable, that $U'(.) > 0$, and that $U''(w) < 0$.

At the beginning of the game the manager privately learns his type. Without observing the manager's type, the two firms offer contracts to the manager. A contract specifies that if the manager accepts it, he will receive a nonnegative payment from the firm for each subsequent public history of the game. If the manager accepts the offer, he privately observes signal ρ on the investment and decides whether to invest or not. An action profile for the manager is a vector $i = (i_V, i_L, i_H) \in \{I, N\}^3$ where i_V, i_L, and i_H denote the decision to take when the signal received by the manager is respectively V, L, or H. We assume that the manager's action is publicly observable and so is the ensuing realization of profit. In other words, we assume that at the end of the game a realization $P \in \{F, S, N\}$ is publicly observed, where F and S indicate a failure (revenue equal to 0) or a success (revenue equal to s).

The main objective of the paper is to study whether executive pay should also be made directly contingent on signals on the type of the manager. For this reason we assume that after the manager is hired but before P is observed, a signal on the manager's type, $\alpha \in \{\underline{\alpha}, \bar{\alpha}\}$, is observed, with

$$\Pr(\overline{\alpha}|\tau) = \begin{cases} \gamma & \text{if } \tau = G \\ 1-\gamma & \text{if } \tau = B \end{cases}$$

and $\gamma \in \left[\frac{1}{2}, 1\right]$. We will be interested in two cases:

1. Case $\mathcal{C}$ (contractible signal): Signal α is publicly observed.
2. Case $\mathcal{N}$ (noncontractible signal): Signal α is privately observed by the firm and the firm publicly announces that it received signal $\hat{\alpha} \in \{\underline{\alpha}, \bar{\alpha}\}$.

The labels for the two cases refer to the fact because executive pay may be conditional only on the public history of the game following acceptance of the contract, in case $\mathcal{C}$ the signal is contractible but in case $\mathcal{N}$ it is not. Notice that the standard assumption in the literature on subjective evaluation is that signals are public but nonverifiable. This is useful in a repeated setting in which a public signal makes it easier to trigger punishments against parties that deviate from the equilibrium. Because we ignore dynamic considerations, the distinction between the case of a public but nonverifiable signal and a private signal is immaterial and we stick to the second formulation.

A contract specifies that, if the manager accepts it, he will receive a non negative payment from the firm for each subsequent public history of the game, i.e., for each $(P, \alpha) \in \{N, F, S\} \times \{\underline{\alpha}, \bar{\alpha}\}$ in case $\mathcal{C}$ and for each $(P, \hat{\alpha}) \in \{N, F, S\} \times \{\underline{\alpha}, \overline{\alpha}\}$ in case N. To simplify notation we will denote a contract by

$$w = (\underline{w}, \overline{w}) = (\underline{w}_N, \underline{w}_F, \underline{w}_S, \overline{w}_N, \overline{w}_F, \overline{w}_S) \in \Re^6_+$$

where $\underline{w}_P$ (respectively, $\overline{w}_P$) denotes the non negative payment to the manager when the outcome of the investment process is $P \in \{N, F, S\}$ and when $\alpha = \underline{\alpha}$ in case $\mathcal{C}$ and $\hat{\alpha} = \underline{\alpha}$ in case $\mathcal{N}$ (respectively, when $\alpha = \overline{\alpha}$ in case $\mathcal{C}$ and $\hat{\alpha} = \overline{\alpha}$ in case $\mathcal{N}$).

We assume that every manager is offered a finite set of contracts $w \in \Re^6_+$ by each firm and chooses one contract (if any) out of them. We finally make the assumption that a firm's reservation level is $\tilde{\pi} = ps - 1$.

In the following we summarize the extensive form of the game.

1. *Nature* chooses the type of the manager, G with probability μ and B with probability $1 - \mu$.
2. The *manager* privately observes his type.
3. Without observing nature's choices, each of the two *firms* offers the manager a finite set of contracts, each of them of the form
$$(\underline{w}, \overline{w}) = (\underline{w}_N, \underline{w}_F, \underline{w}_S, \overline{w}_N, \overline{w}_F, \overline{w}_S) \in \Re^6_+$$

4. The *manager* either accepts an offer or rejects them all.

   (a) If the manager *rejects* all offers the game ends. The manager receives a salary of 0 and each of the firms receives $\tilde{\pi}$.

   (b) If the manager *accepts* an offer, he is hired. The firm whose offers were not accepted receives $\tilde{\pi}$.

      i. Nature chooses the realization of the investment project, S with probability p and F with probability $1-p$.

      ii. The manager receives a private signal $\rho \in \{V, L, H\}$ on the investment project.

      iii. Nature chooses the realization of signal α.

         - Case $\mathcal{C}$: The realization of α is publicly observed.
         - Case $\mathcal{N}$: The realization of α is privately observed by the firm; The firm publicly announces that it received signal $\hat{\alpha}$.

      iv. The manager decides whether to invest or not, $i \in \{I, N\}$.

      v. The manager's investment decision and the return realization in case of investment are publicly observed, $P \in \{N, F, S\}$.

      vi. The firm pays the manager salary w_σ, where

         - Case $\mathcal{C}$: $\sigma = (P, \alpha) \in \{N, F, S\} \times \{\underline{\alpha}, \bar{\alpha}\}$
         - Case $\mathcal{N}$: $\sigma = (P, \hat{\alpha}) \in \{N, F, S\} \times \{\underline{\alpha}, \overline{\alpha}\}$.

