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# Job assignments as a screening device *

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**Abstract**

We study intra-firm competition for promotions when the ability of the competing candidates is imperfectly observed. We show that firms should offer the jobs that require the highest degree of involvement to the candidates whose ability is known with least certainty (typically, juniors and outsiders) because these individuals have the strongest career-concern incentives to perform efficiently. Also, when firms have to delegate the selection of the screening procedure to their insider candidates, then the proportion of internal promotions relative to external hirings is excessively high.

**Keywords**: Screening, job allocation, delegation, favoritism, career concerns.

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# 1 Introduction

Selection and promotion of the most able employees is a key determinant of the economic performance of firms. It is therefore not surprising to observe that most organizations devote a substantial amount of resources to *screen* candidates, through an implicit or explicit system of relative performance evaluation. The screening procedure can be roughly divided in two steps: first, each employee's ability or capacity to perform in the firm is accurately tested against that of his peers, then the most suitable candidate is selected for the job (or promoted).[1]

The mechanisms behind these evaluation and selection processes may look trivial. For instance, suppose that the manager is forced to delegate the design of the screening procedure to one of the job-candidates. One might think that such delegation is relatively less costly when the candidate in charge of the screening is –on average– better than his competitors. Given his a priori dominance, he might want to design a process as efficient as possible (i.e one that reveals the maximum amount of information to the manager) in order to prove his superiority. In fact, the opposite is true: relying on the employees' choice of the screening process is more costly the higher the expected quality of the individual to whom this decision is delegated. This was first pointed out by Baliga and Sjöström (2001), and it constitutes the starting point of the paper.

Consider the following situation. Two candidates compete for one position in an organization. Their "talent" or "fit between their ability and the needs of the organization" is partly unknown both to the organization and to the individuals themselves. More precisely, we assume that candidates differ both in their expected ability and in the variance of this estimation: the ability of the employee already working in the firm –the "senior" or "incumbent"– is less uncertain than that of a recent hire or an individual from the job market –the "junior" or "outsider". We further assume that there is a fixed number of screening tasks that serve to imperfectly evaluate the true capacity of the two candidates. Each task can be performed by one and only one of them. Given that the (risk-neutral) manager wants to appoint the candidate with highest ability among the two, he will use these tasks to elicit as much information as possible from the two individuals. How is this achieved? In Proposition 1 we show that the manager should split the tasks between the two candidates. Furthermore, the candidate whose ability is more uncertain (the junior/outsider) performs more tasks than his rival, but the optimal allocation does not depend on the candidates' prior expected abilities. One may at first be surprised that the choice of the manager is not influenced by the relative position of the candidates. The intuition is simply that the manager maximizes the *total quantity* of information that the screening process conveys about the two

[1] Although we will focus on the relationship between a manager and two job candidates, there are many other situations that could be analyzed with a similar model: a political party that chooses between two potential leaders for the upcoming electoral campaign, a firm that chooses a subcontractor for the activities outside its core business, etc.

individuals. In this model, the value of each signal depends on the precision of the information (which is affected by the prior knowledge about the ability of that candidate) but not on its expected value.

Using the manager's optimal allocation as a benchmark, we can then characterize the inefficiencies that arise when the allocation of screening tasks has to be delegated to one of the candidates. Contrary to the manager's optimal rule, the optimal choice of the candidate will depend on the relative expected abilities of the two competitors (Proposition 2). An individual with a lower expected ability than his rival wants to maximize the probability of leapfrogging the opponent, which is achieved by maximizing the amount of information revealed during the screening process. It is true that information is more likely to confirm his inferiority than to reveal a superiority. However, it is also his best and only chance to be ex-post considered more able than his opponent. Using a symmetric reasoning, one can see that a candidate who is on average better than the rival wants to minimize the chances of being leapfrogged by the opponent. We show that minimization of information is obtained by concentrating all the available tasks on the hands of the incumbent, whose ability is already relatively well known. Again, the incentives of the candidate ahead and the candidate behind do not depend on the magnitude of the difference in their expected abilities.

Overall, there is a conflict of interests between the manager who wants to select the most able candidate for the job and the candidates who want to maximize their probability of being selected. Despite this tension, the manager can always avoid the costs of delegation; it suffices to allow the least able candidate to choose his preferred screening procedure. Our theory also predicts that when the most able candidate is in charge of allocating the screening tasks, then it may be optimal to bias the competition against him (Corollary 1).

After having determined the inefficiencies of delegating the screening process, we move on to analyze the suitability of favoring some types of employees over others. To this purpose, we assume that there are two qualitatively different screening tasks, each candidate has to perform one and only one of them, and the manager decides which one is performed by each of them. As before, both types of tasks allow the manager to imperfectly infer the ability of the candidate. Furthermore, screening tasks are productive, in the sense that they affect directly the utility of the manager, and one of them is more productive than the other. Last, performance in each task depends stochastically not only on the ability of the candidate who undertakes it, but also on his (unobservable) effort. Ability is, by assumption, most valuable in the most productive task. Then, absent effort considerations, the manager's optimal rule is trivial: he first allocates the candidate with highest expected prior ability to the most productive screening task and then keeps for the job the one with highest expected posterior ability given the observed performances. Including the possibility of effort modifies this conclusion. Once individuals are allocated to tasks, they do not internalize the possible effects of their effort in the outcome of the screening activity. Hence, they will never exert effort to affect the performance in the screening job (this conclusion is reminiscent of the well-known literature on career concerns, see Holmström (1999)). Instead, their incentives to work hard are exclusively due to the fact that a high performance signals a high ability, and therefore increases the chances of being selected for the job. We show that, despite the differences with the standard career concerns papers (candidates compete for a fixed price and they do not fully recoup via wages the benefits of their effort), the usual result that the individual with most uncertain ability has the strongest interest in putting effort to bias the perception of his ability holds in our setting. Since the manager recoups part of the benefits generated by the employees' effort, he will take into account their different implicit incentives when deciding the allocation rule. In particular, we show in Proposition 3 that the manager may find it optimal to favor the selection of the outsider/junior for the most valuable task even if his expected ability is lower than that of the incumbent/senior.

To sum up, this paper analyzes the efficiency losses when the screening procedure has to be delegated. It also argues that favoring candidates whose ability is relatively low and relatively unknown may sometimes be optimal for the organization. The model draws other general implications for issues related to the optimal hiring policies in organizations.

Before presenting the model, we would like to briefly mention some papers directly related to ours. As previously mentioned, Baliga and Sjöström (2001) already pointed out the idea that above average agents want to suppress information and below average agents want to generate it. Their paper analyzes the following situation. Two agents have private information about the quality of a project developed by one of them. The project is correlated with the ability of the owner. The principal wants to implement the project only if it is good, and then promote one of the agents. Naturally, agents do not always have incentives to reveal their information truthfully, because it affects the promotion decision of their boss. Their paper differs from ours in objectives, modelling and results. Their goal is to characterize the optimal contract offered by the principal. The ingredients of the model are complete contract, asymmetric information and possibility to provide or hide information (via the implementation or not of the project). One of the central results is that, in the optimal renegotiation-proof contract, the decision whether to implement the project must be delegated to its owner. By contrast, our paper takes delegation for granted. The goal of our Section 2 is to analyze the cost of delegating the screening process. To this purpose, we build a model with incomplete but symmetric information, with a fixed number of screening tasks, and the only tool we consider is the allocation of these tasks (in particular it is not possible to suppress information). Our main contribution is to characterize the optimal allocation of tasks from the viewpoint of the different actors in our economy. This allows us to determine the cost of delegation, which does not depend on the difference in prior expected abilities. From this, we also conclude that if the choice of task allocation has to be delegated to a relatively able individual, it is then optimal to bias the competition against him.[2]

Prescott and Visscher (1980) were among the first authors to analyze screening as a determinant of firm's performance. However, our work also focuses on different issues than theirs. For example, in our paper candidates are in competition, so our key variable is relative ability rather than absolute ability. Also, we fix the number of screening tasks and determine how to efficiently allocate them between different candidates, rather than optimize over the number of test periods for each one of them. Section 3 of our model can be seen as an extension of the seminal paper by Holmström (1999) on career concerns. Contrary to the works in this literature, in our paper candidates compete for a fixed price. This implies that the principal partly recoups the benefits generated by the employees' effort. As a result, he uses the discretion in the allocation of tasks to favor the individual with higher implicit incentives to exert effort, that is the junior or outsider. Prendergast and Stole (1996) already analyzed a situation in which different types of agents have different incentives to distort information: junior agents overreact to news in order to signal that they are talented while senior agents underreact to avoid signaling that their previous behavior was wrong. Distortions are therefore of different (and maybe complementary) nature than in our setting, and rely on private information and a signaling motive. Meyer (1991) is a classical paper on dynamic incentives and the optimal design of tournaments when the principal can extract a positive but limited amount of information from the performance of his subordinates. Last, Carmichael (1988) is a classical reference on optimal incentives for efficient hiring and promotion when the agents within the organization have an input into decisions (like in academia for example).

