WHEN PROMOTIONS INDUCE GOOD MANAGERS TO BE LAZY*

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Abstract

This paper shows that when being perceived as a good manager is a necessary condition to be promoted, a priori talented managers may undertake excessively risky projects. Indeed, such a choice renders more difficult the updating of beliefs process regarding their actual types. In turn, good managers are induced to lower the level of effort they perform since the extent to which effort impacts the perception the market has about their talent is lessened. This adversely impacts the firms' profits. Hence, career concerns do not discipline good managers in our context. However, we show how employers can limit managerial slack by increasing monitoring.

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I. Introduction

The perspective of being promoted in the future doubtlessly impacts the current behavior of a manager. The present paper focuses on a negative effect this perspective can have on her performance. More specifically, we argue that managers who have a good reputation on the labor market are induced to choose risky projects to keep this reputation. This in turn leads them to perform suboptimal levels of effort and decreases the total value of the firms they work in. Hence, the career concerns we consider here do not discipline good managers. We emphasize this dark side of promotions and investigate how monitoring can help the employers alleviate the problem.

As the promotions we consider are equivalent to a substantial increase in revenue, the framework we adopt here allows for many contexts: The R&D engineer who wants to get a promotion or create her own firm, the general partner with a venture capital fund who desires to attract investors to set up another fund at better conditions, or the divisional manager who wants to finance a project that will significantly increase her revenue. And we study the reaction of the party (respectively the hierarchy, the current limited partners, the headquarters) who is penalized because the current behavior implies too much risk and too low effort.

Managers do not have access to high-level positions at the beginning of their careers since they often lack the experience to hold these positions efficiently. To capture this in the simplest way, we consider a two-period model where all managers work within a company during the first period while only managers who have a good reputation are promoted in the second period.

Reputation on the labor market is principally grounded on the manager's past activities. Hence, there exists a high level of uncertainty regarding these abilities when managers begin their professional lives as neither themselves nor their employers know whether they are fit for the positions they hold or desire to hold. Thus, we assume that at the beginning of the first period (today) information is symmetric but incomplete about the managers' skills: The market (and the managers) forms a priori beliefs regarding their talents, taking into account their diplomas for example. We assume that there exists two types of managers: "Good" ones and "bad" ones.

However, as managers go on with their careers, both the market and themselves come to learn information regarding their competencies. Thus, a priori beliefs are updated with respect to available information. Accounting profits and a public report on the manager's activity represent two sources of hard information. Naturally, managers will exert effort in an attempt to influence positively the market's beliefs. To phrase it differently, managers have career concerns. Indeed, according to DeMarzo and Duffie [1995], "Career concerns arise whenever the (internal or external) labor market uses a worker's current output to update the beliefs about the worker's ability and then bases future wages on these updated beliefs". As in traditional models of career concerns, the labor market anticipates theses actions in equilibrium and draws the correct inference about ability from the observed output.

The two sources of information we consider differ along two dimensions. First of all, managers can manipulate the accuracy of the information content of the profits by choosing to undertake a more or less risky project, whereas they cannot influence the variance of the information contained in the report. Managers may favor risk since a very risky project makes it difficult to infer from its outcome whether success is due to fortune or managerial talent, and whether failure occurs because of bad luck or a lack of managerial skills. We assume the project risk-profile to be observable but not verifiable: Company owners observe the choices managers make but are unable to write contracts contingent on this soft information. Next, company owners have the opportunity to choose the accuracy of the information content of the report. For example, they hire a supervisor to monitor the manager. This allows them to elicit information regarding the managers' talent and facilitates the updating of beliefs process regarding the managers' abilities. Conversely, they cannot impact the accuracy of the information content of the profits.

We analyze how the perspective of being promoted in the future influences the current willingness of managers to let the market (and themselves) learn information regarding their characteristics as well as their employers' willingness to gather this information. It seems reasonable that a condition for managers to be promoted is that the updated beliefs regarding their types are good enough, that is, they need to be perceived as good managers at the end of the first period. In this context, we identify two opposite behaviors depending on the initial reputation of the managers. On the one hand, a priori bad managers want the market to change its beliefs regarding their types. Hence, we show that, provided that the additional revenue associated with the promotion is attractive enough, they choose the less risky project to facilitate the updating of beliefs process. On the other hand, a priori good managers want the market to keep its a priori about their talents. Therefore, they are likely to opt for the riskier project so as to limit the updating process. This induces them to reduce their levels of effort since the extent to which effort impacts the perception the market has about their talent is lessened. This negatively impacts the total value of the firm they work in. However, employers can partially prevent such behaviors. They monitor the managers which improves the accuracy of information regarding actual managerial talent and incentivizes managers to exert a higher level of effort than they would otherwise perform. We show that employers monitor more managers of the a priori good type than managers of the a priori bad type. To sum up briefly these results, employers complement one source of manipulable- by the manager - information (accounting profits) with a non-manipulable one (the report they receive).

The present research builds on the career concerns literature. The starting point of this literature is that managers are disciplined directly through the labor market: Superior performances generate high wage offers whereas poor performances generate low wage offers. In such a context, Fama [1980] developed the idea that explicit incentives are not necessary. This suggestion is only correct under narrow assumptions (neutrality with respect to risk and no discounting rate) [Holmström, 1982, 1999]. Nevertheless, if managers have time preferences, Fama's conclusion does not hold. However, career concerns still create important incentives, even in the presence of explicit incentive contracts [Gibbons and Murphy, 1992]. Thus, an optimal compensation contract optimizes total incentives, that is, the combination of the implicit incentives from career concerns and the explicit incentives from compensation contracts. In this paper, we have chosen not to tackle the explicit incentives issue. We do not mean to suggest that such incentives are irrelevant: Employers actually use them in formal compensation contracts [Murphy, 1998, Gibbons and Murphy, 1992]. However, some constraints limit their utilization so that the explicit incentives facing CEOs in large firms are overall weak [Jensen and Murphy, 1990]. Hence, implicit incentives play a critical role and we focus on this specific role here.

In some occasions, managers have private information regarding their abilities. This is captured in Zwiebel [1995], Breeden and Viswanathan [1998], or Prendengast and Stole [1996][1]. We examine the opposite case where managers and the labor market share the same information, which makes sense when managers are at the early stages of their career or when they want to switch for another job requiring different talents. Considering a situation where information is symmetric (as in Holmström [1982, 1999]) and where there exists several types of managers, allows us to derive different behaviors depending on whether managers are a priori good or bad.

The choice of risk policy by risk-averse managers has been studied in the career concerns literature [Holmström, 1982, 1999, DeMarzo and Duffie, 1995[2], Hermalin, 1993]. In a context where managers are concerned by a promotion, we argue that risk is a relevant element to be taken into account even if managers are risk-neutral.

[1] See also Diamond [1989] in another context.

Managers try to influence the perception the market has regarding their ability by manipulating the learning process. Either they exert effort to inflate their output [Holmström, 1982, 1999] or they modify the accuracy of the information that accrues to the market by choosing the risk of the project they undertake [Holmström, 1982, 1999, Hermalin, 1993], or by resorting to hedging technics [DeMarzo and Duffie, 1995[3], Breeden and Viswanathan, 1998]. What is new in the present paper is that we examine the impact of the risk-taking policy on the level of effort exerted.

Moreover, we investigate how monitoring help company owners improve the accuracy of information regarding actual managerial talent, which in turns restores incentives to work.

The paper is organized as follows. Section II introduces the model and discusses the most important assumptions. In Section III, we assume that accounting profits are the only source of information. Then, we derive the optimal behaviors of both kinds of managers for both periods regarding their choices of level of effort and their choices of risk. Section IV examines these choices when employers can resort to monitoring. It also discusses the relation of the paper with the existing literature and proposes implications. Concluding remarks follow. Proofs are supplied to the Appendix.

II. The Model

We consider a two-period model with a competitive labor market. There exists a continuum of firms (also referred to as company owners or employers) and a continuum of managers (also referred to as employees). During the first period, all managers are at the same level in the hierarchy . In the second period managers perceived as good are promoted. All parties are risk-neutral.

II.A. First Period

A firm's gross accounting profit π_1 is given by

$$\pi_1(\theta, r_{p_i}, e) = \theta + r_{p_i} + e, \quad (1)$$

where θ represents the manager's talent, r_{p_i} is the project's risk and e is the manager's effort. The manager's talent is unknown both to her and to her employers. However, it is common knowledge that θ is drawn from the distribution $\theta \sim N(\mathbb{E}_\theta; \sigma_\theta^2)$. Thus, information is incomplete but symmetric. Either $\mathbb{E}_\theta = \mathbb{E}_\theta^g$ and managers are assumed to be of the "good " type or $\mathbb{E}_\theta = \mathbb{E}_\theta^b < \mathbb{E}_\theta^g$ and managers are of the "bad" type. Managers must choose between two projects that exhibit different risk-profiles. Both projects are risky and project p_A defined by $r_{p_A} \sim N(0; \sigma_{p_A}^2)$ is less risky than project p_B defined by $r_{p_B} \sim N(0; \sigma_{p_B}^2)$: $\sigma_{p_B}^2 > \sigma_{p_A}^2$. Furthermore, we assume p_B to be risky enough and p_A to exhibit a sufficiently low level of risk. The choice of project is observable but not verifiable. As Hermalin [1993] suggests, this assumption makes sense: Stock analysts are to evaluate project risks; board of directors often have the expertise to do so; even the business press sometimes assesses the risk of new projects[4]. This implies that no contract can be contingent on the choice of project[5]. Once the manager has decided which project to undertake, she exerts an unobservable level of effort e. This effort costs her $\psi(e)$, with $\psi' > 0$, $\psi'' > 0$ and $\psi'''(e) > 0$.

Company owners have access to a monitoring technology (e.g. hire a supervisor or an auditor). They choose the precision of the report τ, once the manager has chosen the project p_i, but before she exerts the effort e. Let ϖ (with $\varpi \sim N(0; \sigma_\varpi^2)$) represent an observation error. Setting up a monitoring technology that costs $c\left(\sigma_\varpi^2\right)$ (with $c' < 0$, $c'' > 0$, $c''' < 0$, $c(\infty) = 0$, $c'(0) = -\infty$ and $c'(\infty) = 0$) allows company owners to choose the monitoring level: σ_ϖ^2. Company owners can opt for $\sigma_\varpi^2 = \infty$ which amounts to choosing not to monitor the managers. The report

$$\tau(\theta, e, \varpi) = \theta + e + \varpi \quad (2)$$

is delivered once the manager has exerted her effort.

The profit and the report are observable by everyone but we do not analyze explicit contracts in what follows. In the tradition of Holmström [1982,1999] or Scharfstein and Stein [1990], we assume that managers cannot be bound to their firms against their will ex post. This implies that any long-term contract that would pay some type less than spot market wages in the second period is infeasible. Of course, short term incentive contracts could serve to help align managers and firms interests, by specifying a profit-contingent wage in the first period. Thus, in principle, managers could be induced to act so as to maximize a weighted average of the firm's expected profits and their future compensation. However, this more general formulation leads to the same qualitative results (see Scharfstein and Stein [1990], Prendergast and Stole [1996], as well as Breeden and Viswanathan [1998]) that obtain if managers care only about reputation -although naturally, the inefficiencies are reduced. For the sake of starkness, we leave expected profits out of the managerial objective function. Hence, implicit incentives are at the heart of our analysis. Managers are paid a fixed wage $W_1(\mathbb{E}_\theta)$ at the end of the first period as is standard in career concerns models. Since the labor market is competitive, $W_1(\mathbb{E}_\theta)$ corresponds to the first-period marginal productivity of each manager. Hence, managers exert effort and choose a level of risk solely to influence their revenues tomorrow.