It is useful to introduce notation for the strategy of the manager following his acceptance of a contract w. We denote such strategy as

$$i(w) = \left(\underline{i}(w), \bar{i}(w)\right) = \left(\underline{i}_V(w), \underline{i}_L(w), \underline{i}_H(w), \bar{i}_V(w), \bar{i}_L(w), \bar{i}_H(w)\right) \in \{I, N\}^6$$

where $\underline{i}_\sigma$ (respectively, $\bar{i}_\sigma$) denotes the manager's investment decision conditional on private signal $\sigma \in \{V, L, H\}$ and on $\alpha = \underline{\alpha}$ in case $\mathcal{C}$ and $\hat{\alpha} = \underline{\alpha}$ in case $\mathcal{N}$ (respectively, on $\alpha = \overline{\alpha}$ in case $\mathcal{C}$, $\hat{\alpha} = \overline{\alpha}$ in case $\mathcal{N}$). Given that no additional use of notation will be made, we choose not to provide a full description of strategies and strategy spaces. Also, for notational convenience, we will occasionally omit arguments whenever this cannot cause any confusion.

The equilibrium concept we use is subgame perfect Nash equilibrium. To ensure the existence of such an equilibrium we will assume the following standard tie-breaking rules: (i) whenever indifferent between investing or not, the manager plays the action with the higher expected profit; (ii) whenever indifferent between accepting a contract or rejecting all, the manager accepts a contract.

3 The Benchmarks

In this section we analyze two benchmark situations. In the first, no post-contractual information on the manager's type is available. In the second, post-contractual information on the manager's type becomes available and is contractible.

3.1 No information on managers

When no signal on the manager's type is observed, contracts specify payments to the manager conditional only on whether the manager invested or not and in case of investment whether the realization of the investment project was success or failure. The equilibrium characterization for such a situation is described in Caruana and Celentani (2002)[7]. We reproduce the result and comment on it.

Proposition 1 (Caruana and Celentani, 2002, Proposition 1) *In all equilibria:*

[7] Caruana and Celentani (2002) studies managerial career concerns and Proposition 1 characterizes contracts accepted in equilibrium in the second period of a two-period model. The emphasis in Caruana and Celentani (2002) is on managerial reputational concerns and their effects on executive compensation and operating decisions, rather than on the use of information in executive contracts as in the present paper.

1. *The unique contract which is accepted by both types of managers is w with:*

$$w_N = \frac{\mu(1-p)}{1+\mu(1-p)}$$
$$w_F = 0$$
$$w_S = \frac{\mu(1-p)}{p[1+\mu(1-p)]}$$

2. *The investment action profile played by the manager on the equilibrium path is efficient.*

Proposition 1 analyzes the impact of asymmetric information on equilibrium contracts and shows that they are (i) *Pooling*: A manager that is believed to be good with probability μ accepts offer w regardless of whether he is good or bad; (ii) *Efficient*: On the equilibrium path the manager plays the efficient investment action profile.

To see why equilibria are efficient, note that competition for managers tends to lead to surplus maximization (efficiency).

To see that equilibria are pooling it is necessary to show that offers that are more attractive to a good manager are not profitable deviations for the firms. The following argument will show that this is the case because, once the incentive compatibility constraints are kept into account, the indifference curves of the two types of managers do not intersect, and offers that are preferred by a good manager are also preferred by a bad manager.

Without loss of generality assume first that $w_F = 0$[8] and consider pairs $(w_N, w_S) \in \Re^2_+$. Figure 1 depicts the indifference curves for the good and the bad manager in that space keeping into account their incentive compatibility constraints. Given that the incentives are simply determined by explicit compensation, it is easy to see that so long as $w_S \geq w_N$ (i.e., below the 45 degree line) the typical indifference curve for the good manager is the negatively sloped line represented as U^G as a good manager's expected utility is $pw_S + (1-p)w_N$. Note that if $w_S < w_N$ the manager would always refrain from investing and his utility would be w_N. The typical indifference curve for the bad manager instead is like the kinked line represented as U^B: above line (IC) (i.e., whenever $pw_S < w_N$) a bad manager chooses not to invest and gets w_N, whereas below line (IC) (i.e., whenever $pw_S \geq w_N$) he chooses to invest and gets pw_S.

Since it is easy to check that in equilibrium managers fully extract their expected value (and firms only make $ps - 1$ in expected terms), in Figure 1 we represent the condition ensuring this as the broken double line (FE). Given this, it is easy to verify that any contract on (FE) but different from the intersection of lines (IC) and the rightmost part of (FE) is such that a profitable deviation for a firm exists (attracting only good managers), whereas no such deviation exists for the contract at that intersection. Since it is easy to verify that this last contract is the one mentioned in Proposition 1, the result follows.

3.2 Contractible Information on Manager

In this section we analyze Case $\mathcal{C}$.

PROPOSITION 2 *In case $\mathcal{C}$ in all equilibria*

1. *The unique contract which is accepted with positive probability by both types of managers is w such that:*

$$(\overline{w}_N, \overline{w}_F, \overline{w}_S, \underline{w}_N, \underline{w}_F, \underline{w}_S) = \left(\frac{\mu(1-p)}{\mu\gamma(2-p)+(1-\mu)(1-\gamma)}, 0, \frac{\mu(1-p)}{p[\mu\gamma(2-p)+(1-\mu)(1-\gamma)]}, 0, 0, 0\right).$$

2. *The investment action profile played by the manager on the equilibrium path is efficient.*

[8] By this we mean that (i) in equilibrium $w_F = 0$ has to hold and (ii) if no profitable deviation with $w_F = 0$ from a proposed equilibrium exists, then no profitable deviation exists at all.