## 2 Screening with the number of tasks

We consider the decision problem of a risk-neutral manager (from now referred to as "principal") who has to determine the value of different job-candidates (from now referred to as "agents") in order to keep the most able one. More precisely, the principal has to choose between two agents $a \in \{i, o\}$: an "incumbent" ($i$) who has been already working in the firm and an "outsider" ($o$) who is new to the firm. The model can also be interpreted as the choice between a "senior" agent ($i$) who has been in the firm for a long time and a recent hire or "junior" one ($o$). The two agents differ exclusively in their *ability*, $\theta_i$ and $\theta_o$, to perform tasks, or the *fit* between their talent and the needs of the organization. All the actors have *imperfect but symmetric* information about

[2]Note that in Baliga and Sjötröm (2001), the contest may also be biased in favor of the (ex-post) least able agent. However, such strategy is optimal in their paper because it provides incentives for truth-telling given the asymmetry of information, and in our paper because it provides incentives for optimal allocation of tasks.

the (unidimensional) ability parameters of both agents. Formally, they all know that abilities are drawn from the following distribution:

$$\theta_a \sim \mathcal{N}(m_a, \sigma_a^2) \qquad a \in \{i, o\} \tag{1}$$

Agents differ in two respects. First, they have different expected abilities $m_a$. For our analysis we will consider all the possible pairs $(m_i, m_o)$. Second, the precision of the estimates of the agents' abilities $\sigma_a^2$ are also different. For the rest of the paper, we will assume that the ability of the incumbent/senior ($i$) is known with more accuracy than the ability of the outsider/junior ($o$):

**Assumption** $\sigma_i^2 < \sigma_o^2$.

We introduce this assumption because, in our view, the longer the previous labor relation between the principal and the agent, the more accurate is the information that the principal has collected about the capacity of the agent. In other words, the principal has a better knowledge about how good the "matching" or "fit" between firm and incumbent (or firm and senior employee) is than between firm and outsider (or firm and junior employee). Note that, given the principal's risk-neutrality, this *does not give any a priori advantage* to incumbent and senior agents.[3]

The agent selected by the principal to work in the firm receives an exogenous wage $b$ $(> 0)$.[4] The other agent receives zero, which is the outside wage or opportunity cost (not modelled in the paper). For simplicity, the performance of the agent selected for the job is equal to his ability. The principal cannot commit to a choice rule for the selection between the agents. He will therefore retain the agent with highest expected ability conditional on the information available at the selection stage[5] (see Corollary 1 for a discussion of what happens when we relax this assumption).

In order to increase the knowledge about the ability of the agents, the principal can assign them some screening tasks. In this section, we consider the following three specific characteristics of the screening process:

(i) A fixed number $n$ of screening tasks need to be split between the two competitors. All screening tasks are identical and each of them can be performed by one and only one agent. The costs of delegation are determined by comparing the optimal allocation from the principal's perspective with the optimal allocation from the agents' perspective.

(ii) Screening tasks are unproductive, i.e. performance of the agents in these activities has no intrinsic value for the principal.[6]

[3]The reader not convinced by this interpretation may simply retain that the variance in the ability of agents is different and exogenously given.

[4]This is made for simplicity. As we discuss later on, including more sophisticated contracts do not necessarily alter the insights of the paper, although some incentive problems might be alleviated (see Remark 1).

[5]Our results immediately extend to the case of positive correlation between ability and performance. All that matters is that the higher the agent's ability, the higher the likelihood of his being selected.

[6]However, our qualitative results would still hold if screening tasks affected the payoff of the organization.

(iii) Performance on a screening task is a stochastic function of the ability of the agent to whom it is assigned. Formally, if agent $a$ undertakes task $k \in \{1, ..., n\}$, his performance $x_a^k$ is:

$$x_a^k = \theta_a + \varepsilon_a^k \qquad \text{where} \quad \varepsilon_a^k \ \text{ i.i.d. } \ \mathcal{N}(0, \sigma_\varepsilon^2). \tag{2}$$

The outcome $x_a^k$ is publicly observed. This information is valuable even if the principal does not derive any direct utility from the outcome of the task and the agents are not rewarded for their performance. In fact, each piece of news gives some information about the agent's ability. Therefore, it influences the decision of the principal to keep one agent or the other, and hence the payoff of the three actors in this economy.

In the case of the Normal distribution, computing the posterior belief about the agent's ability given his performance in the screening tasks is particularly simple. For instance, if agent $a$ realizes tasks 1 to $s$ with performances $\{x_a^1, x_a^2, ..., x_a^s\}$ the posterior distribution of his ability becomes:[7]

$$\theta_a \,|\, \{x_a^k\}_{k=1}^s \ \sim \ \mathcal{N}\left(\lambda_a^s \, m_a + \frac{1 - \lambda_a^s}{s} \sum_{k=1}^{s} x_a^k \,,\, \sigma_a^2 \, \lambda_a^s\right) \quad \text{where} \quad \lambda_a^s = \frac{\sigma_\varepsilon^2}{\sigma_\varepsilon^2 + s\, \sigma_a^2}. \tag{3}$$

In words, the posterior distribution is also Normal. Its mean is a weighted average of the prior mean and the sum of the performances. Its variance is deterministic and decreasing in $s$, the number of tasks realized. Note that, in order to update the beliefs about the agent's ability, the "total performance in screening tasks" (that we denote by $X_a^s \equiv \sum_{k=1}^s x_a^k$) is a sufficient statistic. From (2) and the independence of the noise terms, we can see that:

$$X_a^s \ \sim \ \mathcal{N}\left(s\, m_a,\ s\,(\sigma_\varepsilon^2 + s\, \sigma_a^2)\right) \tag{4}$$

Suppose that the incumbent realizes $s$ screening tasks with total performance $X_i^s$, and the outsider the remaining $n - s$ ones with total performance $X_o^{n-s}$. Denote by $w \in \{i, o\}$ the "winner", that is the agent ex-post selected by the principal after observing the performances in the $n$ tasks. Recall that the on-the-job productivity of the winner is equal to (or positively correlated with) his imperfectly known ability and that the principal cannot commit on the selection rule. Given his risk-neutrality, the principal will therefore choose for the job the agent with highest expected posterior ability conditional on the outcomes of the screening tasks. Formally:

$$w = \underset{\{i,o\}}{\arg\max} \left\{ E[\theta_i \,|\, X_i^s], E[\theta_o \,|\, X_o^{n-s}] \right\} \tag{5}$$

Our objective in this section is to determine the costs of delegation. We thus compare the first-best scenario –in which the principal is responsible for the allocation of screening tasks between the two agents– to the second-best scenario –in which either the incumbent/senior or the

[7] In order to avoid integer problems, we will treat $s$ and $n$ as real numbers in the optimization problem below.

outsider/junior choose how to split the tasks. In both cases, the winner is determined by the principal according to his ex-post optimal selection rule (given by equation (5)). From the preferences and payoffs described above, we can notice that the principal and the agents have conflicting goals: the former wants to maximize the probability of selecting the most able agent while the latter want to maximize their own probability of being selected. Because of this tension, the different individuals have different preferences over the revelation of information, and therefore different desires concerning the optimal splitting rule of the screening activities. The timing of our game is summarized as follows.