II.B. Second Period

Beliefs about managers' talent are updated taking into account the information that accrues at the end of the first period, i.e. the profit π_1, the report τ_1, the first-period project $p_i,$ the anticipated equilibrium monitoring level σ_ϖ^{2*} and the anticipated equilibrium effort e^*. Let $\mathbb{E}(\theta \mid \pi_1, \tau_1, p_i, \sigma_\varpi^{2*}, e^*)$ represent these updated beliefs.

Managers cannot be promoted at the beginning of the first period because they lack experience.

Holding their position during the first period allows them to gain experience χ. Promoting a manager impacts the second-period profits π_2 in the sense that if an a posteriori good manager is promoted, profits are increased by Δ which reflects that she is fit for her new position. Conversely, if an a posteriori bad manager is promoted, second-period profits are decreased by Δ. This reflects that promoting a wrong person is detrimental to the firm. Let $\overline{\theta}$ be the talent-related threshold above which managers are promoted. Then,

(3) $$\pi_2 (\theta, r_{p_i}, e, \Delta) = \pi_1 (\theta, r_{p_i}, e) + \Delta \text{ if } \mathbb{E} (\theta \mid) + \chi \geq \overline{\theta},$$

(4) $$= \pi_1 (\theta, r_{p_i}, e) - \Delta \text{ if } \mathbb{E} (\theta \mid) + \chi < \overline{\theta} \text{ and the manager is promoted,}$$

(5) $$= \pi_1 (\theta, r_{p_i}, e) \text{ if } \mathbb{E} (\theta \mid) + \chi < \overline{\theta} \text{ and the manager is \textit{not} promoted.}$$

Equations (3) and (4) show that firms promote managers if and only if the updated beliefs regarding their types are sufficiently good, that is if and only if $\mathbb{E} (\theta \mid \pi_1, \tau_1, p_i, e^*) + \chi \geq \overline{\theta}$. When a manager is not promoted, the second-period firm's accounting profit π_2 is given by (5). When a manager is promoted, the second-period firm's accounting profit is given by (3).

In order to have the problem interesting, a priori good (respectively a priori bad) managers are (respectively are not) promoted if the market keeps similar beliefs about their abilities. Besides, even good managers cannot be promoted at the beginning of the first period: They lack experience. To summarize,

$$\mathbb{E}^g_\theta + \chi \geq \overline{\theta} > \mathbb{E}^g_\theta \text{ and } \mathbb{E}^b_\theta + \chi < \overline{\theta}.$$

The timing of events can be summarized as follows:

First period

1. At the beginning of the first period, existing companies hire all managers. They agree on the fixed wages to be paid at the end of the first period.

2. Each manager chooses the risk-profile of the project she undertakes (p_A or p_B). This choice is observable but not contractible.

3. By incurring a cost $c(\sigma_{\varpi}^2)$, company owners can increase the precision of the report τ they *will* receive *at date 5*.

4. Then, each manager chooses her level of effort e, which is not observable.

5. Profits π_1 are realized. The public report τ is delivered. Wages are paid.

6. Based on realized profits, the observed report, the observed choice of project, the anticipated level of effort and the anticipated monitoring level, beliefs regarding all managers are updated.

Second period

1. Either updated beliefs regarding a manager's type are good enough and the manager is promoted or updated beliefs are not high enough and the manager remains at the same level in the hierarchy.

2. Then, both kinds of managers choose to undertake either p_A or p_B and the level of effort they exert.

III. ACCOUNTING PROFITS AS THE UNIQUE SOURCE OF INFORMATION

In this section, we assume that accounting profits are the unique source of information that allows the market to update beliefs. Working backward, we first determine each kind of managers' levels of effort. Then, we derive the level of risk they opt for.

III.A. Managers' Choices of Effort

Since effort is costly, unobservable and does not increase her first-period wage (which is already fixed at the beginning of the period), a manager exerts e solely to influence favorably the updating process, and in turn her second-period wage. A manager is paid her marginal productivity since the labor market is competitive. The manager's marginal productivity corresponds to her expected ability over all possible values for π_1 including the experience she gained during the first period, plus the expected value of the additional revenue related to the promotion[6], minus her cost of effort. Suppose that the market anticipates the equilibrium effort e^*. The manager chooses e so as to maximize her second period expected revenue less her first-period effort

$$\mathbb{E}_{\pi_1}\left[\mathbb{E}_\theta(\theta \mid \pi_1, p_i, e^*)\right] + \chi + \Pr\left(\mathbb{E}(\theta \mid \pi_1, p_i, e^*) + \chi \geq \overline{\theta}\right) \times \Delta - \psi\left(e\right). \tag{6}$$

Assuming interior solution, the first-order condition for an equilibrium satisfies

$$cov\left(\theta, \frac{\widehat{f}_e\left(\pi_1 \mid p_i, e^*\right)}{\widehat{f}\left(\pi_1 \mid p_i, e^*\right)}\right) + \frac{\partial}{\partial e}\left\{\Pr\left(\mathbb{E}(\theta \mid \pi_1, p_i, e^*) + \chi \geq \overline{\theta}\right) \times \Delta\right\} = \psi'\left(e^*\right), \tag{7}$$

where $f\left(\theta, \pi_1 \mid \right)$ and $\widehat{f}\left(\pi_1 \mid \right) = \int f\left(\theta, \pi_1 \mid \right) d\theta$ respectively denote the joint density of the talent and the profit π_1, given the effort level e^* and the type of project p_i, and the marginal density of π_1. Besides, $\widehat{f}_e$ denotes the derivative of the marginal distribution with respect to effort. Overall, equation (7) shows that the manager's marginal incentives (left-hand-side) must be equal to her marginal cost (right-hand-side).

The first-order condition given by (7) reduces to

$$\frac{\sigma_\theta^2}{\sigma_\theta^2 + \sigma_{p_i}^2} + \frac{1}{\left(\sigma_\theta^2 + \sigma_{p_i}^2\right)^{\frac{1}{2}}} \frac{1}{\sqrt{2\pi}} \exp\left(-\frac{1}{2}\frac{(\overline{\theta} - (\mathbb{E}_\theta + \chi))^2\left(\sigma_\theta^2 + \sigma_{p_i}^2\right)}{\sigma_\theta^4}\right) \times \Delta = \psi'\left(e^*\right), \tag{8}$$

We derive the first term in the left-hand-side of equation (8) from the computation of the covariance from equation (7). This term represents the marginal gain of effort due to the incentives related to the accounting data π_1 through the updating process. The second term indicates the marginal gain of effort due to the expected additional revenue Δ the manager earns when she is promoted. A couple of results are obtained. On the one hand, the larger this additional revenue, the more powerful these incentives: The attractiveness of being promoted increases. On the other hand, the farther the manager's talent from the threshold that allows her to be promoted (i.e. the higher $\left|\overline{\theta} - (\mathbb{E}_\theta + \chi)\right|$), the lower these incentives. Indeed, as $\left|\overline{\theta} - (\mathbb{E}_\theta + \chi)\right|$ increases, the impact that effort has on the probability to be above the threshold $\overline{\theta}$ decreases.

We can now determine the choice of risk a manager makes regarding the project she has under her control during the first period.

III.B. Managers' Choices of Risk

Each manager chooses between the two projects, p_A or p_B, which differ according to their risk-profile. Since her first-period wage $W_1(\mathbb{E}_\theta)$ is already determined, a manager opts for the project that maximizes her second-period revenue minus the cost of effort she exerts during the first period:

$$\text{(9)} \qquad \mathbb{E}_{\pi_1}\left[\mathbb{E}_\theta(\theta \mid \pi_1, p_i, e^*)\right] + \chi + \Pr\left(\mathbb{E}(\theta \mid \pi_1, p_i, e^*) + \chi \geq \overline{\theta}\right) \times \Delta - \psi\left(e^*\left(p_i\right)\right).$$

At the equilibrium, the market perfectly anticipates e^* and observes the choice of project. Thus, $\mathbb{E}_{\pi_1}\left[\mathbb{E}_\theta(\theta \mid \pi_1, p_i, e^*)\right]$ is equal to $\mathbb{E}_{\pi_1}\left[\mathbb{E}_\theta(\theta \mid \pi_1(e^*), p_i, e^*)\right]$. Since the market anticipates e^*, we can apply the law of iterated expectations. Finally, the market draws the correct inference about the manager's ability from the realized first-period output (i.e. the expectation of the conditional expectation is equal to the non-conditional expectation $\mathbb{E}_\theta$[7]). Therefore, a manager only considers the impact her choice has on the probability to be promoted-, which drives the additional revenue Δ, -and on the cost resulting from her effort. Using statistic rules (see DeGroot 1970) for computing the conditional expectation in the case of normal laws[8], we obtain that

$$\mathbb{E}(\theta \mid \pi_1, p_i, e^*) \sim N\left(\mathbb{E}_\theta; \frac{\sigma_\theta^4}{\sigma_\theta^2 + \sigma_{p_i}^2}\right). \tag{10}$$

In other words, $E(\theta \mid \pi_1, p_i, e^*)$ is centered on the non-conditional expectation $\mathbb{E}_\theta$ and its variance is decreasing in $\sigma_{p_i}^2$.

Depending on the managers' type, the choice of risk-profile differs. First consider the case of a priori good managers. Two effects are at work. Equation (8) shows that effort increases when performance becomes more informative, i.e. the variance $\sigma_{p_i}^2$ decreases. Hence, effort has a greater impact on the updated beliefs when a manager opts for project p_A than when she opts for p_B: $\sigma_{p_B}^2 > \sigma_{p_A}^2$. Therefore, choosing the less risky project implies a higher equilibrium effort which results in a higher cost for the manager. This is the "cost effect". Next consider the "probability effect". A priori good managers are promoted provided that the updated beliefs $\mathbb{E}_\theta(\theta \mid \pi_1, p_i, e^*)$ and the *ex ante* beliefs $\mathbb{E}_\theta^g$ about their talents are similar enough. Thus, these managers prefer the beliefs regarding their types not to be modified. Hence, they want to minimize the variance of $\mathbb{E}(\theta \mid \pi_1, p_i, e^*)$. Equation (10) shows that this induces them to favor the riskier project. The intuition is the following: If the project is very risky, it is difficult to infer from its outcome whether success is due to fortune or managerial talent, and whether failure occurs because of bad luck or a lack of managerial skills. Hence the market cannot update efficiently its a priori beliefs. Note that both the "cost effect" and the "probability effect" go into the same direction: Opting for p_B today both decreases the cost resulting from the effort incurred by the manager at the equilibrium and maximizes the probability to be promoted tomorrow (see Figure 1).

Insert FIGURE I: A PRIORI GOOD MANAGERS here.

Next, consider the case of a priori bad managers. The analysis regarding the "cost effect" parallels the above one: Opting for the riskier project is less costly in terms of effort. Conversely, the analysis regarding the probability to be promoted tomorrow is reversed. If the market still considers that the manager is bad, the latter is not promoted. Such a manager prefers to maximize $var\left(\mathbb{E}(\theta \mid \pi_1, p_i, e^*)\right)$, which imposes, according to equation (10), to opt for the less risky project (see Figure 2).

Insert FIGURE II: A PRIORI BAD MANAGERS here.

Here, the "cost effect" and the "probability effect" go into two opposite directions. Hence, the final choice of the manager depends on the attractiveness of the promotion (i.e. the size of the additional revenue Δ). When $\Delta \geq \overline{\Delta}\left(\mathbb{E}_\theta^b\right)$[9], with

$$(11) \qquad \overline{\Delta}\left(\mathbb{E}_\theta^b\right) \stackrel{d}{=} \frac{\psi\left(e^*\left(p_A\right)\right) - \psi\left(e^*\left(p_B\right)\right)}{\Phi\left[\frac{\left(\sigma_\theta^2 + \sigma_{p_B}^2\right)^{\frac{1}{2}}}{\sigma_\theta^2}\left(\overline{\theta} - \left(\mathbb{E}_\theta^b + \chi\right)\right)\right] - \Phi\left[\frac{\left(\sigma_\theta^2 + \sigma_{p_A}^2\right)^{\frac{1}{2}}}{\sigma_\theta^2}\left(\overline{\theta} - \left(\mathbb{E}_\theta^b + \chi\right)\right)\right]},$$

a priori bad managers choose the less risky project. Indeed, (11) ensures that the additional revenue more than offsets the larger cost incurred by the manager due to her higher effort.