PROOF. Appendix

Proposition 2 analyzes the impact of exogenous noisy contractible information about managers ability on equilibrium contracts and shows that they are (i) *Pooling:* Both types of manager accept the same contract; (ii) *Efficient*: The manager plays the efficient investment action profile. (iii) *Talent based:* The salary payment made to the manager depends not only on the firm's performance, $P \in \{N, F, S\}$, but also on the public signal $\alpha \in \{\underline{\alpha}, \bar{\alpha}\}$ on the manager's type.

Notice first that equilibria are pooling and efficient for reasons similar to the ones mentioned in the discussion of Proposition 1. Equilibria are efficient because competition for managers tends to lead to surplus maximization and are pooling because the incentive compatibility constraints imply that the indifference curves of the two types of managers do not intersect, and offers that are preferred by a good manager are also preferred by a bad manager.

We now want to clarify why equilibria are also talent based. Recall first that the public signal is observed before the manager takes the decision of investing or not. This means that it is necessary to analyze the preferences over contracts of the two types of manager after each of the two realizations of the public signal. The following discussion clarifies that, conditional on each realization of the public signal, the result is similar to Proposition 1 in the sense that the contracts accepted in equilibrium are such that the incentive compatibility condition for the bad manager is binding.

- Consider the situation after the realization of public signal was $\overline{\alpha}$. Assume without loss of generality that[9]

$$\overline{w}_F = 0 \tag{1}$$

and consider pairs $(\overline{w}_S, \overline{w}_N) \in \Re^2_+$. In Figure 2(a) we depict in a way similar to Proposition 1 the indifference curves and the full extraction conditions keeping into account the incentive compatibility constraints. Given that the incentives are determined by explicit compensation, it is easy to see that so long as $\overline{w}_S \geq \overline{w}_N$ the typical indifference curve for the good manager in Figure 2(a) is the negatively sloped line represented as $\overline{U}^G$ as a good manager's expected utility is $p\overline{w}_S + (1-p)\,\overline{w}_N$. If $\overline{w}_S < \overline{w}_N$ the manager would always refrains from investing and his utility would be $\overline{w}_N$. The indifference curve for the bad manager is the kinked line represented by $\overline{U}^B$: above line $\left(\overline{IC}\right)$ (i.e., whenever $p\overline{w}_S < \overline{w}_N$) a bad manager chooses not to invest and gets $\overline{w}_N$, whereas below line $\left(\overline{IC}\right)$ (i.e., whenever $p\overline{w}_S \geq \overline{w}_N$) he chooses to invest and gets $p\overline{w}_S$. In Figure 2(a) we also represent the set of contracts that generate the same expected profit for the firm conditional on public signal $\overline{\alpha}$. The set is given by the broken line $\left(\overline{\Pi}\right)$. Given this, it is easy to verify that any contract on $\left(\overline{\Pi}\right)$ but different from the intersection of lines $\left(\overline{IC}\right)$ and the rightmost part of $\left(\overline{\Pi}\right)$ is such that there exists a profitable deviation which consists of offering a contract that is accepted only by the good manager, whereas no such deviation exists for the contract at that intersection. In equilibrium we have that

$$p\overline{w}_S = \overline{w}_N. \tag{2}$$

- Consider now the situation after the realization of public signal was $\underline{\alpha}$. Assume without loss of generality that[10]

$$\underline{w}_F = 0 \tag{3}$$

and consider pairs $(\underline{w}_S, \underline{w}_N) \in \Re^2_+$. Figure 2(b) is similar to Figure 2(a) and the same type of result applies: All contracts different from the one on the intersection between $(\underline{IC})$ and $(\underline{\Pi})$ are such that a deviation exists that generates an expected profit conditional on the public signal being $\underline{\alpha}$ that is greater than $\underline{\Pi}$. As before, we find that in equilibrium

$$p\underline{w}_S = \underline{w}_N. \tag{4}$$

[9] By this we mean that (i) in equilibrium $\overline{w}_F = 0$ has to hold and (ii) if no profitable deviation with $\overline{w}_F = 0$ from a proposed equilibrium exists, then no profitable deviation exists at all.

[10] Also here we mean that (i) in equilibrium $\underline{w}_F = 0$ has to hold and (ii) if no profitable deviation with $\underline{w}_F = 0$ from a proposed equilibrium exists, then no profitable deviation exists at all.

The previous discussion clarifies that the contracts accepted in equilibrium have to satisfy (1)-(4). Making use of this we can write the expected utility of the two types of manager over the contracts satisfying these constraints as a function of $\underline{w}_N$ and $\overline{w}_N$ only:

$$EU(w;\tau=G)=\gamma\left[p\overline{w}_S+(1-p)\overline{w}_N\right]+(1-\gamma)\left[p\underline{w}_S+(1-p)\underline{w}_N\right]=\gamma(2-p)\overline{w}_N+(1-\gamma)(2-p)\underline{w}_N;$$
$$EU(w;\tau=B)=\gamma p\underline{w}_S+(1-\gamma)p\overline{w}_S=\gamma\underline{w}_N+(1-\gamma)\overline{w}_N.$$

Given that

$$MRS^G_{\underline{w}_N,\overline{w}_N}=-\frac{\partial U^G/\partial\underline{w}_N}{\partial U^G/\partial\overline{w}_N}=-\frac{1-\gamma}{\gamma}>MRS^B_{\underline{w}_N,\overline{w}_N}=-\frac{\partial U^B/\partial\underline{w}_N}{\partial U^B/\partial\overline{w}_N}=-\frac{\gamma}{1-\gamma}$$

we have that a good manager is more willing than a bad manager to trade compensation in the event of $(P,\alpha)=(N,\bar{\alpha})$ against compensation in the event of $(P,\alpha)=(N,\underline{\alpha})$. This means that competition forces firms to offer a contract for the good manager with higher compensation in the first event than in the second. This implies that for all $\underline{w}_N>0$ there exists a profitable deviation for a firm offering a contract which is strictly preferred by the good manager only. This implies that $\underline{w}_N=0$. From (4) we have that $\underline{w}_S=0$. Combining this with the zero profit condition provides the result of Proposition 2.