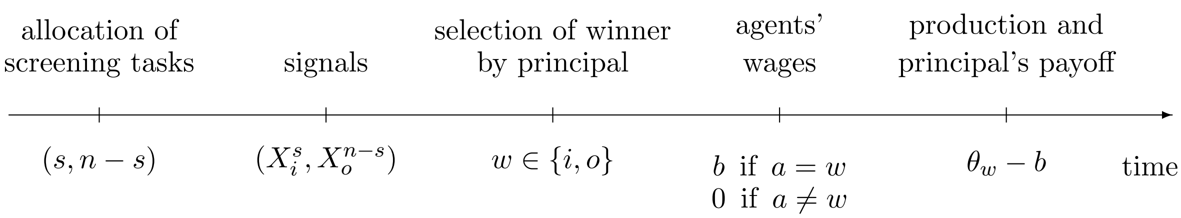


**Figure 1.** Timing in the "number of screening tasks" game.

Note that (5) implicitly assumes that the principal keeps one and only one agent. Nothing would change if we included the possibility of not retaining any agent. Also, keeping exactly one agent is formally equivalent to retaining both agents and promoting one and only one of them to a more valuable job (as for example in Baliga and Sjöström, 2001).

## 2.1 Principal's optimal allocation of screening tasks

Think of the following situation. The principal is the manager of a small software company who needs to hire (or promote) a software expert. To evaluate the capacity of the candidates, the manager asks them to develop some simple computer programs. The incumbent and the outsider realize $s$ and $n-s$ of these programs as screening tasks, respectively. The ex-ante welfare of the principal is the expected ability of the winner net of the fixed remuneration $b$. The expected ability of the winner is the sum of two factors. First, $V_i^s$ the expected ability of the incumbent conditional on being selected (i.e. on being the one with highest expected posterior ability) weighted by his ex-ante probability of being selected. Second, $V_o^{n-s}$ the expected ability of the outsider conditional on being selected, weighted by his ex-ante probability of being selected. Formally:

$$\begin{aligned} V_i^s &= E\left[\theta_i \,\middle|\, E[\theta_i \,|\, X_i^s] > E[\theta_o \,|\, X_o^{n-s}]\right] \times \Pr\left[E[\theta_i \,|\, X_i^s] > E[\theta_o \,|\, X_o^{n-s}]\right], \\ V_o^{n-s} &= E\left[\theta_o \,\middle|\, E[\theta_i \,|\, X_i^s] < E[\theta_o \,|\, X_o^{n-s}]\right] \times \Pr\left[E[\theta_i \,|\, X_i^s] < E[\theta_o \,|\, X_o^{n-s}]\right]. \end{aligned}$$

Define,

$$W(s) \equiv V_i^s + V_o^{n-s}$$

and denote by $s_p^*$ the number of tasks optimally delegated to the incumbent from the principal's viewpoint ($n - s_p^*$ are then optimally delegated to the outsider). We have:

$$s_p^* = \arg\max_s \quad W(s) \tag{6}$$

At this stage, we can characterize the optimal choice of the principal.

**Proposition 1** *When the principal decides how to allocate the screening tasks, then* $s_p^* \equiv \tilde{s} \in [0, n/2)$, *where* $\tilde{s}$ *is independent of* $m_i$ *and* $m_o$, $\partial \tilde{s}/\partial \sigma_i^2 \geq 0$, *and* $\lim_{\sigma_i^2 \to \sigma_o^2} \tilde{s}(\sigma_i^2) = n/2$.[8] *Moreover,* $\text{sign}\,(\frac{\partial W(s)}{\partial m_i} - \frac{\partial W(s)}{\partial m_o}) = \text{sign}\,(m_i - m_o)$ *and* $\text{sign}\,(\frac{\partial^2 W(s)}{\partial f(s)\,\partial m_i} - \frac{\partial^2 W(s)}{f(s)\,\partial m_o}) = -\,\text{sign}\,(m_i - m_o)$.

Proof. Using integration by parts and straightforward (although tedious) algebra we get that:[9]

$$W(s) = m_i\,\Phi\left(\frac{m_i - m_o}{f(s)}\right) + m_o\left[1 - \Phi\left(\frac{m_i - m_o}{f(s)}\right)\right] + f(s)\,\varphi\left(\frac{m_i - m_o}{f(s)}\right), \tag{7}$$

where $f(s) = \sqrt{\frac{s\,\sigma_i^4}{\sigma_\varepsilon^2 + s\,\sigma_i^2} + \frac{(n-s)\sigma_o^4}{\sigma_\varepsilon^2 + (n-s)\sigma_o^2}}$ and $\varphi(\cdot)$ and $\Phi(\cdot)$ are respectively the density and c.d.f. of the standard Normal distribution. From (7) and given that a property of the Normal distribution is $\varphi'(x) = -x\,\varphi(x)$, we can easily check that: $\frac{\partial W(s)}{\partial f(s)} = \varphi\left(\frac{m_i - m_o}{f(s)}\right) > 0$, and therefore $s_p^* = \arg\max_s f(s)$. Simple computations show that $f''(s) < 0$. Given $\sigma_i^2 < \sigma_o^2$, then $f'(n/2) < 0$, so that $\tilde{s} < n/2$.[10] Differentiating $f'(\tilde{s}; \sigma_i^2)$ we obtain that $\partial \tilde{s}/\partial \sigma_i^2 \propto \partial f'(\tilde{s}; \sigma_i^2)/\partial \sigma_i^2 > 0$. Also, $f'(n/2) = 0$ when $\sigma_i^2 = \sigma_o^2$. Finally, also from (7), $\frac{\partial W(s)}{\partial m_i} = \Phi\left(\frac{m_i - m_o}{f(s)}\right)$, $\frac{\partial W(s)}{\partial m_o} = 1 - \Phi\left(\frac{m_i - m_o}{f(s)}\right)$, $\frac{\partial W(s)}{\partial m_i} - \frac{\partial W(s)}{\partial m_o} = 2\,\Phi\left(\frac{m_i - m_o}{f(s)}\right) - 1$ and $\frac{\partial^2 W(s)}{\partial f(s)\,\partial m_i} - \frac{\partial^2 W(s)}{f(s)\,\partial m_o} = -\frac{2}{f(s)}\frac{m_i - m_o}{f(s)}\,\varphi\left(\frac{m_i - m_o}{f(s)}\right)$. □

The principal is interested in determining "how able is the most able agent". Therefore, he wants to use the screening process to extract as much information as possible from both agents. Given that the informational content of each task decreases with the number of tasks previously realized, then maximal information is disclosed when screening tasks are divided between the two agents. Proposition 1 provides an analytical characterization of this optimal allocation. It shows that as the ex-ante difference between the variance of abilities decreases ($\sigma_i^2 \to \sigma_o^2$), then the difference between the number of tasks performed by each agent also decreases ($\tilde{s} \to n - \tilde{s}$).

The most interesting characteristic of Proposition 1 is that the prior expected abilities of the two agents will not affect the allocation of tasks by the principal. One could think that if one

[8] More precisely, $\tilde{s} = \arg\max_s \frac{s\,\sigma_i^4}{\sigma_\varepsilon^2 + s\,\sigma_i^2} + \frac{(n-s)\sigma_o^4}{\sigma_\varepsilon^2 + (n-s)\sigma_o^2}$.

[9] See any advanced book in Statistics dealing with the Normal distribution, or Carrillo and Mariotti (2001, Lemma 1) for a similar proof in a context of electoral competition between political parties.