These results are summarized in the following proposition.

Proposition 1 *Suppose accounting profits are the unique source of information. Then,*

(i) A priori good managers choose the riskier project (p_B),

(ii) A priori bad managers choose

- the less risky project (p_A) when $\Delta \geq \overline{\Delta}\left(\mathbb{E}_\theta^b\right)$,

- the riskier project (p_B) when $\Delta < \overline{\Delta}\left(\mathbb{E}_\theta^b\right)$.

It is worth comparing the level of effort performed by good and bad managers when $\Delta \geq \Delta\left(\mathbb{E}_\theta^b\right)$. Equation (8) shows that two effects are at work. First, choosing the riskier project leads to lower the level of effort exerted. Second, the farther the manager's talent from the threshold that allows her to be promoted (i.e. the higher $\left|\overline{\theta}-(\mathbb{E}_\theta+\chi)\right|$), the lower these incentives. Hence, when the distance that separates bad and good managers to the threshold that allows them to be promoted is the same, the former ones work more than the latter ones since they choose the less risky project (provided that the promotion is attractive enough), whereas good managers choose the riskier project. Being talented induces laziness which adversely impacts the profits of the firm.

Proposition 2 *Suppose accounting profits are the unique source of information. Let* $\Delta \geq \Delta\left(\mathbb{E}_\theta^b\right)$ *and* $\left|\overline{\theta}-(\mathbb{E}_\theta^g+\chi)\right| = \left|\overline{\theta}-(\mathbb{E}_\theta^b+\chi)\right|$. *Then, a priori bad managers exert a higher level of effort than a priori good managers.*

Note that $\overline{\Delta}\left(\mathbb{E}_\theta^b\right)$ depends on the distance between the second-period expected ability of a priori bad managers $E_\theta^b+\chi$ and the threshold $\overline{\theta}$ above which they are promoted. When this distance is low, a priori bad managers have a $\frac{1}{2}$ probability to be promoted, whatever the project undertaken. Similarly, when this distance is high, the probability to be promoted is close to zero, whatever the project carried out. Hence, in these two occasions, the additional revenue must be very attractive to induce a priori bad managers to opt for p_A : $\overline{\Delta}\left(\mathbb{E}_\theta^b\right)$ is very high. The threshold $\overline{\Delta}\left(\mathbb{E}_\theta^b\right)$ is lower when choosing p_A rather than p_B induces a a reasonable difference in the probabilities of promotion, that is when $\left|\overline{\theta}-(\mathbb{E}_\theta^b+\chi)\right|$ takes intermediate values.

IV. MONITORING AS A SECOND SOURCE OF INFORMATION

We now investigate the case where the company owners have the opportunity to monitor[10] the manager during the first period. We work backward: We first determine the managers' choices of effort.

Then, we investigate the company owners' level of monitoring. Finally, we analyze the managers' choices of risk.

IV.A. The Managers' Choices of Effort

Suppose that the market anticipates both e^* and the monitoring level σ_{ϖ}^{2*}. A manager chooses e so as to maximize her second period expected revenue less her first-period effort

$$\text{(12)} \qquad \mathbb{E}_{\pi_1,\tau}\left[\mathbb{E}_\theta(\theta \mid \pi_1,\tau,p_i,\sigma_{\varpi}^{2*},e^*)\right] + \chi + \Pr\left(\mathbb{E}(\theta \mid \pi_1,\tau,p_i,\sigma_{\varpi}^{2*},e^*) + \chi \geq \overline{\theta}\right) \times \Delta - \psi\left(e\right).$$

Assuming interior solution, the first-order condition for an equilibrium satisfies

$$\text{(13)} \quad cov\left(\theta, \frac{\widehat{f}_e\left(\pi_1,\tau \mid p_i,\sigma_{\varpi}^{2*},e^*\right)}{\widehat{f}\left(\pi_1,\tau \mid p_i,\sigma_{\varpi}^{2*},e^*\right)}\right) + \frac{\partial}{\partial e}\left\{\Pr\left(\mathbb{E}(\theta \mid \pi_1,\tau,p_i,\sigma_{\varpi}^{2*},e^*) + \chi \geq \overline{\theta}\right) \times \Delta\right\} = \psi'\left(e^*\right).$$

The addition of a second source of information, namely the public report τ, modifies the updating process. Overall, equation (13) describes the manager's marginal incentives. It reduces to

$$\text{(14)} \qquad \underbrace{\frac{\sigma_\theta^2}{\sigma_\theta^2+\sigma_{p_i}^2}}_{Term\,1} + \underbrace{\frac{\sigma_\theta^2\sigma_{p_i}^2}{\sigma_\theta^2(\sigma_{p_i}^2+\sigma_{\varpi}^{2*})+\sigma_{p_i}^2\sigma_{\varpi}^{2*}}}_{Term\,2} + \underbrace{v\left(\left(\overline{\theta}-(\mathbb{E}_\theta+\chi)\right)^2, \sigma_\theta^2, \sigma_{p_i}^2, \sigma_{\varpi}^{2*}\right) \times \Delta}_{Term\,3} = \psi'\left(e^*\right),$$

where

$$v\left(.\right) \stackrel{d}{=}$$
$$\frac{\sigma_{p_i}^2+\sigma_{\varpi}^{2*}}{\left[\sigma_{r_{p_i}}^4\left(\sigma_\theta^2+\sigma_{\varpi}^{2*}\right)+\left(\sigma_\theta^2+\sigma_{p_i}^2\right)\sigma_{\varpi}^{2*}\right]^{\frac{1}{2}}}\frac{1}{\sqrt{2\pi}}\exp\left[-\frac{1}{2}\frac{\left(\overline{\theta}-(\mathbb{E}_\theta+\chi)\right)^2\left(\sigma_\theta^2\left(\sigma_{p_i}^2+\sigma_{\varpi}^{2*}\right)+\sigma_{p_i}^2\sigma_{\varpi}^{2*}\right)^2}{\sigma_\theta^4\left[\sigma_{r_{p_i}}^4\left(\sigma_\theta^2+\sigma_{\varpi}^{2*}\right)+\left(\sigma_\theta^2+\sigma_{p_i}^2\right)\sigma_{\varpi}^{4*}\right]}\right],$$

is decreasing in $\left|\overline{\theta}-(\mathbb{E}_\theta+\chi)\right|$. We derive the first two terms of equation (14) from the computation of the covariance in equation (13). *Term 1* is identical to the first term in equation (8) where accounting profits were the unique source of information. *Term 2* represents the marginal increase in effort due to the incentives created by the second source of information (i.e. the report τ) through the updating process. *Term 3* shows the marginal increase in effort created by the additional revenue Δ the manager earns when she is promoted. *Term 3* is larger than its corresponding term in (8). Comparing (8) and (14) shows that when projects are risky enough the existence of the second source of information reinforces the incentives to work.

IV.B. The Company Owners' Monitoring Decision

By incurring a cost $c(\sigma_\varpi^2)$, the employers choose the precision of the report τ they receive. When doing so, managers are already hired for the first period. This implies that employers choose the level of monitoring that maximizes the firms' first-period expected net profits:

$$\sigma_\varpi^{2*} = \underset{\sigma_\varpi^2}{\arg\max}\, \mathbb{E}\left(\pi_1\left(\theta, r_{p_i}, e^* \mid p_i\right)\right) - W_1(\mathbb{E}_\theta) - c\left(\sigma_\varpi^2\right).$$

The first-order condition reduces to

$$(15) \qquad \frac{\partial e^*}{\partial \sigma_\varpi^2} = c'\left(\sigma_\varpi^{2*}\right),$$

where c' corresponds to the derivative of the cost function with respect to σ_ϖ^2, and e^* is the manager's optimal choice of effort.

Let ψ'^{-1} denote the reciprocal function of ψ'. Equation (15) reduces to

$$(16) \qquad \left(\underbrace{\frac{\sigma_\theta^2 \sigma_{p_i}^2 \left(\sigma_\theta^2 + \sigma_{p_i}^2\right)}{\left[\sigma_\theta^2\left(\sigma_\varpi^2 + \sigma_{p_i}^2\right) + \sigma_\varpi^2 \sigma_{p_i}^2\right]^2}}_{Term\ A} - \underbrace{\frac{\partial v\left(.\right)}{\partial \sigma_\varpi^2} \times \Delta}_{Term\ B} \right) \times \psi'^{-1}\left(.\right) = \underbrace{-c'\left(\sigma_\varpi^2\right)}_{>0}.$$

Term A shows the impact of monitoring on the marginal incentives to exert effort created by the second source of information, that is, the marginal increase of *Term 2* (see (14)) when σ_ϖ^2 decreases. *Term B* represents the impact of monitoring on the marginal incentives to exert effort created by the additional revenue Δ, that is, the marginal increase in *Term 3* when σ_{ϖ}^2 decreases. Overall, the left-hand side of (16) represents the marginal gain of monitoring for the company owners. At the equilibrium, this gain just offsets the monitoring marginal cost $-c'\left(\sigma_{\varpi}^2\right)$[11].

When projects are risky enough, the marginal gain of monitoring is higher when a manager has chosen the riskier project (p_B) than when she has chosen the less risky project (p_A). Since the marginal cost of monitoring does not depend on the risk of the project undertaken ($\sigma_{p_i}^2$), we obtain the next proposition.

Proposition 3 *For a given manager, company owners exert a higher monitoring level if this manager has opted for the riskier project (p_B) rather than for the less risky project (p_A).*

Finally, we determine the choice of risk by the managers.

IV.C. Managers' Choices of Risk

The managers, whatever their type, anticipate that the observable choice of risk they make will induce company owners to perform an adequate level of monitoring.

As when accounting profits are the sole source of information, a priori bad managers balance the "cost effect" and the "probability effect" when considering the choice of project. What differs here is that both the "probability effect" and the "cost effect" consist of a direct as well as an indirect effect. The direct "probability effect" results from the shift from p_B to p_A on the probability of promotion. This effect is positive since p_B is sufficiently risky to impede the updating of beliefs process whereas p_A exhibits a sufficiently low enough level of risk to facilitate the updating of beliefs process. The indirect "probability effect" corresponds to the positive effect of monitoring on the probability of promotion, times the negative impact of a shift from p_B to p_A on the equilibrium level of monitoring. Note that monitoring decreases because its marginal gain (i.e. the increase in managerial effort) is higher when project p_B is chosen than when project p_A is chosen, whereas its marginal cost does not depend on the risk of the project. Hence, this indirect effect is negative. However, it does not offset the positive direct effect if the marginal cost of monitoring is sufficiently increasing to avoid a large difference between monitoring levels depending on p_A or p_B had been chosen (i.e. $c''\left(\sigma_{\varpi}^{2*}\left(\sigma_{p_A}^2\right)\right)$ high enough). To summarize, opting for p_A rather than p_B increases the probability to be promoted for a priori bad managers.

Next, turn to the "cost effect" which also consists of a direct as well as an indirect effect. On the one hand, opting for the less risky project increases the equilibrium level of effort which raises the cost incurred by a priori bad managers (direct effect). On the other hand, opting for the less risky project decreases the level of monitoring while monitoring increases the equilibrium level of effort. Thus, the indirect effect is positive for a priori bad managers. However, it does not offset the negative impact of a shift from p_B to p_A on the cost resulting from e^* when the marginal cost of monitoring is sufficiently increasing to avoid a large difference between monitoring levels depending on p_A or p_B had been chosen (i.e. $c''\left(\sigma_{\varpi}^{2*}\left(\sigma_{p_A}^2\right)\right)$ high enough). To summarize, a priori bad managers increase their cost of effort when they opt for p_A rather than p_B.