The previous discussion may be summarized by saying that Proposition 2 arises for the following two reasons:

- *The likelihood of no investment relative to successful investment is higher for the good manager than for the bad.* This implies that a contract accepted in equilibrium has to be such that no firm can take advantage of this difference in preferences to deviate and make an offer that is preferred only by the good manager and that generate expected profits above the firms' reservation levels. In the simplified environment we consider in this paper where both types of the manager are risk-neutral, such profitable deviations cease to exist only when the salaries in case of no investment are set as high as possible. The incentive compatibility constraints for the bad manager require that his expected salary under no investment is no higher than his expected salary when he invests (his efficient action) and therefore force (2) and (4).

- *The likelihood of a high public signal relative to a low public signal is higher for the good manager than for the bad.* This implies that a good manager is more willing than the bad manager to trade compensation in the event of a high public signal against compensation in the event of a low public signal. As in the previous argument, this implies that in our simplified environment with a risk neutral manager, profitable deviations for firms cease to exist only when the manager's compensation in the event of a high public signal are as high as possible. The nonnegativity constraints on the salaries imply that this happens when salaries following the low public signal, $\alpha=\underline{\alpha}$, are identically equal to 0.

Before concluding it is also worth mentioning that the qualitative result of Proposition 2 does not depend on the informativeness of signal α in the sense that pay is equal to 0 with a low public signal regardless of γ and that the ratio between $\overline{w}_S$ and $\overline{w}_N$ is independent of γ.

4 Subjective Evaluations: Noncontractible Information

We now consider Case $\mathcal{N}$ in which the information the firm receives is noncontractible and in which, therefore, executive pay may be made contingent on the firm's public announcement of the signal it privately received but not on signal itself. Recall also that the firm may lie about the signal it received and it will if it finds profitable to do so.

Proposition 3 *In all equilibria*

1. *The unique contract which is accepted with positive probability by both types of managers is w such that:*

$$(\overline{w}_N,\overline{w}_F,\overline{w}_S,\underline{w}_N,\underline{w}_F,\underline{w}_S)=\left(\frac{\mu(1-p)}{1+\mu(1-p)},0,\frac{\mu(1-p)}{p[1+\mu(1-p)]},\frac{\mu(1-p)}{1+\mu(1-p)},0,\frac{\mu(1-p)}{p[1+\mu(1-p)]}\right).$$

2. The investment action profile played by the manager on the equilibrium path is efficient.

PROOF. Appendix.

The results of Proposition 3 are best understood if contrasted with the results of Propositions 1 and 2. Proposition 3 states that as in the case with no information (the benchmark case of Proposition 1) and in the case with contractible information (case $\mathcal{C}$ in Proposition 2) when the signal on the manager is noncontractible (case $\mathcal{N}$), the contracts accepted in equilibrium are (i) *Pooling:* Both types of manager accept the same contract; (ii) *Efficient*: The manager plays the efficient investment action profile.

Unlike the case with contractible information (case $\mathcal{C}$) Proposition 3 shows that when the signal on the manager is noncontractible (case N), the contracts accepted in equilibrium are (iii) *Independent of subjective evaluations:* The salary payment made to the manager depends only on the firm's performance, $P \in \{N, F, S\}$, but not on $\hat{\alpha}$, the public announcement the firm makes of α, the signal on the manager's type it privately received. Notice that given that contracts accepted in equilibrium are independent of the firm's announcements they are also independent of the firm's private signal and they therefore generate the same distribution over pay as in the benchmark case of Proposition 1 in which no information, neither private nor public was available.

To understand the result of Proposition 3 it is useful to notice that the firm will publicly reveal the information it privately received so long as it finds it profitable to do so, given its assessment of the manager's likely type conditional on the private signal it received. A necessary condition for that to be the case is that the salaries to be paid following a given announcement are not all higher than the salaries to be paid following the other announcement. To see why, suppose that the firm knows that by making an announcement, say $\hat{\alpha} = \overline{\alpha}$, it will have to pay salaries that dominate the salaries following the other announcement, $\hat{\alpha} = \underline{\alpha}$, ($\overline{w} > \underline{w}$, i.e., $\overline{w}_P \geq \underline{w}_P$, $P \in \{N, F, S\}$, with at least one strict inequality). In this case the firm prefers to announce $\hat{\alpha} = \underline{\alpha}$, regardless of the signal it received. This clarifies that a contract may be implicitly dependent on the private signal only of it creates incentives for the firm to publicly reveal this information and a necessary condition for this to happen is that no salary vector following each of the two public announcements dominates the salary vector following the other announcement.

The previous discussion may be summarized by saying that Proposition 3 arises from the following three forces:

- *The likelihood of no investment relative to successful investment is higher for the good manager than for the bad.* As in the benchmark case and in the case with contractible information, this implies that profitable deviations for firms cease to exist only when the salaries in case of no investment are set as high as possible. The incentive compatibility constraints for the bad manager require that his expected salary under no investment is no higher than his expected salary when he invests (his efficient action) and therefore force (2) and (4).