[10] Note that if $f'(0) > 0$ (for which $n\,\sigma_i^2 > \sigma_\varepsilon^2$ is a sufficient condition) then the solution for $\tilde{s}$ is interior. That is, it is optimal for the principal that both agents realize some screening tasks.

agent is on average much better than the other, then the principal should concentrate his efforts in testing this agent, just to make sure that he is as good as he looks. This intuition is incorrect. In fact, the principal focuses exclusively on the *amount* of information collected with the screening process. The maximization of total knowledge is obtained by equating the marginal quantity of learning about each agent, which depends on the accuracy of the previous information (their ex-ante variance in ability) but not on the type of information (their ex-ante expected ability).

However, this is not to say that the principal is not affected by the prior expected abilities of the agents. First and trivially, his welfare increases with the agents' ex-ante expected ability ($\frac{\partial W(s)}{\partial m_i} > 0$ and $\frac{\partial W(s)}{\partial m_o} > 0$). More interestingly, keeping the sum of expected abilities constant, the principal is worse-off the closer the expected abilities are (formally, $\frac{\partial W(s)}{\partial m_i} - \frac{\partial W(s)}{\partial m_o} > 0$ if $m_i > m_o$). The idea is simply that the principal will only keep one agent. Hence, the higher the difference in their prior expected abilities, the higher the posterior expected ability of the most able agent. Last, even though the relative benefits of screening one agent or the other do not depend on $(m_i, m_o)$, the marginal benefits of splitting the screening tasks are higher the closer the prior expected abilities (formally, $\frac{\partial^2 W(s)}{\partial f(s)\, \partial m_i} - \frac{\partial^2 W(s)}{\partial f(s)\, \partial m_o} > 0$ if $m_i < m_o$). If the prior abilities are sufficiently different, the agent with highest prior expected ability is most likely to keep his advantage after the revelation of information. The evaluation tasks are then going to reverse the prior ranking only with a small probability, which makes screening relatively less valuable.

Proposition 1 has also some interesting implications. It predicts that as an agent spends more and more time within the organization, it becomes less and less important to test him before deciding about his promotion. We should therefore rarely observe senior employees being scrutinized. At the same time, it also says that optimal testing depends exclusively on the relative prior knowledge about the competitors. Therefore, being rigorously tested should not be interpreted by agents as a negative indicator of their perceived capacity. In other words, according to our theory and other things being equal, there should be no correlation between which of the agents competing for the position is tested more exhaustively and which one is finally promoted.

### 2.2 Agents' optimal allocation of screening tasks

The idea according to which the principal is the ultimate responsible for the selection of the agent most suitable for the job seems quite natural. If possible, he would also prefer to decide how to allocate efficiently the screening tasks between agents. However, it is not unusual to observe a delegation of this choice to one of the agents. There are several reasons for the necessity of delegation. The simplest one is work overload. The principal performs several other tasks within the organization. Therefore, even if designing the screening process is important, the opportunity cost of spending time on this problem might be too high (besides, it is a priori unclear how costly delegation is, and the purpose of the section is precisely to evaluate it). A second reason for delegation is superior information of agents. For instance, suppose that there are $N$ potential screening tasks, it is only possible to evaluate the performance in a subset $n$ of them, and screening is time-consuming, so that only $n$ tasks can be undertaken before the selection is made. If only agents know the $n$ tasks where performance can be evaluated, then for $N$ sufficiently large the principal will be better-off by delegating the allocation choice rather than making a blind guess. This idea is related to Aghion and Tirole (1997), where the principal may find it optimal to delegate authority to the agent even if the interests of the two parties are not perfectly congruent.[11]

Denote by $s_a^*$ the number of tasks undertaken by the incumbent/senior if agent $a$ chooses the allocation, in which case $n - s_a^*$ is the number of tasks undertaken by the outsider/junior. Recall that, absent commitment devices, the agent selected by the principal after the screening process is the one with highest expected posterior ability. Hence, from the perspective of agent $a$ ($\in \{i, o\}$), the optimal number of tasks that the incumbent/senior should undertake is:

$$s_i^* = \arg\max_s \; \Pr\left[E[\theta_i \,|\, X_i^s] > E[\theta_o \,|\, X_o^{n-s}]\right], \tag{8}$$

$$s_o^* = \arg\max_s \; \Pr\left[E[\theta_i \,|\, X_i^s] < E[\theta_o \,|\, X_o^{n-s}]\right]. \tag{9}$$

Given (8) and (9), we can now characterize the optimal choice from the agents' viewpoint, which also informs us about the inefficiencies of delegation.

**Proposition 2** *The optimal allocation of tasks from the perspective of the incumbent/senior (i) and the outsider/junior (o) is:*

- $s_i^* = n$ *if* $m_i > m_o$ *and* $s_i^* = \tilde{s}$ *if* $m_i < m_o$.
- $s_o^* = \tilde{s}$ *if* $m_i > m_o$ *and* $s_o^* = n$ *if* $m_i < m_o$.

Proof. Given (3), (4) and (8), the probability of keeping an incumbent who realizes $s$ tasks is:

$$\Pr\left[\lambda_i^s \, m_i + \frac{1-\lambda_i^s}{s} \, X_i^s > \lambda_o^{n-s} \, m_o + \frac{1-\lambda_o^{n-s}}{n-s} \, X_o^{n-s}\right] = \Phi\left(\frac{m_i - m_o}{f(s)}\right)$$

and that of keeping the outsider is $1 - \Phi\left(\frac{m_i - m_o}{f(s)}\right) = \Phi\left(\frac{m_o - m_i}{f(s)}\right)$. Hence, $s_i^* = \arg\min_s f(s)$ if $m_i > m_o$ and $s_i^* = \arg\max_s f(s)$ if $m_i < m_o$. Conversely, $s_o^* = \arg\max_s f(s)$ if $m_i > m_o$ and $s_o^* = \arg\min_s f(s)$ if $m_i < m_o$. Recall that $f''(s) < 0$. Given $\sigma_i^2 < \sigma_o^2$, then $f(0) > f(n)$. Therefore, $n = \arg\min_s f(s)$ and, as before, $\tilde{s} = \arg\max_s f(s)$. □

[11] In Baliga and Sjöström (2001), delegation is part of the renegotiation-proof contract offered by the principal given the asymmetry of information with the agents.

Suppose that the agent with highest prior expected ability decides the allocation of tasks. This agent wants to minimize the probability of being leapfrogged by his rival. In order to keep his advantage with the greatest possible probability, he will design a screening procedure that conveys the *minimum* amount of information. Conversely, the agent with lowest prior expected ability will *maximize* the information revealed during the screening process in order to overcome his prior handicap with greatest probability. This result is reminiscent of the work by Baliga and Sjöström (2001) and may at first be surprising. In fact, we tend to think that the higher the ability of an agent, the higher his willingness to disclose information. However, in our setting the opposite is true: the agent with highest expected ability can only lose from the revelation of information, while the agent with lowest expected ability can only win from its disclosure.

An interesting question is to understand how can agents maximize (resp. minimize) the amount of information revealed. One obvious alternative is to maximize (resp. minimize) the number of screening tasks, but this possibility is ruled out in our setting. The only degree of freedom is the rule for splitting tasks. Since the informational content of each task decreases with the number of tasks previously realized, then by concentrating all the tasks on the hands of the agent whose ability is best known (the incumbent/senior), the amount of information revealed is minimized. This possibility will be chosen by the agent with highest expected ability when the screening procedure is delegated to him. Conversely, maximal information is disclosed when screening tasks are split among the two agents, with $\tilde{s}$ ($< n/2$) tasks allocated to the incumbent. This alternative will be optimally selected by the agent whose expected ability is lowest.