Hence, the "cost effect" and the "probability effect" go into two opposite directions. Thus, a priori bad managers face a trade-off between increasing the probability to be promoted and reducing the cost of effort they incur. Overall, they opt for the less risky project when the promotion is sufficiently attractive, that is when $\Delta \geq \underline{\Delta}\left(\mathbb{E}_{\theta}^{b}\right)$, where

$$\underline{\Delta}\left(\mathbb{E}_{\theta}^{b}\right) \stackrel{d}{=} \frac{\psi\left(e^{*}\left(p_{A}\right)\right)-\psi\left(e^{*}\left(p_{B}\right)\right)}{\left\{\begin{array}{l}\Phi\left[\frac{\left(\overline{\theta}-\left(\mathbb{E}_{\theta}^{b}+\chi\right)\right)\left(\sigma_{\theta}^{2}\left(\sigma_{p_B}^{2}+\sigma_{\varpi}^{2*}(p_B)\right)+\sigma_{p_B}^{2}\sigma_{\varpi}^{2*}(p_B)\right)}{\sigma_{\theta}^{2}\left[\sigma_{r_{p_B}}^{4}\left(\sigma_{\theta}^{2}+\sigma_{\varpi}^{2*}(p_B)\right)+\left(\sigma_{\theta}^{2}+\sigma_{p_B}^{2}\right)\sigma_{\varpi}^{4*}(p_B)\right]^{\frac{1}{2}}}\right] \\ -\Phi\left[\frac{\left(\overline{\theta}-\left(\mathbb{E}_{\theta}^{b}+\chi\right)\right)\left(\sigma_{\theta}^{2}\left(\sigma_{p_A}^{2}+\sigma_{\varpi}^{2*}(p_A)\right)+\sigma_{p_A}^{2}\sigma_{\varpi}^{2*}(p_A)\right)}{\sigma_{\theta}^{2}\left[\sigma_{r_{p_A}}^{4}\left(\sigma_{\theta}^{2}+\sigma_{\varpi}^{2*}(p_A)\right)+\left(\sigma_{\theta}^{2}+\sigma_{p_A}^{2}\right)\sigma_{\varpi}^{4*}(p_A)\right]^{\frac{1}{2}}}\right]\end{array}\right\}}.$$

Now consider a priori good managers. For the “cost effect” as well as for the “probability effect”, the indirect effect is dominated by the direct effect under the same conditions as above. Both the “cost effect” and the “probability effect” induce a priori good managers to opt for the riskier project (p_B) as when accounting profits are the sole source of information.

For a given manager, undertaking a more risky project raises the company owners monitoring activity (See Proposition 3). This implies that when $\left|\overline{\theta}-(\mathbb{E}_{\theta}^{g}+\chi)\right| = \left|\overline{\theta}-(\mathbb{E}_{\theta}^{b}+\chi)\right|$, corporate owners monitor more intensely a priori good managers than a priori bad managers. These results are summarized in the following proposition.

Proposition 4 *Suppose $c''\left(\sigma_{\varpi}^{2*}\left(\sigma_{p_A}^{2}\right)\right)$ is high enough.*

(i) A priori good managers opt for the riskier project (p_B),

(ii) A priori bad managers choose the less risky project (p_A) when $\Delta \geq \underline{\Delta}\left(\mathbb{E}_{\theta}^{b}\right)$,

(iii) Let $\left|\overline{\theta}-(\mathbb{E}_{\theta}^{g}+\chi)\right| = \left|\overline{\theta}-(\mathbb{E}_{\theta}^{b}+\chi)\right|$. Then, company owners monitor more intensely a priori good managers than a priori bad managers.

IV.D Related literature

Our paper is most closely related to DeMarzo and Duffie [1995], Breeden and Viswanathan [1998], and Hermalin [1993]. This connection deserves some comments.

When the managers privately know their respective type while their policy with respect to risk (through hedging) is not observable, good managers want the market to learn information regarding their talent. Hence, they hedge because hedging ameliorates the accuracy of the information contained by corporate profits regarding their ability as it eliminates extraneous noise. Conversely, bad managers do not want the market to learn information. Accordingly, they do not hedge [Breeden and Viswanathan[12] , 1998]. In our model, all the existing information is already available to the market. Then, a priori good managers try to impede the learning process since they favor the statu quo while a priori bad managers want to facilitate this process since they want the market to modify its beliefs. This is possible since the risk-taking policy is observable.

Now consider the case where managers do not have privileged information regarding their talent and are risk-averse in the sense that they fear to have their wages reassessed. Whatever their talent, if their policy with respect to risk (either through a choice of project or through hedging) is observable, they have an incentive to impede the updating of beliefs process. This can take the form of a no-hedging policy [DeMarzo and Duffie, 1995] or a high-risk-taking policy [Hermalin, 1993]. We show that this motive still holds for the risk-neutral managers we consider provided they are a priori of the good type. However, a priori bad risk-neutral managers opts for the less risky projects to facilitate the learning process since the statu quo is detrimental to them.

Moreover what also differentiates our research from the above papers is that we analyze the impact of the risk-taking policy on the incentives to exert effort. Specifically, we show that because a priori good managers impede the learning process by favoring risk, this induces them to lower the level of effort they exert. Hence, the mechanism through which the profitability of firms is adversely impacted is different from what Hermalin considers: He simply assumes that the managers and the company owners interests about the risk-taking policy may not be aligned, while we show that risk-taking indirectly decreases profitability.

Finally, we investigate how company owners increase monitoring when a priori good managers try to impede the updating process. This second source of information is absent in the three papers analyzed above.

IV.E Implications

The framework we develop here allows for many contexts and sources of information. Consider the case of an engineer working in a R&D department and on the eve of being promoted. In order to keep her good reputation, she undertakes very risky projects. In such a case, her supervisor's reaction could be to adjust the number of engineers she has under her control since this would alter the accuracy of the assessment of their individual inputs. General partners periodically seek funds from limited partners to set up new venture capital funds. Well-established general partners are able to obtain better conditions than newcomers in the industry. Setting up a new fund thus implies a substantial increase in revenue for the general partners. To prevent the market from updating its beliefs regarding their types, they can increase the risk of the projects the current fund they manage invests in: For example, they select a high proportion of early-stage ventures they allocate funds to. The limited partners reaction is to bargain for more seats on the advisory board so as to better monitor the investments or to resort to gatekeepers. In the same vein, a divisional manager may benefit from launching ambitious programs of investment (more perks and fame associated to the increase of the size of the division). So as to keep her good reputation, she can undertake very risky ventures before the headquarters makes the expansion decision. The latter can obtain more accurate and non-manipulable information by carving out the division.

V. Concluding Remarks

In this paper, we show that the perspective of a promotion may not discipline managers that have a good reputation to keep. We also examine a possible reaction of their current employers: Resorting to a source of information the precision of which is not manipulable by the managers to facilitate the updating of beliefs process that good managers try to render difficult by undertaking risky projects.

We focus on implicit incentives and leave aside explicit devices. It would be worth extending the idea developed in the present paper to the context of risk aversion where implicit incentives are necessary to complement explicit mechanisms, particularly for managers who are at the beginning of their careers. Our results should be robust to such an extension.

APPENDIX

A. PROFITS AS THE UNIQUE SOURCE OF INFORMATION : PROOF OF PROPOSITION 1 AND PROPOSITION 2

First, we determine the choice of effort by the managers.

A.1 Choice of effort by the managers in the first period

Suppose that the market anticipates the equilibrium effort e^*. The manager chooses e so as to maximize

$$\mathbb{E}_{\pi_1}\left[\mathbb{E}_\theta(\theta \mid \pi_1, p_i, e^*)\right] + \chi + \Pr\left(\mathbb{E}(\theta \mid \pi_1, p_i, e^*) + \chi \geq \overline{\theta}\right)\Delta - \psi\left(e\right), \tag{17}$$

where

$$\pi_1 = \theta + r_{p_i} + e.$$

Assuming an interior solution, the first-order condition for an equilibrium is

$$\frac{\partial}{\partial e}\left[\int\left(\int \theta \frac{f\left(\theta, \pi_1 \mid p_i, e^*\right)}{\widehat{f}\left(\pi_1 \mid p_i, e^*\right)} d\theta\right) d\widehat{F}\left(\pi_1 \mid p_i, e\right) + \Pr\left(\mathbb{E}(\theta \mid \pi_1, p_i, e^*) + \chi \geq \overline{\theta}\right)\Delta\right]\Bigg|_{e=e^*} = \psi'\left(e^*\right),$$

or

$$\int\int \theta \frac{\widehat{f}_e\left(\pi_1 \mid p_i, e^*\right)}{\widehat{f}\left(\pi_1 \mid p_i, e^*\right)} f\left(\theta, \pi_1 \mid p_i, e^*\right) d\pi_1 d\theta + \frac{\partial \Pr\left(\mathbb{E}(\theta \mid \pi_1, p_i, e^*) + \chi \geq \overline{\theta}\right)\Delta}{\partial e} = \psi'\left(e^*\right), \tag{18}$$

where

$$\widehat{f}\left(\pi_1 \mid \right) = \int f\left(\pi_1, \theta \mid \right) d\theta \tag{19}$$

and $f\left(\pi_1, \theta \mid \right)$ denote respectively the marginal density of the observables and the joint density of the talent and of the observables, given the equilibrium level of effort e^* and the choice of project p_i. $\widehat{f}_e$ denotes the derivative of the marginal distribution with respect to effort.

Consider the first part on the left-hand side of equation (18). Since the likelihood ratio has zero mean, i.e. $\mathbb{E}\left(\frac{\widehat{f}_e}{\widehat{f}}\right) = 0$,

(20) $$\int\int \theta \frac{\widehat{f}_e\left(\pi_1 \mid p_i, e^*\right)}{\widehat{f}\left(\pi_1 \mid p_i, e^*\right)} f\left(\theta, \pi_1 \mid p_i, e^*\right) d\pi_1 d\theta = cov\left(\theta, \frac{\widehat{f}_e}{\widehat{f}}\right).$$

The marginal density $\widehat{f}\left(\pi_1 \mid p_i, e^*\right)$ is proportional to

$$\exp\left(-\frac{1}{2}\frac{\left(\pi_1 - \left(\mathbb{E}_\theta + e\right)\right)^2}{\sigma_\theta^2 + \sigma_{p_i}^2}\right),$$

and

$$\frac{\widehat{f}_e\left(.\right)}{\widehat{f}\left(.\right)} = \frac{\left(\theta - \mathbb{E}_\theta\right) + r_{p_i}}{\sigma_\theta^2 + \sigma_{p_i}^2}.$$

Thus, we obtain

(21) $$cov\left(\theta, \frac{\widehat{f}_e}{\widehat{f}}\right) = \frac{\sigma_\theta^2}{\sigma_\theta^2 + \sigma_{p_i}^2}.$$

Now turn to the second part on the left-hand side of equation (18). Applying statistic rules for computing a conditional expectation in the case of normal laws gives

(22) $$\mathbb{E}(\theta \mid \pi_1, p_i, e^*) = \mathbb{E}_\theta + \frac{\sigma_\theta^2}{\sigma_\theta^2 + \sigma_{p_i}^2}\left(\pi_1 - \mathbb{E}(\pi_1)\right),$$

which leads to

$$\Pr\left(\mathbb{E}(\theta \mid \pi_1, p_i, e^*) + \chi \geq \overline{\theta}\right) = 1 - \Phi\left(\frac{\left(\overline{\theta} - \left(\mathbb{E}_\theta + \chi\right)\right) + \frac{\sigma_\theta^2}{\sigma_\theta^2 + \sigma_{p_i}^2}\left(e^* - e\right)}{\frac{\sigma_\theta^2}{\left(\sigma_\theta^2 + \sigma_{p_i}^2\right)^{\frac{1}{2}}}}\right).$$