- *The likelihood of a high private signal relative to a low private signal is higher for the good manager than for the bad.* Suppose that the firm publicly revealed its private signal about the manager. In such a situation a good manager would be more willing than the bad manager to trade compensation in the event of a high public announcement (and therefore a high private signal) against compensation in the event of a low public announcement (and therefore a low private signal). In a way similar to the case with contractible information, in the present case profitable deviations for firms cease to exist only when the manager's compensation in the event of a high public announcement are as high as possible. The nonnegativity constraints on the salaries imply that this happens when salaries following the low public announcement, $\hat{\alpha} = \overline{\alpha}$, are identically equal to 0.

- *The firm publicly announces the signal it received privately only if it finds it profitable to do so.* From the discussion above we concluded that a necessary condition for this to happen is that neither $\overline{w} > \underline{w}$ nor $\overline{w} < \underline{w}$.

The interaction of the last two forces implies that in equilibrium $\overline{w} = \underline{w}$. To see why suppose first that in equilibrium both types of manager accept a contract $(\overline{w}, \underline{w})$, with the property that the firm publicly announces the signal it privately received. From above we know that neither $\overline{w} > \underline{w}$ nor $\overline{w} < \underline{w}$ can hold. In particular the fact that $\overline{w} > \underline{w}$ does not hold, implies that there exists a realization of the investment

decision process, $P \in \{N, F, S\}$, such that $\overline{w}_P < \underline{w}_P$. Notice that because the likelihood of a high private signal relative to a low private signal is higher for the good manager than for the bad, $\overline{w}_P < \underline{w}_P$ implies that a profitable deviation for a firm exists, and a contradiction arises. This means that in equilibrium $\overline{w} = \underline{w}$. In other words, incentives for the firm to reveal a high public signal require that some of the salary following such announcement is lower than the corresponding salary following the low announcement, but, if that is the case, deviations exist for the firms that attract only the good manager and lead to a positive expected profit.

Notice that a similar argument may be used to show that providing incentives for the firm to publicly reveal the signal it privately received and make sure that the different likelihoods of no investment relative to investment with success for the two types do not imply that profitable deviations exist at the contracting stage. Making sure that such profitable opportunities do not exist at the contracting stage forces (2) and (4) to hold and this contrasts with the necessary requirement for truthful revelation of the private signal, that neither $\overline{w} > \underline{w}$ nor $\overline{w} < \underline{w}$ hold unless $\overline{w} = \underline{w}$. We have chosen to present the other argument because the differences in the likelihood of one profit realization (0, in the case of no investment) relative to another ($s - 1$, in the case of a successful investment) and the fact the incentive compatibility constraints impose restrictions on the salaries associated to these two events seems specific to the model we present. But the assumption that a good manager is more likely to generate a high signal than a bad manager seems a generally palatable conjecture for any model that studies the impact of information on managers' type on their compensation. In this sense our arguments may be applied to a more general setting.

A useful way of assessing the implications of our results is to notice that the equilibrium contracts described in Proposition 3 are independent of γ, the informativeness of signal α. In other words, equilibrium compensation ignores costless postcontractual information on the manager's type not only when it is very noisy but also when such information is arbitrarily precise. It is also useful to underline that we analyze a situation in which a pooling equilibrium arises in the sense that the manager accepts a given contract regardless of his type. This is important because a signal on the manager's type that becomes available after the manager has accepted an employment contract may be of interest only if the manager's acceptance strategy does not reveal his type, or in other words only in a pooling equilibrium.

5 Conclusion

In this paper we study information on the ability of a manager that becomes costlessly available after the latter has accepted an employment contract but before contractible performance measures become available. In particular we are interested in whether contracts accepted in equilibrium are based on such information or disregard it. We perform this analysis in a context in which two firms compete for a manager who has superior information about his own ability. To center our attention on a situation in which the information on the manager's type is socially valuable we analyze a situation in which equilibria are pooling and therefore uncertainty as to the likely type of the manager persists after the manager has accepted a contract. We find that when the exogenous signal on the manager's ability is contractible, contracts accepted in equilibrium base executive pay on the signal. But when the signal on the manager's type is non-contractible, the contract accepted in equilibrium makes pay independent of subjective evaluations and equilibrium pay is therefore independent of the signal on the manager's ability.

This result is shown to arise because it is impossible to provide for firms to publicly announce the signal on the manager's type they privately observe and at the same time make sure that no profitable deviations exist for firms at the contracting stage. To exhaust profitable deviations at the contracting stage requires offering a contract that makes pay in the event of a high public announcement higher than in the event of a low public announcement, because the good manager has a higher likelihood of a high signal relative to a low signal than the bad manager. But this implies that the firm has incentives to always announce that it received the low signal rather than the high one. The result is that the only way to provide the firm with incentives to reveal its information is to make pay independent of the firm's announcements and therefore of the signal on the manager's type.

Our findings confirm the results on the literature on subjective performance evaluation that has argued that noncontractible information may be used only when deviations are made unattractive by the threat of future punishments or of extra contractual conflicts. Our main contribution is to show that this is true even in a realistic setting in which evolving informal evaluations take place before contractible (e.g., accounting

or financial) measures of performance are available.

Our results contrast with Holmström's informativeness principle (1979) because they show that information that may be valuable to assess a manager's likely type and therefore the strategy he plays is not used in contracting. Our findings are also reminiscent of Cremer (1995) who finds that socially valuable information is disregarded in optimal contracting. While Cremer (1995), however, finds that ignoring a signal on an agent may be a cheap way to provide the agent with incentives to work hard, we center our attention on the incentives that the receiver of information (the firm) has to publicly disclose it and find that in equilibrium these incentives only exist if contracts are independent of such disclosures of information.