Overall, the combination of Propositions 1 and 2 suggests that despite the conflict of interests between the principal (interested in selecting the agent with highest ability) and the agents (interested in maximizing their probability of being selected), delegation of screening will not be costly as long as the agent with lowest expected ability bears this responsibility. This result holds independently of the magnitude of the difference between the expected abilities of the two agents ($m_i - m_o$), and also independently of the number of screening tasks available ($n$).[12]

At this point we can offer some implications for screening and turnover in organizations. Consider a firm where the incumbent agents control the allocation of the screening jobs (independently of their relative expected ability). First, if we adopt a dynamic perspective, our model suggests that it may not always be desirable to hire the best available applicants. Naturally, ability affects productivity and therefore is valuable. However, it also blocks the quality of the (future) screening procedure. In other words, the organization might find it optimal not to retain an agent who is

[12] In Baliga and Sjöström (2001), the principal cannot avoid all the costs of delegation because, in their paper, the only way to generate information is by implementing a project. Therefore, the principal trades-off the cost of the project and the benefits of information whereas the agent with lowest expected ability only maximizes the revelation of information.

slightly better than the average outside applicant because the gain of his higher expected ability will be offset by the cost of an inefficient future selection rule. Second, there is an interesting relation between turnover rates and efficient screening. On the one hand, low firing and turnover implies that the agents working in the organization must be better than the outside pool of applicants. On the other hand, it may just be the consequence of an inefficient screening rule set by incumbents who are just above average. Third, consider a chain of command in which a senior agent decides whether to perform a job himself or leave it to his junior colleague. If the senior is, on average, relatively good then he will perform all the tasks to avoid that the principal learns about the ability of the junior member. This result can be seen as complementary to the chain of command and transmission of information argument of Friebel and Raith (1997).

*Remark 1.* If we could make the payoff of the agent promoted a function of his job productivity (an incentive contract of the type $b_w(E[\theta_w])$) and the incumbent were delegated the allocation of tasks, then he would choose $s$ so as to maximize $V_i^s$. Even in that case, the incumbent's objectives would not be aligned with those of the principal, so the inefficiency highlighted earlier when the incumbent is relatively able would still be present.[13] Note however that $b$ fixed seems a reasonable assumption in statutory jobs, where agents compete for a promotion but pay scales are fixed.

*Remark 2.* The reader might view our modelling of screening as being excessively simplistic. First, one should treat the total number of screening tasks as an optimization variable.[14] Although this would quantitatively change our results, our basic insight would only be reinforced: the marginal value for the principal of a new task would still be positive and greatest when allocated to the agent with most uncertain ability, whereas the agent with highest ability would still prefer to concentrate all tasks on the hands of the agent with least uncertain ability (or, even better, to minimize the total number of tasks). Second, allowing both agents to perform the same task could sometimes facilitate the principal's choice. Yet, if there are multiple ways to undertake each task, there is no fundamental difference between both agents completing the same task or each agent completing a different one. Third, and more interestingly, if tasks were allocated sequentially (i.e., task $k+1$ were allocated after observing agent $a$'s performance $x_a^k$ in task $k$), the principal's optimal strategy would still be to allocate each task to the agent whose ability is most uncertain. However, contrary to our current results, the interests of the principal and the agent with lowest ability would no longer be perfectly aligned, since that individual would not necessarily remain

[13] The principal can obtain an alignment of interests by making the incumbent's payoff contingent on the productivity of the agent appointed for the job. However, a mechanism where an agent is fired and still gets a payoff from the productivity of his competitor retained for the job seems both awkward and difficult to enforce.

[14] Our model implicitly assumes that the cost for the firm of organizing the screening process is nil up to $n$ tasks and infinite afterwards. Obviously, optimizing over one variable (the fraction of tasks undertaken by each agent) instead of two variables (the number of tasks undertaken by each agent) considerably simplifies the technical aspects of the model.

behind during the whole screening process.

### 2.3 Principal's welfare and optimal bias in the selection rule

Up to now, we have assumed that the task allocation can be delegated to any agent. However, if we interpret our model as the competition for a position between an incumbent and an outsider, delegation to the latter does not make much sense, as he is not even working in the firm. If the principal is forced to delegate the screening procedure and the incumbent is the only candidate for this activity, Propositions 1 and 2 suggest that this agent will choose an allocation that discloses too little information whenever he is relatively good. However, this inefficiency will be alleviated if the principal can commit on the selection procedure.

**Corollary 1** *If the highest ability agent designs the screening process, it may be optimal for the principal to commit to bias the decision rule in favor of the lowest ability agent.*

Proof. Suppose that $m_i = m_o + \Delta$, with $\Delta > 0$. By Proposition 2, information is minimized ($s_i^* = n$). Information can be maximized if the principal commits ex-ante to the selection rule $w' = \arg\max_{\{i,o\}} \{E[\theta_i \,|\, X_i^s], E[\theta_o \,|\, X_o^{n-s}] + 2\Delta\}$ instead of (5). As $\Delta \to 0$, the cost of this commitment goes to zero whereas the benefit of $s_i^* = \tilde{s}$ instead of $s_i^* = n$ is strictly positive. □

The agent who chooses the screening rule will either minimize or maximize revelation of information depending on whether he is on average more or less able than his rival. Biasing the contest in favor of the least able agent is formally equivalent to putting ahead the worker who is behind. If the difference between the expected abilities of the agents is small, the cost of committing to this ex-post inefficient decision rule is small, whereas the benefit of inducing the agent to maximize (rather than minimize) the amount of information revealed can be substantial.[15]

This result has an interesting implication: organizations that bias the promotion decision against their own employees and instead rely mainly on the outside labor market, are likely to perform better than organizations in which insider workers are favored. It is also counterintuitive, as in practice we frequently observe the opposite bias.[16]

From the analysis of Sections 2.1 and 2.2 we can also determine whether the principal and the agents benefit from an accurate screening process and a highly volatile ability of agents.

**Corollary 2** *Independently of which individual chooses the allocation of the screening tasks, the welfare of both the principal and the agent with lowest expected ability increase in the variance of*

[15] See Meyer (1991) for a comprehensive theoretical analysis of optimal design of cutoff rules in contests.

[16] One should be careful when interpreting this result, as there may be other reasons (mainly based on incentive issues) for the optimality of the opposite bias.

*the agents' abilities ($\sigma_i^2$ and $\sigma_o^2$) and decrease in the variance of the noise ($\sigma_\varepsilon^2$). Conversely, the welfare of the agent with highest expected ability decreases in $\sigma_i^2$ and $\sigma_o^2$, and increases in $\sigma_\varepsilon^2$.*

Proof. Immediate if we note that $\frac{\partial f(s)}{\partial \sigma_i^2} > 0$, $\frac{\partial f(s)}{\partial \sigma_o^2} > 0$ and $\frac{\partial f(s)}{\partial \sigma_\varepsilon^2} < 0$. □

The principal and the lowest ability want to maximize information revelation, whereas the highest ability agent wants to minimize it. The amount of learning is greater when performances provide an accurate signal about the capacity of the individuals ($\sigma_\varepsilon^2$ small) and when the ability of the agents is very volatile ($\sigma_a^2$ high), because then the prior knowledge about their capacity is scarce. Overall, the fact that the principal is going to keep only the best agent makes him endogenously risk-lover with respect to the agents' ability.

## 3 Screening with the quality of tasks

Once we have studied the costs of delegation, we can analyze the issue of *favoritism*, defined as the possibility of choosing for the best job the agent with lowest expected ability. We consider an extended version of the model presented in Section 2. As before, the principal chooses between an incumbent/senior and an outsider/junior with different and imperfectly known abilities. The agent selected for the job (or promoted) receives an exogenously fixed wage $b$ while the other one gets 0. The agent's on-the-job productivity is equal to his ability. Unlike in Section 2, we assume that there are only two screening tasks available ($n = 2$) and that each agent has to perform one and only one of them ($s = 1$). (We will generically use the indexes $\alpha, \beta \in \{h, l\}$ with $\alpha \neq \beta$ to denote the two tasks). Simplifying the number of tasks allows us to better focus on new issues, namely those related to vertical differentiation of the screening activities and agents' incentives to perform efficiently. The new features of the screening process are the following:

(i) Screening tasks are valuable, i.e. the performance of the agents in these activities enters directly in the utility function of the principal.