Thus,

(23)
$$\left.\frac{\partial \Pr\left(\mathbb{E}(\theta \mid \pi_1, p_i, e^*) + \chi \geq \overline{\theta}\right)}{\partial e}\right|_{e=e^*} = \frac{1}{\left(\sigma_\theta^2 + \sigma_{p_i}^2\right)^{\frac{1}{2}}}\frac{1}{\sqrt{2\pi}}\exp\left[-\frac{1}{2}\frac{\left(\overline{\theta} - \left(\mathbb{E}_\theta + \chi\right)\right)^2\left(\sigma_\theta^2 + \sigma_{p_i}^2\right)}{\sigma_\theta^4}\right].$$

Combining (21) and (23), and rearranging shows that the manager exerts an effort e^* that verifies

$$(24)\qquad \frac{\sigma_\theta^2}{\sigma_\theta^2+\sigma_{p_i}^2}+\frac{\Delta}{\left(\sigma_\theta^2+\sigma_{p_i}^2\right)^{\frac{1}{2}}}\frac{1}{\sqrt{2\pi}}\exp\left[-\frac{1}{2}\frac{\left(\overline{\theta}-(\mathbb{E}_\theta+\chi)\right)^2\left(\sigma_\theta^2+\sigma_{p_i}^2\right)}{\sigma_\theta^4}\right]=\psi'\left(e^*\right).$$

A.2 Choice of risk by the managers in the first-period

Managers choose p_i so as to maximize

$$(25)\qquad \mathbb{E}_{\pi_1}\left[\mathbb{E}_\theta(\theta\mid\pi_1,p_i,e^*)\right]+\chi+\Pr\left(\mathbb{E}(\theta\mid\pi_1,p_i,e^*)+\chi\geq\overline{\theta}\right)\times\Delta-\psi\left(e^*\left(p_i\right)\right).$$

According to equation (25), managers ground their risk decision by considering the cost of effort implied by the project and the probability to be promoted. They leave aside $\mathbb{E}_{\pi_1}\left[\mathbb{E}_\theta(\theta\mid\pi_1,p_i,e^*)\right]$ since at the equilibrium, the market perfectly anticipates e^* and observes the choice of project. Thus,

$$\mathbb{E}_{\pi_1}\left[\mathbb{E}_\theta(\theta\mid\pi_1,p_i,e^*)\right]=\mathbb{E}_{\pi_1}\left[\mathbb{E}_\theta(\theta\mid\pi_1(e^*),p_i,e^*)\right]=\mathbb{E}_\theta.$$

Consider a priori good managers. First, it appears from (24) that minimizing the cost of effort implies to maximize $\sigma_{p_i}^2$. Next, let us examine the probability of promotion: Using statistic rules for computing conditional expectations in the case of normal laws (see DeGroot 1970), we obtain $\mathbb{E}(\theta\mid\pi_1,p_i,e^*)\sim N\left(\mathbb{E}_\theta;\dfrac{\sigma_\theta^4}{\sigma_\theta^2+\sigma_{p_i}^2}\right)$. It indicates that raising $\sigma_{p_i}^2$ decreases the variance of $\mathbb{E}(\theta\mid\pi_1,p_i,e^*)$ and in turn maximizes the probability to be above the threshold $\overline{\theta}$. Indeed, $\mathbb{E}_\theta^g+\chi\geq\overline{\theta}$. Hence, overall, an a priori good manager opts for, p_B, the more risky project.

Now consider bad managers. Their situation is different. Since $\mathbb{E}_\theta^b+\chi<\overline{\theta}$, they maximize the probability of promotion when minimizing $\sigma_{p_i}^2$. However, minimizing $\sigma_{p_i}^2$ implies a higher cost of effort. Hence, the trade-off they face. A priori bad managers choose the less risky project p_A when

$$(26)\qquad \left[\begin{array}{c}-\psi\left(e^*\left(p_A\right)\right)\\+\Pr\left(\mathbb{E}(\theta\mid\pi_1,p_A,e^*)+\chi\geq\overline{\theta}\right)\Delta\end{array}\right]\geq\left[\begin{array}{c}-\psi\left(e^*\left(p_B\right)\right)\\+\Pr\left(\mathbb{E}(\theta\mid\pi_1,p_B,e^*)+\chi\geq\overline{\theta}\right)\Delta\end{array}\right],$$

which imposes that the additional revenue Δ is attractive enough: $\Delta \geq \overline{\Delta}\left(\mathbb{E}_{\theta}^{b}\right)$, with

$$\overline{\Delta}\left(\mathbb{E}_{\theta}^{b}\right) \overset{d}{=} \frac{\psi\left(e^{*}\left(p_{A}\right)\right)-\psi\left(e^{*}\left(p_{B}\right)\right)}{\Phi\left[\frac{\left(\sigma_{\theta}^{2}+\sigma_{p_{B}}^{2}\right)^{\frac{1}{2}}}{\sigma_{\theta}^{2}}\left(\overline{\theta}-\left(\mathbb{E}_{\theta}^{b}+\chi\right)\right)\right]-\Phi\left[\frac{\left(\sigma_{\theta}^{2}+\sigma_{p_{A}}^{2}\right)^{\frac{1}{2}}}{\sigma_{\theta}^{2}}\left(\overline{\theta}-\left(\mathbb{E}_{\theta}^{b}+\chi\right)\right)\right]}. \tag{27}$$

B. The report as a second source of information: Proofs of Proposition 3 and Proposition 4

B.1 Choice of effort by the managers in the first period

First, let us determine the equilibrium effort e^{*}. Suppose that the market anticipates both e^{*} and the monitoring level σ_{ϖ}^{2*}. The manager chooses e so as to maximize

$$\mathbb{E}_{\pi_1,\tau}\left[\mathbb{E}_{\theta}(\theta \mid \pi_1,\tau,p_i,\sigma_{\varpi}^{2*},e^{*})\right]+\chi+\Pr\left(\mathbb{E}(\theta \mid \pi_1,\tau,p_i,\sigma_{\varpi}^{2*},e^{*})+\chi \geq \overline{\theta}\right)\Delta-\psi\left(e\right).$$

Assuming an interior solution, the first-order condition for an equilibrium is

$$\frac{\partial}{\partial e}\left[\int\int\left(\int \theta\frac{f\left(\theta,\pi_1,\tau \mid p_i,\sigma_{\varpi}^{2*},e^{*}\right)}{\widehat{f}\left(\pi_1,\tau \mid p_i,\sigma_{\varpi}^{2*},e^{*}\right)}d\theta\right)d\widehat{F}\left(\pi_1,\tau \mid p_i,\sigma_{\varpi}^{2*},e\right)+\Pr\left(\mathbb{E}(\theta \mid \pi_1,\tau,p_i,\sigma_{\varpi}^{2*},e^{*})+\chi \geq \overline{\theta}\right)\Delta\right]\Bigg|_{e=e}$$
$$=\psi'\left(e^{*}\right),$$

or

$$\left(\begin{array}{c}\int\int\int \theta\frac{\widehat{f}_e\left(\pi_1,\tau \mid p_i,\sigma_{\varpi}^{2*},e^{*}\right)}{\widehat{f}\left(\pi_1,\tau \mid p_i,\sigma_{\varpi}^{2*},e^{*}\right)}f\left(\theta,\pi_1,\tau \mid p_i,\sigma_{\varpi}^{2*},e^{*}\right)d\theta d\pi_1 dp_i+\\ \frac{\partial \Pr\left(\mathbb{E}(\theta \mid \pi_1,\tau,p_i,\sigma_{\varpi}^{2*},e^{*})+\chi \geq \overline{\theta}\right)\Delta}{\partial e}\end{array}\right)=\psi'\left(e^{*}\right). \tag{28}$$

Consider the first part in the left-hand side of equation (28). Since the likelihood ratio has zero mean, i.e. $\mathbb{E}\left(\frac{\widehat{f}_e}{\widehat{f}}\right)=0$,

$$\int\int\int \theta\frac{\widehat{f}_e\left(\pi_1,\tau \mid p_i,\sigma_{\varpi}^{2*},e^{*}\right)}{\widehat{f}\left(\pi_1,\tau \mid p_i,\sigma_{\varpi}^{2*},e^{*}\right)}f\left(\theta,\pi_1,\tau \mid p_i,\sigma_{\varpi}^{2*},e^{*}\right)d\theta d\pi_1 d\tau = cov\left(\theta,\frac{\widehat{f}_e}{\widehat{f}}\right). \tag{29}$$

Note that $(\pi_1, \tau \mid p_i, \sigma_{\varpi}^{2*}, e^*)$ follows a normal law, because all the linear compositions of the elements of π_1 and τ (i.e. θ, r_{p_i}, ϖ) are normal since $\theta, r_{p_i},$ and ϖ are independent normal variables. Using Bayes' law, the marginal density can be decomposed as

$$\widehat{f}\left(\pi_1, \tau \mid p_i, \sigma_{\varpi}^{2*}, e^*\right) = g\left(\pi_1 \mid p_i, \sigma_{\varpi}^{2*}, e^*\right) h\left(\tau \mid \pi_1, p_i, \sigma_{\varpi}^{2*}, e^*\right),$$

with

$$g\left(\pi_1 \mid p_i, \sigma_{\varpi}^{2*}, e^*\right) \propto \exp\left(-\frac{1}{2}\frac{\left(\pi_1 - (\mathbb{E}_\theta + e)\right)^2}{\sigma_\theta^2 + \sigma_{p_i}^2}\right),$$

(30) $$\text{which implies that } \frac{g_e(.)}{g(.)} = \frac{(\theta - \mathbb{E}_\theta) + r_{p_i}}{\sigma_\theta^2 + \sigma_{p_i}^2}, \text{ and}$$

$$h\left(\tau \mid \pi_1, p_i, \sigma_{\varpi}^{2*}, e^*\right) \propto \exp -\frac{1}{2}\frac{\left(\tau - \mathbb{E}\left(\tau \mid \pi_1, p_i, \sigma_{\varpi}^{2*}, e^*\right)\right)^2}{Var\left(\tau \mid \pi_1, p_i, \sigma_{\varpi}^{2*}, e^*\right)},$$

(31) $$\text{which implies that } \frac{h_e(.)}{h(.)} = \frac{\tau - \mathbb{E}\left(\tau \mid \pi_1, p_i, \sigma_{\varpi}^{2*}, e^*\right)}{Var\left(\tau \mid \pi_1, p_i, \sigma_{\varpi}^{2*}, e^*\right)}.$$

Applying statistic rules for computing expectations and variances in the case of normal laws, we obtain

$$\mathbb{E}\left(\tau \mid \pi_1, p_i, \sigma_{\varpi}^{2*}, e^*\right) = \mathbb{E}(\tau) + \frac{\sigma_\theta^2}{\sigma_\theta^2 + \sigma_{p_i}^2}\left(\pi_1 - \mathbb{E}(\pi_1)\right) \text{ and}$$

$$Var\left(\tau \mid \pi_1, p_i, \sigma_{\varpi}^{2*}, e^*\right) = \frac{\sigma_\theta^2\left(\sigma_{p_i}^2 + \sigma_{\varpi}^{2*}\right) + \sigma_{p_i}^2\sigma_{\varpi}^{2*}}{\sigma_\theta^2 + \sigma_{p_i}^2}.$$

Combining (30) and (31) allows us to rewrite (29) as

(32) $$cov\left(\theta, \frac{\widehat{f}_e}{\widehat{f}}\right) = \frac{\sigma_\theta^2}{\sigma_\theta^2 + \sigma_{p_i}^2} + \frac{\sigma_\theta^2\sigma_{p_i}^2}{\sigma_\theta^2\left(\sigma_{p_i}^2 + \sigma_{\varpi}^{2*}\right) + \sigma_{p_i}^2\sigma_{\varpi}^{2*}}.$$