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A Appendix

A.1 Proof of Proposition 2

We will prove a sequence of claims. We omit the proofs of the first four claims because they follow easily from the proof of Proposition 1 in Caruana and Celentani (2002).

1. *No separating equilibrium exists.*

2. *In equilibrium firms' expected profits are $ps - 1$.*

3. *The Pareto optimal investment strategy is played on the equilibrium path.*

4. *In equilibrium both types of manager accept a contract w such that $\overline{w}_F = \underline{w}_F = 0$.*

5. *No equilibrium can exist in which both managers accept an offer different from*

$$(\underline{w}_N, \underline{w}_F, \underline{w}_S, \overline{w}_N, \overline{w}_F, \overline{w}_S,) = \left(\underline{w}_N, 0, \frac{\underline{w}_N}{p}, \overline{w}_N, 0, \frac{\overline{w}_N}{p}\right) \tag{5}$$

with

$$[\mu\gamma(2-p) + (1-\mu)(1-\gamma)]\,\overline{w}_N + [\mu(1-\gamma)(2-p) + (1-\mu)\gamma]\,\underline{w}_N = \mu(1-p). \tag{6}$$

From 2-4 we know that if a pooling equilibrium exists, it is such that the manager plays the efficient investment action profile, firms' expected profits are $ps - 1$ and the accepted offer is such that $\overline{w}_F = \underline{w}_F = 0$. By 3 we have that $p\overline{w}_S \geq \overline{w}_N$. Suppose now that the offer accepted in equilibrium by both types of managers is such that $p\overline{w}_S > \overline{w}_N$ and let $w = (\underline{w}_N, \underline{w}_F, \underline{w}_S, \overline{w}_N, \overline{w}_F, \overline{w}_S,)$ denote such an offer. Consider another offer $\widetilde{w} = (\underline{w}_N, 0, \underline{w}_S, \overline{w}_N + \alpha, 0, \overline{w}_S - \varepsilon)$. It is easy to see that there exist $\alpha > 0$ and $\varepsilon > 0$ such that only the good manager strictly prefers $\widetilde{w}$ to w and that gives the firm a profit strictly higher than $ps - 1$ when it is accepted only by the good manager. Given this would constitute a profitable deviation we conclude that $p\overline{w}_S = \overline{w}_N$. A similar argument shows that $p\underline{w}_S = \underline{w}_N$ and proves that the contract accepted in equilibrium has to satisfy (5). Condition (6) follows from 2.

6. *In all equilibria both types of managers accept a contract w such that*

$$(\underline{w}_N, \underline{w}_F, \underline{w}_S, \overline{w}_N, \overline{w}_F, \overline{w}_S) = \left(0, 0, 0, \frac{\mu(1-p)}{\mu\gamma(2-p)+(1-\mu)(1-\gamma)}, 0, \frac{\mu(1-p)}{p[\mu\gamma(2-p)+(1-\mu)(1-\gamma)]}\right). \tag{7}$$

An equilibrium exists.

Suppose that the offer accepted in equilibrium by both types of managers,

$$w = (\underline{w}_N, \underline{w}_F, \underline{w}_S, \overline{w}_N, \overline{w}_F, \overline{w}_S),$$

is such that $\underline{w}_N > 0$. Consider another offer

$$\widetilde{w} = \left(0, 0, 0, \overline{w}_N + \varepsilon, 0, \frac{\overline{w}_N + \varepsilon}{p}\right)$$

Under w and $\widetilde{w}$ the expected salary payments to the good and the bad manager are, respectively

$$E[w|\tau] = \begin{cases} \gamma(2-p)\,\overline{w}_N + (1-\gamma)(2-p)\,\underline{w}_N & \text{if } \tau = G \\ (1-\gamma)\,\overline{w}_N + \gamma\underline{w}_N & \text{if } \tau = B \end{cases}$$

$$E[\widetilde{w}|\tau] = \begin{cases} \gamma(2-p)(\overline{w}_N + \varepsilon) & \text{if } \tau = G \\ (1-\gamma)(\overline{w}_N + \varepsilon) & \text{if } \tau = B \end{cases}.$$

Notice that

$$E[\tilde{w}|G] > E[w|G] \Longleftrightarrow \varepsilon > \frac{(1-\gamma)}{\gamma}\underline{w}_N$$
$$E[\tilde{w}|B] < E[w|B] \Longleftrightarrow \varepsilon < \frac{\gamma}{(1-\gamma)}\underline{w}_N$$

and therefore for all $\varepsilon \in \left(\frac{(1-\gamma)}{\gamma}\underline{w}_N, \frac{\gamma}{(1-\gamma)}\underline{w}_N\right)$, $\tilde{w}$ would be accepted only by the good manager and would therefore constitute a profitable deviation.

Suppose now that the two firms offer the contract in (7). Consider Figure 2(a) and notice that all contracts that are preferred by the good manager are also preferred by the bad manager and are such that the offering firm makes an expected profit strictly less than $ps - 1$ (because the contracts preferred by the good manager all lie above $\overline{\Pi}$, the set of contracts that guarantee an expected profit of $ps - 1$ when accepted by both types). This means that no profitable deviation exists for either firm that is accepted by both types. Consider now deviations consisting of two contracts, w^G and w^B, each one preferred to w by each of the two types. Notice that if type G prefers a contract w^G to w, then

(a) Conditional on only type G accepting the contract, the expected wage payment is higher under w^G than under w (because the manager is risk neutral, the isoprofit line conditional on only type G accepting the contract coincides with G's indifference curve).

(b) $\overline{w}_S^G > \overline{w}_S$.