(ii) The performance $x_a^\alpha$ of agent $a$ allocated to screening task $\alpha$ depends stochastically not only on his ability $\theta_a$ (as before) but also on his effort $e_a$ exerted (which is not observed by the principal) and the type of screening task $\alpha$ realized:

$$x_a^\alpha = \nu(\theta_a, e_a; \alpha) \tag{10}$$

where, for all $\bar{x} \in \mathbb{R}$: (a) $\partial \Pr[x_a^\alpha < \bar{x}] / \partial \theta_a < 0$, (b) $\partial \Pr[x_a^\alpha < \bar{x}] / \partial e_a < 0$, (c) $\Pr[x_a^h < \bar{x}] < \Pr[x_a^l < \bar{x}]$, (d) $\partial \Pr[x_a^h < \bar{x}] / \partial \theta_a < \partial \Pr[x_a^l < \bar{x}] / \partial \theta_a$ $(< 0)$.

(iii) Both agents have the same cost of exerting effort $c(e)$, with $c' > 0$ and $c'' > 0$.

According to this formalization, performance in the screening task is higher (in a stochastic sense) the higher the agent's ability and effort (parts (a) and (b)). Furthermore, performance is also higher in task $h$ (which stands for "high") than in task $l$ (which stands for "low") (part (c)). Last, ability is also relatively more valuable in task $h$ than in task $l$ (part (d)).

The specific timing of the game that we analyze is the following.

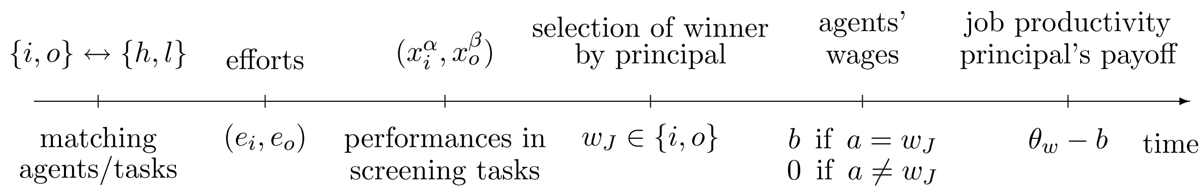


**Figure 2.** Timing in the "quality of screening tasks" game.

In this game, the principal has two objectives: first, to maximize the expected return of the sum of the agents' performances in the screening tasks ($E[x_i^\alpha + x_o^\beta]$) and second, to keep the most able one for the job. By (ii-d), then absent effort considerations, the principal would allocate the agent with highest expected prior ability to the most valuable screening task. Formally,

$$E[\theta_i] > E[\theta_o] \;\Leftrightarrow\; \Pr\left[x_i^h + x_o^l < \bar{x} \,|\, e_a = 0\right] < \Pr\left[x_i^l + x_o^h < \bar{x} \,|\, e_a = 0\right].$$

Then, conditional on the information elicited, the agent with highest expected posterior ability would be retained for the job (we denote $w_J$ the "winner"). However, since different types of individuals have different incentives to work hard, this may no longer be true when effort considerations are taken into account. The objective of this section is to analyze the optimal allocation of agents to the different screening tasks given this moral hazard issue. Contrary to the previous section, we will assume that the principal does not delegate the allocation choice.[17]

*Remark 3.* We have assumed for symmetry with the previous section that agents do not obtain any direct reward from their performance in the screening task. Given that this activity is now intrinsically valuable, one could think that agents should get a wage contingent on the type of the screening task performed, with $b_h > b_l > 0$. As long as these wages are not contingent on the outcome of the screening task (e.g. they are paid before performance is observed), all the results hold and some other insights can be gained with this extra ingredient.

*Remark 4.* Instead of screening and selection, one could easily reinterpret our setting as a two-period, job-allocation model. In this alternative game, two agents working in a firm are allocated according to their ability and anticipated effort to two jobs with different productivity ($h$ and $l$)

[17] Determining the agents' preferences over the different tasks is trivial: if they receive no compensation for their performance in the screening task, they are indifferent between $h$ and $l$ and if they are remunerated according to the type of screening task realized (see Remark 3 below), they both prefer task $h$ independently of their ability.

and different payoff ($b_h$ and $b_l$). At the end of the first period and given their performance ($x_i$ and $x_o$), there is reallocation between jobs $h$ and $l$ according to their updated ability.

*Remark 5.* The model is an extension of the two-period version of Holmström's (1999) career concerns paper. By assumption, wages are not contingent on current performance, so the agent has no incentives to put effort in order to increase it. However, some effort might be incurred in order to bias the principal's perception of the agent's ability. As in a rat race, this is perfectly anticipated by the principal and no bias occurs in equilibrium.[18] The major difference is that in Holmström (1999) and all the subsequent literature there is perfect competition for agents, so in equilibrium individuals are paid according to their expected ability $\theta_a$ and anticipated effort $e_a$. Instead, in our setup there is a fixed reward $b$ for being selected for the job. Given this payoff dichotomy, agents only recoup part of the benefits generated with their effort. Then, it is a priori unclear whether the standard insights of the career concerns literature also hold in this model.

The literature on career concerns has demonstrated that the specific functional form of $\nu(\cdot)$ may affect the incentives of the different types of agents to exert effort. In the next subsections, we solve our model for the cases in which (i) the marginal effect of effort in the outcome does not depend on the ability of the individual (formally, $\partial^2 \Pr[x_a^\alpha < \bar{x}] / \partial e_a \, \partial \theta_a = 0$) and (ii) effort is more valuable the higher the ability of the individual (formally, $\partial^2 \Pr[x_a^\alpha < \bar{x}] / \partial e_a \, \partial \theta_a < 0$).

### 3.1 Career concerns when ability and effort are independent

This case –which is the one analyzed in the paper by Holmström (1999) and almost all the subsequent literature– is characterized by a production function additively separable in effort and ability. The specific functional form of the performance function $\nu(\cdot)$ that we are going to adopt (see (10)) is:

$$x_a^\alpha = \rho_\alpha \Big[\theta_a + e_a + u_a\Big], \qquad u_a \text{ i.i.d. } \mathcal{N}(0, \sigma_u^2) \quad \text{and} \quad \rho_h > \rho_l > 0. \tag{11}$$

We proceed to the formal analysis of the game. Recall that ability is most valuable in the most productive screening task, only the outcome (and not the effort) is observed by the principal, and abilities determine the agents' future job productivity. Hence, the principal will select for the job the agent with highest expected ability conditional on the performances and *anticipated* efforts of both agents in the screening tasks. Denote by $\tilde{e}_a$ agent $a$'s anticipated effort. We have:

$$w_J = \arg\max_{\{i,o\}} \Big\{ E[\theta_i \,|\, x_i^\alpha, \tilde{e}_i], E[\theta_o \,|\, x_o^\beta, \tilde{e}_o] \Big\} \tag{12}$$

[18] Our results would not be affected if we assumed that the performance of the agent selected for the job depended also on his effort. As in the standard career concern models, the agent in the last period (here, once in the job) has no incentives to exert effort because there is no future perception of ability to bias.