Now turn to the second part in the left-hand-side of equation (28). Applying statistic rules for computing a conditional expectation in the case of normal laws gives

$$\mathbb{E}(\theta \mid \pi_1, \tau, p_i, \sigma_{\varpi}^{2*}, e^*) = \frac{\begin{pmatrix} \mathbb{E}_\theta\sigma_{p_i}^2\sigma_{\varpi}^{2*} - e^*\left(\sigma_{p_i}^2 + \sigma_{\varpi}^{2*}\right)\sigma_\theta^2 \\ +(\theta + e)\,\sigma_\theta^2\left(\sigma_{p_i}^2 + \sigma_{\varpi}^{2*}\right) + \sigma_\theta^2\sigma_{p_i}^2\varpi + \sigma_\theta^2 r_{p_i}\sigma_{\varpi}^{2*} \end{pmatrix}}{\sigma_\theta^2\left(\sigma_{p_i}^2 + \sigma_{\varpi}^{2*}\right) + \sigma_{p_i}^2\sigma_{\varpi}^{2*}},$$

which leads to

$$\Pr\left(\mathbb{E}(\theta \mid \pi_1, \tau, p_i, \sigma_\varpi^{2*}, e^*) + \chi \geq \overline{\theta}\right) =$$
$$1 - \Phi\left(\frac{\left(\overline{\theta} - (\mathbb{E}_\theta + \chi)\right)\left(\sigma_\theta^2\left(\sigma_{p_i}^2 + \sigma_\varpi^{2*}\right) + \sigma_{p_i}^2\sigma_\varpi^{2*}\right) + (e^* - e)\,\sigma_\theta^2\left(\sigma_{p_i}^2 + \sigma_\varpi^{2*}\right)}{\sigma_\theta^2\left[\sigma_{r_{p_i}}^4\left(\sigma_\theta^2 + \sigma_\varpi^{2*}\right) + \left(\sigma_\theta^2 + \sigma_{r_{p_i}}^4\right)\sigma_\varpi^{4*}\right]^{\frac{1}{2}}}\right).$$

Thus, the second part in the left-hand side of equation (28) can be rewritten as

$$\left.\frac{\partial \Pr\left(\mathbb{E}(\theta \mid \pi_1, \tau, p_i, \sigma_\varpi^{2*}, e^*) + \chi \geq \overline{\theta}\right)}{\partial e}\right|_{e=e^*} =$$

(33)
$$\frac{\sigma_{p_i}^2 + \sigma_\varpi^{2*}}{\left[\sigma_{r_{p_i}}^4\left(\sigma_\theta^2 + \sigma_\varpi^{2*}\right) + \left(\sigma_\theta^2 + \sigma_{r_{p_i}}^4\right)\sigma_\varpi^{4*}\right]^{\frac{1}{2}}}\frac{1}{\sqrt{2\pi}}\exp\left[-\frac{1}{2}\frac{\left(\overline{\theta} - (\mathbb{E}_\theta + \chi)\right)^2\left(\sigma_\theta^2\left(\sigma_{p_i}^2 + \sigma_\varpi^{2*}\right) + \sigma_{p_i}^2\sigma_\varpi^{2*}\right)^2}{\sigma_\theta^4\left[\sigma_{r_{p_i}}^4\left(\sigma_\theta^2 + \sigma_\varpi^{2*}\right) + \left(\sigma_\theta^2 + \sigma_{r_{p_i}}^4\right)\sigma_\varpi^{4*}\right]}\right].$$

Combining (32) and (33), and rearranging shows that the manager exerts an effort e^* that verifies

(34)
$$\begin{array}{c}\frac{\sigma_\theta^2}{\sigma_\theta^2 + \sigma_{p_i}^2} + \frac{\sigma_\theta^2\sigma_{p_i}^2}{\sigma_\theta^2\left(\sigma_{p_i}^2 + \sigma_\varpi^{2*}\right) + \sigma_{p_i}^2\sigma_\varpi^{2*}} + \\ \frac{\left(\sigma_{p_i}^2 + \sigma_\varpi^{2*}\right)\Delta}{\left[\sigma_{r_{p_i}}^4\left(\sigma_\theta^2 + \sigma_\varpi^{2*}\right) + \left(\sigma_\theta^2 + \sigma_{p_i}^2\right)\sigma_\varpi^{4*}\right]^{\frac{1}{2}}}\frac{1}{\sqrt{2\pi}}\exp\left[-\frac{1}{2}\frac{\left(\overline{\theta} - (\mathbb{E}_\theta + \chi)\right)^2\left(\sigma_\theta^2\left(\sigma_{p_i}^2 + \sigma_\varpi^{2*}\right) + \sigma_{p_i}^2\sigma_\varpi^{2*}\right)^2}{\sigma_\theta^4\left[\sigma_{r_{p_i}}^4\left(\sigma_\theta^2 + \sigma_\varpi^{2*}\right) + \left(\sigma_\theta^2 + \sigma_{p_i}^2\right)\sigma_\varpi^{4*}\right]}\right]\end{array} = \psi'\left(e^*\right).$$

For reading convenience, we define

(35)
$$v(.) \stackrel{d}{=} \frac{\sigma_{p_i}^2 + \sigma_\varpi^{2*}}{\left[\sigma_{r_{p_i}}^4\left(\sigma_\theta^2 + \sigma_\varpi^{2*}\right) + \left(\sigma_\theta^2 + \sigma_{p_i}^2\right)\sigma_\varpi^{4*}\right]^{\frac{1}{2}}}\frac{1}{\sqrt{2\pi}}\exp\left[-\frac{1}{2}\frac{\left(\overline{\theta} - (\mathbb{E}_\theta + \chi)\right)^2\left(\sigma_\theta^2\left(\sigma_{p_i}^2 + \sigma_\varpi^{2*}\right) + \sigma_{p_i}^2\sigma_\varpi^{2*}\right)^2}{\sigma_\theta^4\left[\sigma_{r_{p_i}}^4\left(\sigma_\theta^2 + \sigma_\varpi^{2*}\right) + \left(\sigma_\theta^2 + \sigma_{p_i}^2\right)\sigma_\varpi^{4*}\right]}\right]$$

and

$$j(.) \stackrel{d}{=} \frac{\sigma_\theta^2}{\sigma_\theta^2 + \sigma_{p_i}^2} + \frac{\sigma_\theta^2\sigma_{p_i}^2}{\sigma_\theta^2\left(\sigma_\varpi^{2*} + \sigma_{p_i}^2\right) + \sigma_\varpi^{2*}\sigma_{p_i}^2} + v(.) \times \Delta.$$

B.2 Choice of monitoring by company owners

Based on the observed project p_i, company owners choose the level of monitoring that maximizes the firm's first-period expected net profits:

(36)
$$\sigma_\varpi^{2*} = \underset{\sigma_\varpi^2}{\arg\max}\,\mathbb{E}\left(\pi_1\left(\theta, r_{p_i}, e^*\right) \mid p_i\right) - W_1(\mathbb{E}_\theta) - c\left(\sigma_\varpi^2\right).$$

The first-order condition of this concave program[13] reduces to

$$\frac{\partial e^*}{\partial \sigma_\varpi^2} = c'\left(\sigma_\varpi^{2*}\right), \tag{37}$$

since $W_1(\mathbb{E}_\theta)$ is already fixed. After computations, equation (37) reduces to

(38)

$$\left(\frac{\sigma_\theta^2\sigma_{p_i}^2\left(\sigma_\theta^2+\sigma_{p_i}^2\right)}{\left[\sigma_\theta^2\left(\sigma_{p_i}^2+\sigma_\varpi^{2*}\right)+\sigma_{p_i}^2\sigma_\varpi^{2*}\right]^2} - \frac{\partial v\left(\overline{\theta},\mathbb{E}_\theta,\chi,\sigma_\theta^2,\sigma_{p_i}^2,\sigma_\varpi^2\right)}{\partial \sigma_\varpi^2}\Delta\right)(\psi'^{-1})'\left(j\left(\overline{\theta},\mathbb{E}_\theta,\chi,\sigma_\theta^2,\sigma_{p_i}^2,\sigma_\varpi^2\right)\right)$$
$$= \underbrace{-c'\left(\sigma_\varpi^{2*}\right)}_{>0},$$

where ψ'^{-1} is the reciprocal function of ψ'. The left-hand side of (38) represents the marginal gain when there is more monitoring: When σ_ϖ^2 decreases, the equilibrium level of effort e^* increases. The right-hand side of equation (38) corresponds to the marginal cost when there is more monitoring: When σ_ϖ^2 decreases, $c\left(\sigma_\varpi^2\right)$ increases.

According to the left-hand side of (38), $\frac{\partial e^*}{\partial \sigma_\varpi^2}$ is positive when $\sigma_{p_i}^2$ is high enough since

$$\left(\psi'^{-1}\right)'(e) = \frac{1}{\psi''\left(\psi'^{-1}(e)\right)} \geq 0 \text{ since } \psi''(e) > 0,$$

and $-\frac{\partial v(\,)}{\partial \sigma_\varpi^2}$ is strictly positive if $\sigma_{p_i}^2$ is high enough. This implies that company owners exert a strictly positive monitoring effort.

Note that it may be the case that $\frac{\partial e^*}{\partial \sigma_\varpi^2}$ is negative when $\sigma_{p_A}^2$ is low enough and $(\mathbb{E}_\theta + \chi)$ takes intermediate values with respect to the threshold $\overline{\theta}$ (see (35)). Then, more monitoring implies less effort at the equilibrium. Since monitoring is costly, it is not valuable for corporate owners. Then, the latter only use accounting profits for updating beliefs about managers.

Let us consider the impact of a shift from p_B to p_A on the monitoring level. Consider the marginal gain of monitoring given by equation (38). It is higher for p_B than for p_A if

$$\left(\frac{\sigma_\theta^2\sigma_{p_i}^2\left(\sigma_\theta^2+\sigma_{p_i}^2\right)}{\left[\sigma_\theta^2\left(\sigma_\varpi^2+\sigma_{p_i}^2\right)+\sigma_\varpi^2\sigma_{p_i}^2\right]^2}-\frac{\partial v\left(.\right)}{\partial\sigma_\varpi^2}\times\Delta\right)(\psi'^{-1})'\left(j\left(\overline{\theta},\mathbb{E}_\theta,\chi,\sigma_\theta^2,\sigma_{p_i}^2,\sigma_\varpi^2\right)\right)\Bigg|_{\sigma_{p_i}^2=\sigma_{p_B}^2}$$

$$(39)\quad >\left(\frac{\sigma_\theta^2\sigma_{p_i}^2\left(\sigma_\theta^2+\sigma_{p_i}^2\right)}{\left[\sigma_\theta^2\left(\sigma_\varpi^2+\sigma_{p_i}^2\right)+\sigma_\varpi^2\sigma_{p_i}^2\right]^2}-\frac{\partial v\left(.\right)}{\partial\sigma_\varpi^2}\times\Delta\right)(\psi'^{-1})'\left(j\left(\overline{\theta},\mathbb{E}_\theta,\chi,\sigma_\theta^2,\sigma_{p_i}^2,\sigma_\varpi^2\right)\right)\Bigg|_{\sigma_{p_i}^2=\sigma_{p_A}^2}.$$

First, remark that

$$\frac{\sigma_\theta^2\sigma_{p_B}^2\left(\sigma_\theta^2+\sigma_{p_B}^2\right)}{\left[\sigma_\theta^2\left(\sigma_\varpi^2+\sigma_{p_B}^2\right)+\sigma_\varpi^2\sigma_{p_B}^2\right]^2}>\frac{\sigma_\theta^2\sigma_{p_A}^2\left(\sigma_\theta^2+\sigma_{p_A}^2\right)}{\left[\sigma_\theta^2\left(\sigma_\varpi^2+\sigma_{p_A}^2\right)+\sigma_\varpi^2\sigma_{p_A}^2\right]^2}\text{ if and only if:}$$

$$\sigma_{p_B}^2>\frac{1}{\sigma_\theta^2\left(\sigma_{p_A}^2+\sigma_\varpi^2\right)+\sigma_\varpi^2\sigma_{p_A}^2}\left[\sigma_{r_{p_A}}^4\left(\sigma_\theta^2+\sigma_\varpi^2\right)-\sigma_\theta^4\sigma_\varpi^2+\frac{\sigma_\theta^2\left(\sigma_\theta^2\sigma_{p_A}^2\sigma_\varpi^2+\sigma_\varpi^2\sigma_{r_{p_A}}^4\right)}{\sigma_{p_B}^2}\right].$$