By 6b, for type B to prefer w^B to both w^G and w it is necessary that $\overline{w}_S^B > \overline{w}_S$. This means that conditional on only type B accepting the contract, the expected wage payment is higher under w^B than under w(because the manager is risk neutral, the isoprofit line conditional on only type B accepting the contract coincides with B's indifference curve). This together with 6a implies that no profitable deviation of this type exists and that an equilibrium exists in which both types accept the contract in (7).

A.2 Proof of Proposition 3

We prove Proposition 3 through a sequence of claims. We omit the proof of the first five claims because they are identical to the corresponding claims of Proposition 2. In claim 6 we analyze the implications of imposing incentive compatibility constraints for the employing firm to truthfully reveal the signal on the manager's ability it received. Finally in claim 7, we analyze the implications of these constraints on the contract accepted in equilibrium.

1. *No separating equilibrium exists.*
2. *In equilibrium firms' expected profits are $ps - 1$.*
3. *The Pareto optimal investment strategy is played on the equilibrium path.*
4. *In equilibrium both types of manager accept a contract w such that $\overline{w}_F = \underline{w}_F = 0$.*
5. *No equilibrium can exist in which both managers accept an offer different from*

$$(\underline{w}_N, \underline{w}_F, \underline{w}_S, \overline{w}_N, \overline{w}_F, \overline{w}_S) = \left(\underline{w}_N, 0, \frac{\underline{w}_N}{p}, \overline{w}_N, 0, \frac{\overline{w}_N}{p}\right) \tag{8}$$

with

$$[\mu\gamma(2-p) + (1-\mu)(1-\gamma)]\,\overline{w}_N + [\mu(1-\gamma)(2-p) + (1-\mu)\gamma]\,\underline{w}_N = \mu(1-p). \tag{9}$$

6. *A necessary condition for a firm offering a contract that is accepted by the manager to truthfully announce the private signal it observed, is that* $\overline{w}_N \leq \underline{w}_N$.

A necessary condition for a firm offering a contract that is accepted by the manager to truthfully announce the private signal it observed, is that the salaries to be paid following a given announcement are not all higher than the salaries to be paid following the other announcement. In other words we have either

$$\left(\overline{w}_N \geq \underline{w}_N \wedge \overline{w}_S \leq \underline{w}_S\right) \vee \left(\overline{w}_N \leq \underline{w}_N \wedge \overline{w}_S \geq \underline{w}_S\right). \tag{10}$$

Suppose now that

$$\overline{w}_N > \underline{w}_N \wedge \overline{w}_S < \underline{w}_S. \tag{11}$$

The incentive compatibility conditions for firms are as follows. If the firm observes $\alpha = \overline{\alpha}$, it announces $\widehat{\alpha} = \overline{\alpha}$ if and only if

$$\bar{\mu}\left(1-p\right)\left(\overline{w}_N - \underline{w}_N\right) + p\left(\overline{w}_S - \underline{w}_S\right) \leq 0. \tag{12}$$

If the firm observes $\alpha = \underline{\alpha}$, it announces $\widehat{\alpha} = \underline{\alpha}$ if and only if

$$\underline{\mu}\left(1-p\right)\left(\overline{w}_N - \underline{w}_N\right) + p\left(\overline{w}_S - \underline{w}_S\right) \geq 0. \tag{13}$$

Subtracting (13) from (12) we obtain

$$\left(\bar{\mu} - \underline{\mu}\right)\left(1-p\right)\left(\overline{w}_N - \underline{w}_N\right) \leq 0. \tag{14}$$

Given that for $\gamma > \left(\frac{1}{2}, 1\right]$, $\bar{\mu} - \underline{\mu} > 0$, we conclude that (11) cannot hold and from (10) we obtain

$$\overline{w}_N \leq \underline{w}_N \wedge \overline{w}_S \geq \underline{w}_S. \tag{15}$$

7. *In all equilibria both types of managers accept a contract* w *such that*

$$\left(\underline{w}_N, \underline{w}_F, \underline{w}_S, \overline{w}_N, \overline{w}_F, \overline{w}_S\right) = \left(\frac{\mu\left(1-p\right)}{1+\mu\left(1-p\right)}, 0, \frac{\mu\left(1-p\right)}{p\left[1+\mu\left(1-p\right)\right]}, \frac{\mu\left(1-p\right)}{1+\mu\left(1-p\right)}, 0, \frac{\mu\left(1-p\right)}{p\left[1+\mu\left(1-p\right)\right]}\right). \tag{16}$$

An equilibrium exists.

Consider first a contract

$$\left(\underline{w}_N, \underline{w}_F, \underline{w}_S, \overline{w}_N, \overline{w}_F, \overline{w}_S\right) = \left(\underline{w}_N, 0, \frac{\underline{w}_N}{p}, \overline{w}_N, 0, \frac{\overline{w}_N}{p}\right)$$

with $\overline{w}_N < \underline{w}_N$ and suppose that this contract may be accepted in equilibrium. Consider another contract

$$\widetilde{w} = \left(\underline{w}_N - \lambda, 0, \frac{\underline{w}_N - \lambda}{p}, \overline{w}_N + \varepsilon, 0, \frac{\overline{w}_N + \varepsilon}{p}\right).$$