Agents will have incentives to exert effort even if they are not compensated for it (see Remark 5) or if the payoff for the screening activity is sunk (as in the interpretation given by Remark 3). In fact, for any level of effort anticipated by the principal, exerting effort influences current performance, which in turn affects the perception of ability by the principal, and therefore the probability of being selected for the job. Anticipating the principal's selection rule given by (12), and for a given allocation $(\alpha, \beta)$ of screening tasks, the maximization problems of the agents are:

$$\begin{aligned} e_i &= \arg\max_e \ \Pr\Big[E[\theta_i \,|\, x_i^\alpha(e), \tilde{e}_i] > E[\theta_o \,|\, x_o^\beta(e_o), \tilde{e}_o]\Big]\, b \,-\, c(e) \\ e_o &= \arg\max_e \ \Pr\Big[E[\theta_o \,|\, x_o^\beta(e), \tilde{e}_o] > E[\theta_i \,|\, x_i^\alpha(e_i), \tilde{e}_i]\Big]\, b \,-\, c(e) \end{aligned}$$

From (11) and using the same techniques as in the previous section for updating beliefs, we get:

$$E[\theta_a \,|\, x_a^\alpha(e_a), \tilde{e}_a] = (1-\gamma_a)\, m_a + \gamma_a \left( \frac{x_a^\alpha(e_a)}{\rho_\alpha} - \tilde{e}_a \right) \qquad \text{where} \quad \gamma_a = \frac{\sigma_a^2}{\sigma_u^2 + \sigma_a^2}. \tag{13}$$

Given (12), (13) and the fact that $x_a^\alpha(e_a) \sim \mathcal{N}\Big(\rho_\alpha(m_a + e_a), \rho_\alpha^2(\sigma_a^2 + \sigma_u^2)\Big)$, one can show that:

$$\Pr[w_J = i] = \Pr\Big[E[\theta_i \,|\, x_i^\alpha(e_i), \tilde{e}_i] > E[\theta_o \,|\, x_o^\beta(e_o), \tilde{e}_o]\Big] = \Phi\left( \tfrac{m_i - m_o + \gamma_i(e_i - \tilde{e}_i) - \gamma_o(e_o - \tilde{e}_o)}{g(\sigma_i^2, \sigma_o^2, \sigma_u^2)} \right) \tag{14}$$

where $g(\cdot) = \sqrt{\frac{\sigma_i^4}{\sigma_i^2 + \sigma_u^2} + \frac{\sigma_o^4}{\sigma_o^2 + \sigma_u^2}}$.[19] Note that (14) does not depend on how agents were allocated to tasks ($\rho_h$ and $\rho_l$). The reason is that the principal is able to discount for the fact that, other things being equal, the agent in task $h$ will exhibit a higher performance than the agent in task $l$.

In equilibrium, expectations must be fulfilled, that is $e_a = \tilde{e}_a$. Using (14), it is therefore immediate that equilibrium efforts $\tilde{e}_a$ are uniquely determined by:

$$c'(\tilde{e}_a) = \frac{\gamma_a}{g(\sigma_i^2, \sigma_o^2, \sigma_u^2)} \times \varphi\left( \frac{m_i - m_o}{g(\sigma_i^2, \sigma_o^2, \sigma_u^2)} \right) b \tag{15}$$

Note that $\tilde{e}_a$ is proportional to $\gamma_a$, and therefore $\tilde{e}_o > \tilde{e}_i$. From (14), the job will be offered to the incumbent/senior and to the outsider/junior with the following equilibrium probabilities:

$$\Pr[\, w_J = i \,] = \Phi\left( \frac{m_i - m_o}{g(\sigma_i^2, \sigma_o^2, \sigma_u^2)} \right) \qquad \text{and} \qquad \Pr[\, w_J = o \,] = \Phi\left( \frac{m_o - m_i}{g(\sigma_i^2, \sigma_o^2, \sigma_u^2)} \right).$$

Once we have determined which agent will be selected by the principal for the job, it is possible to analyze by backward induction the optimal allocation of agents to the different screening tasks. The high-productive screening task $h$ will be executed by the agent satisfying:

$$w_S = \arg\max_{\{i,o\}} \Big\{ m_i + \tilde{e}_i, m_o + \tilde{e}_o \Big\} \tag{16}$$

This leads immediately to our next result.

[19] This function is the analogue of $f(s)$ in Section 2 when $s = 1$ and $n = 2$.

**Proposition 3** *It is optimal for the organization to favor the outsider/junior agent in the allocation of screening tasks. More precisely, task $h$ will be performed by agent $o$ when $m_i - m_o \in [0, \tilde{e}_o - \tilde{e}_i)$. Favoritism is more likely to occur, the higher $b$ and the smaller $|m_i - m_o|$.*

Proof. According to (16), $w_S = o$ if $m_o > m_i - (\tilde{e}_o - \tilde{e}_i)$. By inspection of (15) and given that $\gamma_o > \gamma_i$, we obtain that $\tilde{e}_o > \tilde{e}_i$. Besides, $\frac{\partial(\tilde{e}_o - \tilde{e}_i)}{\partial |m_i - m_o|} < 0$ and $\frac{\partial(\tilde{e}_o - \tilde{e}_i)}{\partial b} > 0$. □

When two agents compete for a promotion, the incentive of agent $a$ to bias the perception of his ability is proportional to $\gamma_a \equiv \sigma_a^2/(\sigma_a^2 + \sigma_u^2)$. Indeed, when the initial knowledge about his ability is very imprecise ($\sigma_a^2$ big), the signal conveys an important amount of information. In that case, the agent has a strong interest in biasing the principal's perception of his ability and, to this purpose, he exerts a great amount of effort. Although no bias occurs in equilibrium, this provides an advantage to the agent with most uncertain ability whenever effort enters directly in the performance function $\nu(\cdot)$: this agent is sometimes selected for task $h$ even though his expected ability is smaller than that of his rival. Formally, agent $o$ is favored (i.e. selected for the most valued task even if he is on average worse than his opponent) as long as $m_o \in (m_i + \tilde{e}_i - \tilde{e}_o, m_i)$.

Suppose that agents obtain a direct payoff from undertaking task $h$ (see Remark 3) or we interpret our model as a dynamic job-allocation game (see Remark 4). Other things being equal, our model has the counterfactual result that in order to perform efficiently a firm should assign the jobs requiring the highest degree of involvement to outsiders and young employees.

To sum up, young agents provide more effort than their old peers. Since the principal is partly residual claimant for the agents' effort, he will maximize the returns of the firm by biasing the competition in their favor. Note that young workers will benefit from such advantage only in the short run if at all (as noted by (12), the final selection will be efficient and the individual eventually appointed to the job will always be the one with highest expected posterior ability). Also, note that if either $\sigma_i^2 = \sigma_o^2$ or $\sigma_u^2 = 0$, then for all pairs $(m_i, m_o)$ both agents exert the same effort ($e_i = e_o$). This proves that the key for the difference in effort between the two agents is their different incentives to bias future perception of ability, and not the (exogenous) difference in their prior expected abilities.

Last, from Proposition 3 we can perform some comparative statics. Suppose that the expected ability of the junior agent is smaller than that of the senior one ($m_o < m_i$). From (15) and (16), we can notice that both agents will put more effort if they are in a close race than if there is little uncertainty about who will be selected for the job ($\frac{\partial \tilde{e}_a}{\partial |m_i - m_o|} < 0$). Moreover, the increase in effort when the race is close will be greatest for the agent whose ability is the least known ($\frac{\partial \tilde{e}_o}{\partial |m_i - m_o|} < \frac{\partial \tilde{e}_i}{\partial |m_i - m_o|}$). Similarly, as the value of the job, $b$, increases, the young agent is more likely to be favored because his incentives to exert effort increase more than those of his opponent.