Next, $\sigma_{p_B}^2$ high enough and $\sigma_{p_A}^2$ low enough ensure that

$$-\frac{\partial v\left(.\right)}{\partial\sigma_\varpi^2}_{\sigma_{p_i}^2=\sigma_{p_B}^2}>-\frac{\partial v\left(.\right)}{\partial\sigma_\varpi^2}_{\sigma_{p_i}^2=\sigma_{p_A}^2}.$$

Finally,

$$\left(\psi'^{-1}\right)''\left(j\left(.\right)\right)=-\frac{\left(\psi'^{-1}\right)'(e)\psi'''\left(\psi'^{-1}(e)\right)}{\left(\psi''\left(\psi'^{-1}(e)\right)\right)^2}<0\text{ since }\left(\psi'^{-1}\right)'(e)>0\text{ and if }\psi'''(e)>0.$$

Moreover,

$$j\left(\overline{\theta},\mathbb{E}_\theta,\chi,\sigma_\theta^2,\sigma_{p_i}^2,\sigma_\varpi^2\right)_{\sigma_{p_i}^2=\sigma_{p_B}^2}<j\left(\overline{\theta},\mathbb{E}_\theta,\chi,\sigma_\theta^2,\sigma_{p_i}^2,\sigma_\varpi^2\right)_{\sigma_{p_i}^2=\sigma_{p_A}^2}$$

if and only if $\sigma_{p_B}^2$ is high enough and $\sigma_{p_A}^2$ is low enough. To summarize, under the conditions that $\sigma_{p_B}^2$ is high enough and $\sigma_{p_A}^2$ is low enough, the marginal gain of monitoring is higher when $\sigma_{p_i}^2=\sigma_{p_B}^2$ than when $\sigma_{p_i}^2=\sigma_{p_A}^2$, whereas the marginal cost of monitoring, $-c'\left(\sigma_\varpi^2\right)$, does not depend on $\sigma_{p_i}^2$. Therefore, the level of monitoring chosen by the corporate owners is higher when a manager chooses p_B rather than p_A.

B.3 Choice of risk by the managers in the first period

When choosing a project or equivalently a level of risk, managers take two elements into account: The cost of effort and the probability to be promoted.

B.3.1 A priori bad managers

First, consider a priori bad managers.

Probability of promotion

Let us first consider the total effect of a shift from project p_B to project p_A on the probability to be promoted at $e = e^*$. For a given level of monitoring chosen by company owners σ^2_{ϖ}, this probability is

$$\Pr\left(\mathbb{E}(\theta \mid \pi_1, \tau, p_i, \sigma^2_{\varpi}, e^*) + \chi \geq \overline{\theta}\right) = 1 - \Phi\left(\frac{\left(\overline{\theta} - (\mathbb{E}_\theta + \chi)\right)\left(\sigma^2_\theta\left(\sigma^2_{p_i} + \sigma^2_{\varpi}\right) + \sigma^2_{p_i}\sigma^2_{\varpi}\right)}{\sigma^2_\theta\left[\sigma^4_{r_{p_i}}\left(\sigma^2_\theta + \sigma^2_{\varpi}\right) + \left(\sigma^2_\theta + \sigma^2_{p_i}\right)\sigma^4_{\varpi}\right]^{\frac{1}{2}}}\right).$$

Two effects are at work.

There is a direct effect that results from a shift from p_B to p_A on this probability. Let $\mathcal{I}(.) \overset{d}{=} \dfrac{\left(\sigma^2_\theta\left(\sigma^2_{p_i} + \sigma^2_{\varpi}\right) + \sigma^2_{p_i}\sigma^2_{\varpi}\right)}{\sigma^2_\theta\left[\sigma^4_{p_i}\left(\sigma^2_\theta + \sigma^2_{\varpi}\right) + \left(\sigma^2_\theta + \sigma^2_{p_i}\right)\sigma^4_{\varpi}\right]^{\frac{1}{2}}}$. Note that for $\sigma^2_{p_B}$ high enough and $\sigma^2_{p_A}$ low enough, we have $\mathcal{I}\left(\sigma^2_\theta, \sigma^2_{p_i}, \sigma^2_{\varpi}\right)\Big|_{\sigma^2_{p_i} = \sigma^2_{p_B}} > \mathcal{I}\left(\sigma^2_\theta, \sigma^2_{p_i}, \sigma^2_{\varpi}\right)\Big|_{\sigma^2_{p_i} = \sigma^2_{p_A}}$. Since $\Phi(.)$ is increasing and $\mathbb{E}^b_\theta + \chi < \overline{\theta}$,

$$1 - \Phi\left(\left(\overline{\theta} - (\mathbb{E}_\theta + \chi)\right) \times \mathcal{I}\left(\sigma^2_\theta, \sigma^2_{p_B}, \sigma^2_{\varpi}\right)\right) < 1 - \Phi\left(\left(\overline{\theta} - (\mathbb{E}_\theta + \chi)\right) \times \mathcal{I}\left(\sigma^2_\theta, \sigma^2_{p_A}, \sigma^2_{\varpi}\right)\right).$$

Thus, the direct effect is positive for a priori bad managers.

The indirect effect corresponds to the impact of a shift from p_B to p_A on the equilibrium level of monitoring σ^{2*}_{ϖ}, times the effect of the level of monitoring on this probability. Assuming that $\sigma^2_{p_i}$ is high enough ensures that

$$\frac{\partial \Pr\left(\mathbb{E}(\theta \mid \pi_1, \tau, p_i, \sigma^2_{\varpi}, e^*) + \chi \geq \overline{\theta}\right)}{\partial \sigma^2_{\varpi}} = -\frac{\left(\overline{\theta} - (\mathbb{E}_\theta + \chi)\right)}{\sigma^2_\theta} \times \mathcal{U}\left(\sigma^2_\theta, \sigma^2_{p_i}, \sigma^2_{\varpi}\right)$$
$$\times \frac{1}{\sqrt{2\pi}} \exp\left[-\frac{1}{2}\frac{\left(\overline{\theta} - (\mathbb{E}_\theta + \chi)\right)^2 \left(\sigma^2_\theta\left(\sigma^2_{p_i} + \sigma^2_{\varpi}\right) + \sigma^2_{p_i}\sigma^2_{\varpi}\right)^2}{\sigma^4_\theta\left[\sigma^4_{r_{p_i}}\left(\sigma^2_\theta + \sigma^2_{\varpi}\right) + \left(\sigma^2_\theta + \sigma^4_{r_{p_i}}\right)\sigma^4_{\varpi}\right]}\right] < 0,$$
$$\text{with } \mathcal{U}(.) \stackrel{d}{=} \frac{\sigma^6_{r_{p_i}}\left(\sigma^2_\theta + \sigma^2_{\varpi}\right) + \sigma^4_{r_{p_i}}\left(2\sigma^4_\theta - \sigma^2_\theta\sigma^2_{\varpi}\right) - 2\sigma^4_\theta\sigma^2_{p_i}\sigma^2_{\varpi}}{2\left[\sigma^4_{r_{p_i}}\left(\sigma^2_\theta + \sigma^2_{\varpi}\right) + \left(\sigma^2_\theta + \sigma^2_{p_i}\right)\sigma^4_{\varpi}\right]^{\frac{3}{2}}},$$

since $\mathbb{E}_\theta + \chi < \overline{\theta}$. Hence, more monitoring raises the probability of promotion for a priori bad managers. Besides, the level of monitoring chosen by corporate owners decreases when a manager chooses p_A rather than p_B (see B.2) when $\sigma^2_{p_B}$ is high enough and $\sigma^2_{p_A}$ is low enough. Therefore, the indirect effect is negative for a priori bad managers.

Hence, the direct and the indirect effect go into two opposite directions. However, if $c'''\left(\sigma^2_{\varpi}\right)$ is negative and if $c''\left(\sigma^{2*}_{\varpi}\left(\sigma^2_{p_A}\right)\right)$ is high enough, the difference in terms of monitoring between project p_A and project p_B is low ($\sigma^{2*}_{\varpi}\left(\sigma^2_{p_A}\right)$ close to $\sigma^{2*}_{\varpi}\left(\sigma^2_{p_B}\right)$) and the indirect effect is low. Thus, the total effect of a shift from p_B to p_A on the probability to be promoted at $e = e^*$ is positive for a priori bad managers. However, this also implies a variation in the equilibrium level of effort e^* we now investigate.

Cost of effort

Let us examine the total effect of a shift from p_B to p_A on e^*. This total effect consists of a direct effect (i.e. the effect of $\sigma^2_{p_i}$ on e^*), as well as of an indirect effect (i.e. the effect of $\sigma^2_{p_i}$ on σ^{2*}_{ϖ}, times the effect of σ^2_{ϖ} on e^*).

First consider the direct effect, that is, for a given σ^2_{ϖ}. We have

$$j\left(\overline{\theta}, \mathbb{E}_\theta, \chi, \sigma^2_\theta, \sigma^2_{p_i}, \sigma^2_{\varpi}\right)_{\sigma^2_{p_i} = \sigma^2_{p_B}} < j\left(\overline{\theta}, \mathbb{E}_\theta, \chi, \sigma^2_\theta, \sigma^2_{p_i}, \sigma^2_{\varpi}\right)_{\sigma^2_{p_i} = \sigma^2_{p_A}}$$

if and only if $\sigma^2_{p_B}$ is high enough and $\sigma^2_{p_A}$ is low enough. Note that $\left(\psi'^{-1}\right)''(j(.)) < 0$ if $\psi'''(e) > 0$.

Thus, the direct effect on the equilibrium cost of effort is negative: For a given σ^2_ϖ, e^* increases when a manager chooses p_A rather than p_B.

Next turn to the indirect effect. As shown above, monitoring increases the equilibrium level of effort e^*. Besides, the level of monitoring chosen by corporate owners decreases when managers choose p_A rather than p_B under the *sufficient* conditions that $\sigma^2_{p_B}$ is high enough and $\sigma^2_{p_A}$ is low enough. Thus, the indirect effect of a shift to the less risky project on the cost incurred by a priori bad managers is positive.

Insert FIGURE III: ILLUSTTRATION, here.

Hence, the direct and the indirect effect go into two opposite directions. However, if $c'''\left(\sigma^2_\varpi\right)$ is negative and if $c''\left(\sigma^{2*}_\varpi\left(\sigma^2_{p_A}\right)\right)$ is high enough, the difference in terms of monitoring between project p_B and project p_A is low (i.e. $\sigma^{2*}_\varpi\left(\sigma^2_{p_B}\right)$ close to $\sigma^{2*}_\varpi\left(\sigma^2_{p_A}\right)$) and the indirect effect is low. Then, the total effect of a shift from p_B to p_A on the equilibrium cost of effort is negative.