Under w and $\widetilde{w}$ the expected salary payments to the good and the bad manager are, respectively

$$E\left[w|\tau\right] = \begin{cases} \gamma\left(2-p\right)\overline{w}_N + \left(1-\gamma\right)\left(2-p\right)\underline{w}_N & \text{if } \tau = G \\ \left(1-\gamma\right)\overline{w}_N + \gamma\underline{w}_N & \text{if } \tau = B \end{cases}$$

$$E\left[\tilde{w}|\tau\right] = \begin{cases} \gamma\left(2-p\right)\left(\overline{w}_N + \varepsilon\right) + \left(1-\gamma\right)\left(2-p\right)\left(\underline{w}_N - \lambda\right) & \text{if } \tau = G \\ \left(1-\gamma\right)\left(\overline{w}_N + \varepsilon\right) + \gamma\left(\underline{w}_N - \lambda\right) & \text{if } \tau = B \end{cases}.$$

Notice that

$$E\left[\tilde{w}|G\right] > E\left[w|G\right] \Longleftrightarrow \varepsilon > \frac{\left(1-\gamma\right)\lambda}{\gamma}$$

$$E\left[\tilde{w}|B\right] < E\left[w|B\right] \Longleftrightarrow \varepsilon < \frac{\gamma\lambda}{\left(1-\gamma\right)}$$

and therefore for all $\varepsilon \in \left(\frac{(1-\gamma)\lambda}{\gamma}, \frac{\gamma\lambda}{(1-\gamma)}\right)$, $\tilde{w}$ would be accepted only by the good manager and would therefore constitute a profitable deviation. This shows that if an equilibrium exists it has to be such that both types of manager accept the contract described in (16). The proof of existence follows along the same lines as in claim 6 in the proof of Proposition 2 and is therefore omitted.

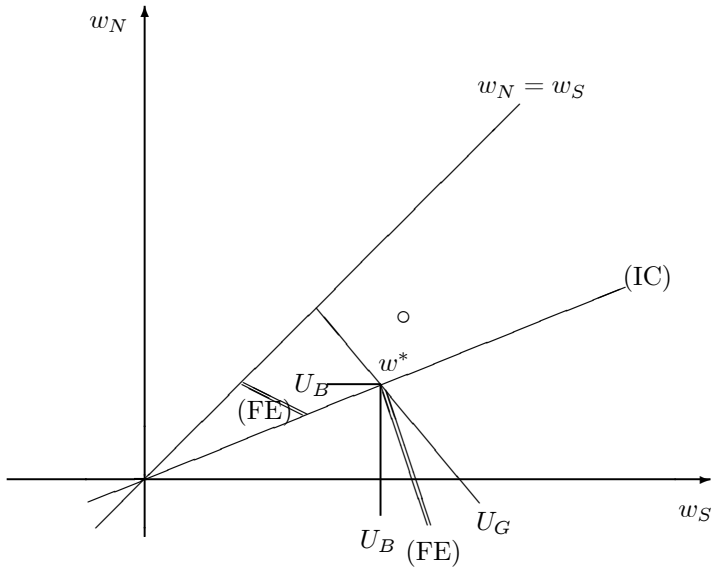

Figure 1

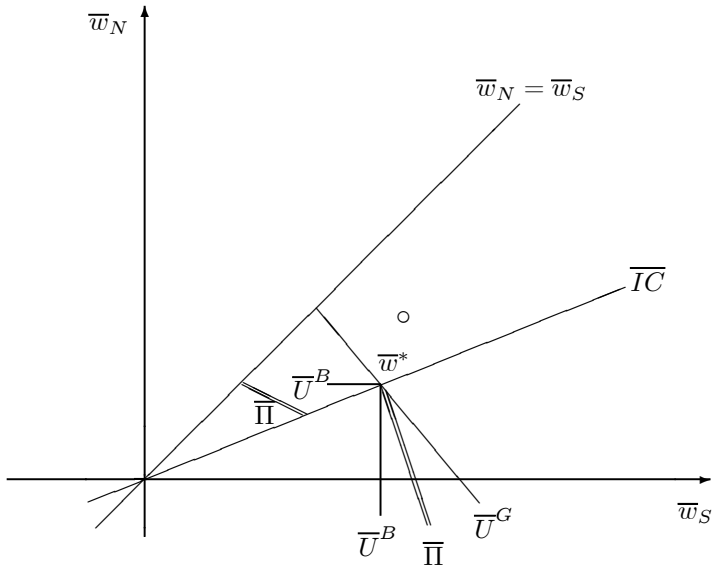

Figure 2(a)

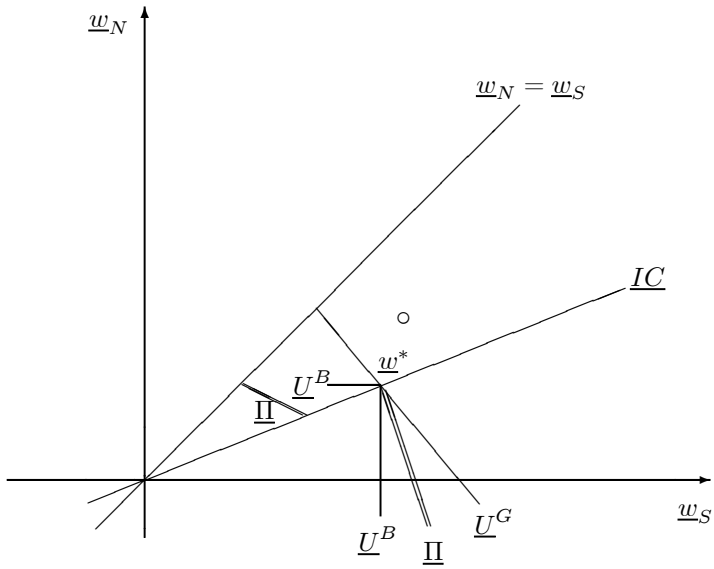

Figure 2(b)