Conclusion

A priori bad managers face a trade-off between increasing the probability to be promoted or reducing the cost of effort when they choose the first-period project. Overall, a priori bad managers choose the less risky project when

$$\left[\begin{array}{c} -\psi\left(e^*\left(p_A\right)\right) \\ +\Pr\left(\mathbb{E}(\theta \mid \pi_1, \tau, p_A, \sigma^{2*}_\varpi\left(p_A\right), e^*) + \chi \geq \overline{\theta}\right)\Delta \end{array}\right] \geq \left[\begin{array}{c} -\psi\left(e^*\left(p_B\right)\right) \\ +\Pr\left(\mathbb{E}(\theta \mid \pi_1, \tau, p_B, \sigma^{2*}_\varpi\left(p_B\right), e^*) + \chi \geq \overline{\theta}\right)\Delta \end{array}\right],$$

which imposes that the additional revenue Δ is attractive enough: $\Delta \geq \underline{\Delta}\left(\mathbb{E}_\theta^b\right)$, with

$$\underline{\Delta}\left(\mathbb{E}_\theta^b\right) \stackrel{d}{=} \frac{\psi\left(e^*\left(p_A\right)\right)-\psi\left(e^*\left(p_B\right)\right)}{\left\{\begin{array}{l}\Phi\left[\frac{\left(\overline{\theta}-\left(\mathbb{E}_\theta^b+\chi\right)\right)\left(\sigma_\theta^2\left(\sigma_{p_B}^2+\sigma_\varpi^{2*}(p_B)\right)+\sigma_{p_B}^2\sigma_\varpi^{2*}(p_B)\right)}{\sigma_\theta^2\left[\sigma_{r_{p_B}}^4\left(\sigma_\theta^2+\sigma_\varpi^{2*}(p_B)\right)+\left(\sigma_\theta^2+\sigma_{p_B}^2\right)\sigma_\varpi^{4*}(p_B)\right]^{\frac{1}{2}}}\right] \\ -\Phi\left[\frac{\left(\overline{\theta}-\left(\mathbb{E}_\theta^b+\chi\right)\right)\left(\sigma_\theta^2\left(\sigma_{p_A}^2+\sigma_\varpi^{2*}(p_A)\right)+\sigma_{p_A}^2\sigma_\varpi^{2*}(p_A)\right)}{\sigma_\theta^2\left[\sigma_{r_{p_A}}^4\left(\sigma_\theta^2+\sigma_\varpi^{2*}(p_A)\right)+\left(\sigma_\theta^2+\sigma_{p_A}^2\right)\sigma_\varpi^{4*}(p_A)\right]^{\frac{1}{2}}}\right]\end{array}\right\}}.$$

B.3.2 A priori good managers

Next, turn to a priori good managers. Assume that $c'''\left(\sigma_\varpi^2\right)$ is negative and if $c''\left(\sigma_\varpi^{2*}\left(\sigma_{p_A}^2\right)\right)$, $\sigma_{p_B}^2$ is high enough and $\sigma_{p_A}^2$ is low enough. Minimizing the cost of effort implies to maximize $\sigma_{p_i}^2$. Maximizing the probability of promotion imposes to raise $\sigma_{p_i}^2$. Hence, overall, an a priori good manager opts for p_B, the more risky project.

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NOTES

1. For a general discussion on career concerns models, we shall refer the reader to Dewatripont, Jewitt and Tirole [1999, part I], who develop a general model of career concerns with multiple tasks and multiple signals.

2. See also Hermalin [1993] who presents a theoretical model of choice of risk by risk-averse managers in a career concerns setting. DeMarzo and Duffie [1995] develop a model of hedging in the same vein.

3. The choice of risk can also be interpreted as a choice of hedging policy. Generally Accepted Accounting Procedures do not impose on those who run firms (i.e. managers) to disclose their hedging decisions. However, company owners have privileged information regarding these hedging policies: They observe the choices managers make but are unable to write contracts contingent on this soft information.

4. Biais and Casamatta [1999] in the spirit of Jensen (1986) also study the case of managers exerting effort and choosing the risk of their ventures. However, both choices are unobservable in their paper which differs from our assumption that the choice of risk is observable. Moreover, they examine explicit incentives whereas we consider implicit incentives.

5. $\Pr\left(E(\theta \mid) + \chi \geq \overline{\theta}\right)$ is the probability that the random variable $E(\theta \mid)$ plus the term χ is higher than the threshold $\overline{\theta}$.

6. Note that even if the choice of risk was not observable, at the equilibrium, the market would perfectly anticipate it so that $\mathbb{E}_{\pi_1}\left[\mathbb{E}_{\theta}(\theta \mid \pi_1, p^*, e^*)\right] = \mathbb{E}_{\pi_1}\left[\mathbb{E}_{\theta}(\theta \mid \pi_1(p^*, e^*), p^*, e^*)\right] = \mathbb{E}_{\theta}$ would obtain.

7. Applying statistic rules for computing conditional expectations in the case of normal laws gives $\mathbb{E}(\theta \mid \pi_1, p_i, e^*) = \mathbb{E}_\theta + \frac{\sigma_\theta^2}{\sigma_\theta^2 + \sigma_{p_i}^2} [\pi_1 - \mathbb{E}\pi_1]$. Hence, $\mathbb{E}(\theta \mid \pi_1, p_i, e^*) \sim N\left(\mathbb{E}_\theta; \frac{\sigma_\theta^4}{\sigma_\theta^2 + \sigma_{p_i}^2}\right)$.

8. $\Phi()$ is the cumulative distribution of $N(0,1)$.

9. Several monitoring technologies are available. In our companion paper, we investigate the role of financial markets monitoring as a second source of information.

10. We refer the reader to the Appendix, proof of Proposition 3, for a discussion of the solution given by equation (16) as the global solution to the company owners' choice of monitoring.

11. The proof regarding the strict concavity of the objective function is available on request to the authors. It is derived from characteristics of the cost function c, i.e. strict convexity and $c''(\sigma_\omega^2)$ high enough.

12. As for managers lying in the intermediate ability-range, the results are mixed. Besides, Breeden and Viswanathan show that there exists a non-intuitive equilibrium where good managers decide not to hedge

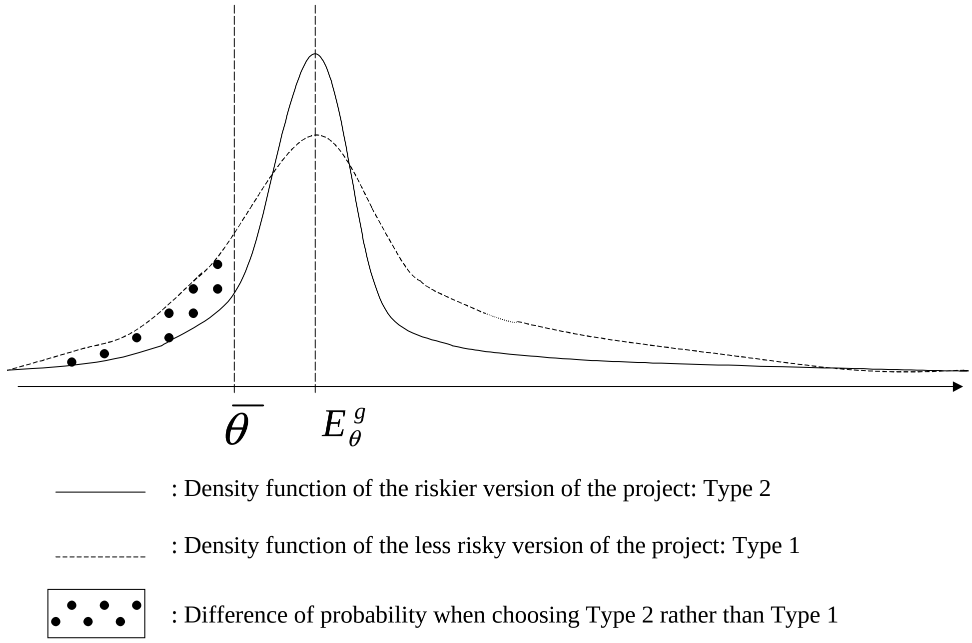
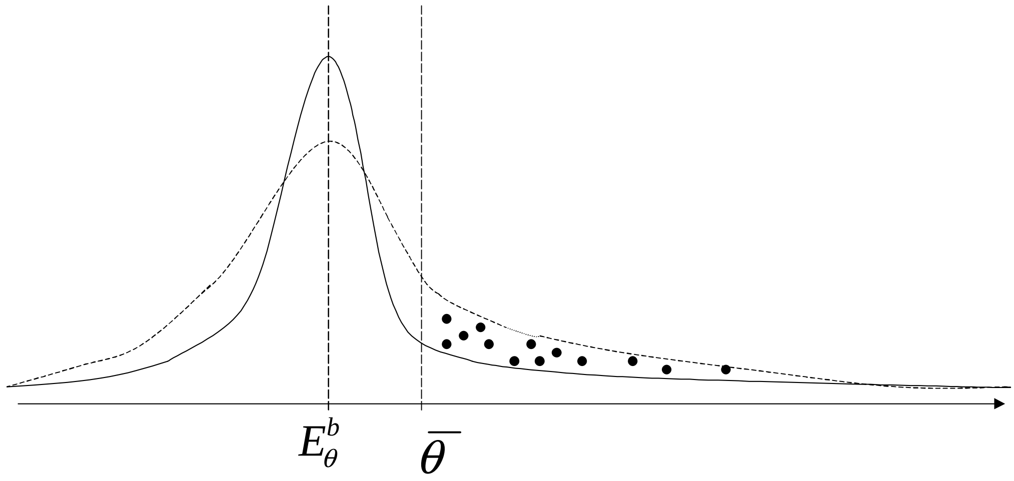


FIGURE I:: A PRIORI GOOD MANAGERS



: Density function of the riskier version of the project: Type 2

: Density function of the less risky version of the project: Type 1

: Difference of probability when choosing Type 1 rather than Type 2

FIGURE II: A PRIORI BAD MANAGERS

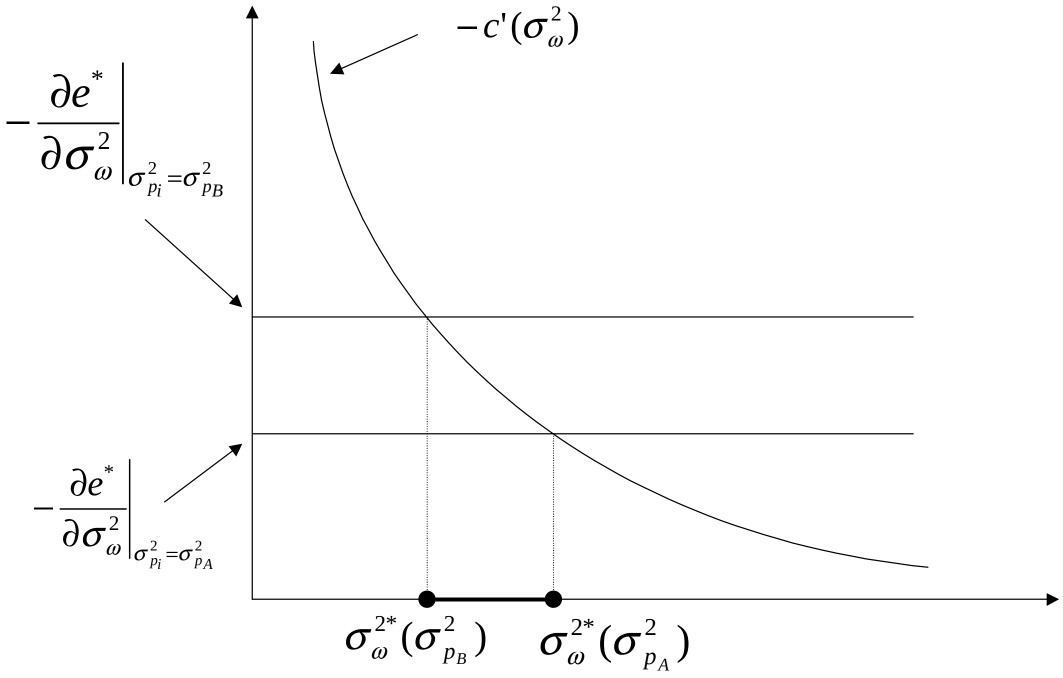


FIGURE III: ILLUSTRATION

For $c'''(\sigma^2_\varpi) < 0,$ when $c''\left(\sigma^{2*}_\varpi\left(\sigma^2_{p_A}\right)\right)$ is high enough, then the difference $\sigma^{2*}_\varpi\left(\sigma^2_{p_A}\right) - \sigma^{2*}_\varpi\left(\sigma^2_{p_B}\right)$ is low.