### 3.2 Career concerns when ability and effort are complements

Dewatripont *et al.* (1999a,1999b) are the first studies in the career concerns literature that analyze a situation in which effort is more valuable the higher the ability of the individual. One of their results is the existence of multiple equilibria. If agents are expected to exert high effort, then a low performance is interpreted as the result of a low ability. This gives high incentives to exert effort in a first place. By contrast, if the anticipated effort is low, then a low performance is interpreted as the result of "bad luck", which provides low incentives to exert effort. With these premises in mind, we will analyze the following specification of the performance function $\nu(\cdot)$:

$$x_a^\alpha = \rho_\alpha \left[\theta_a \, e_a + u_a\right] \tag{17}$$

As in (12), the job is allocated to the agent with highest expected ability given performances and anticipated efforts. Following the same techniques for updating beliefs as in (13), we have:

$$E[\theta_a \,|\, x_a^\alpha(e_a), \tilde{e}_a] = (1-\mu_a(\tilde{e}_a))\, m_a + \frac{\mu_a(\tilde{e}_a)}{\rho_\alpha \, \tilde{e}_a}\, x_a^\alpha(e_a) \quad \text{where} \;\; \mu_a(\tilde{e}_a) = \frac{\tilde{e}_a^2\, \sigma_a^2}{\sigma_u^2 + \tilde{e}_a^2\, \sigma_a^2}. \tag{18}$$

Note that $x_a^\alpha(e_a) \sim \mathcal{N}\Big(\rho_\alpha\, m_a\, e_a, \rho_\alpha^2(e_a^2\, \sigma_a^2 + \sigma_u^2)\Big)$. Hence, effort affects not only the perception of the expected ability but also its variance. We can then determine the analogue of (14):

$$\Pr\left[\, w_J = i\,\right] = \Phi\left(\frac{m_i \frac{\sigma_u^2 + e_i\, \tilde{e}_i\, \sigma_i^2}{\sigma_u^2 + \tilde{e}_i^2\, \sigma_i^2} - m_o \frac{\sigma_u^2 + e_o\, \tilde{e}_o\, \sigma_o^2}{\sigma_u^2 + \tilde{e}_o^2\, \sigma_o^2}}{z(\sigma_i^2, \sigma_o^2, \sigma_u^2; \tilde{e}_i, \tilde{e}_o, e_i, e_o)}\right), \tag{19}$$

where $z(\cdot) = \sqrt{\sigma_i^4\, \tilde{e}_i^2 \frac{\sigma_u^2 + e_i^2\, \sigma_i^2}{(\sigma_u^2 + \tilde{e}_i^2\, \sigma_i^2)^2} + \sigma_o^4\, \tilde{e}_o^2 \frac{\sigma_u^2 + e_o^2\, \sigma_o^2}{(\sigma_u^2 + \tilde{e}_o^2\, \sigma_o^2)^2}}$. From (19), note that the marginal incentive of each agent to exert effort depends on his own anticipated effort level (as in Dewatripont *et al.*, 1999b) and, more importantly, on the *other agent's effort.* These are the two differences with the previous case. Taking the derivative of $\Phi(\cdot)$ in (19) with respect to effort and given that in equilibrium expectations must be fulfilled ($\tilde{e}_a = e_a$), we get the analogue of (15) to the new case:

$$c'(\tilde{e}_a) = \frac{\mu_a(\tilde{e}_a)}{\tilde{e}_a}\left(\frac{m_i \sigma_o^2 \mu_o(\tilde{e}_o) + m_o \sigma_i^2 \mu_i(\tilde{e}_i)}{(\sigma_o^2 \mu_o(\tilde{e}_o) + \sigma_i^2 \mu_i(\tilde{e}_i))^{3/2}}\right) \times \varphi\left(\frac{m_i - m_o}{\sqrt{\sigma_o^2 \mu_o(\tilde{e}_o) + \sigma_i^2 \mu_i(\tilde{e}_i)}}\right) b \tag{20}$$

By inspection of (20), we reach some results that are similar to the previous case. First, the agent whose ability is most uncertain will exert highest effort ($\mu_o(e) > \mu_i(e)$). Second, differences in efforts are due to differences in incentives to bias future perception of ability and, only indirectly, to differences in prior expected abilities (for all $(m_i, m_o)$ we get $\mu_o(e) = \mu_i(e)$ and therefore $\tilde{e}_o = \tilde{e}_i$ if either $\sigma_i^2 = \sigma_o^2$ or $\sigma_u^2 = 0$). The reasons are also the same as before.

Having checked that the conclusions obtained in Section 3.1 also hold under complementarity between ability and effort, we can now state the following new result.

**Proposition 4** *When effort and ability are complements and the variance in abilities of the two agents are sufficiently close, there will be multiple equilibria with the effort of each agent depending positively on the effort of the rival.*

Proof. Let us consider a limiting case. Suppose that $\sigma_i^2 \simeq \sigma_o^2$ $(= \sigma^2)$. Then, $\mu_i(e) \simeq \mu_o(e)$ $(= \mu(e))$ and $\tilde{e}_i \simeq \tilde{e}_o$ $(= \tilde{e})$. The equilibrium condition (20) for both agents becomes:

$$c'(\tilde{e}) = \frac{m_i + m_o}{2\sigma\sqrt{2}} \frac{\sqrt{\mu(\tilde{e})}}{\tilde{e}} \varphi \left( \frac{m_i - m_o}{\sqrt{2\sigma^2 \mu(\tilde{e})}} \right) b \tag{21}$$

Note that $\lim_{\tilde{e}\to 0} \varphi \left( \frac{m_i - m_o}{\sqrt{2\sigma^2 \mu(\tilde{e})}} \right) = 0$, $\lim_{\tilde{e}\to +\infty} \varphi \left( \frac{m_i - m_o}{\sqrt{2\sigma^2 \mu(\tilde{e})}} \right) > 0$, $\lim_{\tilde{e}\to 0} \sqrt{\mu(\tilde{e})}/\tilde{e} > 0$ and $\lim_{\tilde{e}\to +\infty} \sqrt{\mu(\tilde{e})}/\tilde{e} = 0$. So, the r.h.s. of (21) is always non-negative and tends to 0 as $\tilde{e}$ tends to either 0 or $+\infty$. Given $c''(\tilde{e}) > 0$, we get the multiplicity result. By continuity, the argument holds for $\sigma_i^2$ close to $\sigma_o^2$. □

If one agent is expected to work hard, his updated ability will greatly depend on his performance $x_a^\alpha$, so he will try to bias this perception by exerting effort. However, under complementarity between $\theta_a$ and $e_a$, effort also increases the variance of the performance. In other words, the harder an agent works, the more volatile the (stochastic) posterior of his expected ability. This, in turn, increases the uncertainty about who will ex-post have the greatest posterior ability. As the final outcome becomes more uncertain, the incentives to exert effort become less dependent on the prior expected abilities ($m_i$ and $m_o$) and endogenously more sensitive to the performances of the two agents. To sum up, when one agent is expected to work hard, then he is trapped into fulfilling these expectations. Moreover, the outcome of his screening task becomes also more uncertain. This increases the weight of the rival's performance in the determination of who is ex-post selected for the job. Hence, the opponent is also encouraged to exert a high level of effort.

Given this multiplicity, we finally study which agent benefits from coordinating in one equilibrium or the other. From (19) we know that the job will be offered to the incumbent/senior and the outsider/junior with the following ex-ante probabilities, respectively:

$$\Pr[\, w_J = i \,] = \Phi \left( \frac{m_i - m_o}{\sqrt{\sigma_o^2 \mu_o(e_o) + \sigma_i^2 \mu_i(e_i)}} \right) \quad \text{and} \quad \Pr[\, w_J = o \,] = \Phi \left( \frac{m_o - m_i}{\sqrt{\sigma_o^2 \mu_o(e_o) + \sigma_i^2 \mu_i(e_i)}} \right).$$

Consider two possible equilibria, one in which agents exert low effort $e_a = \underline{e}_a$, and another in which agents exert high effort $e_a = \overline{e}_a$ (with $\overline{e}_i > \underline{e}_i$ and $\overline{e}_o > \underline{e}_o$). We have the following result.

**Corollary 3** *The agent with highest prior expected ability will get the job with a higher probability in the low-effort equilibrium $(\underline{e}_i, \underline{e}_o)$ than in the high-effort equilibrium $(\overline{e}_i, \overline{e}_o)$. The converse is true for the agent with lowest prior expected ability.*

Interestingly, the logic behind Corollaries 2 and 3 is the same. In both cases, the key issue is how the information transmitted affects the likelihood of keeping an ex-ante advantage vs. the likelihood of losing it. In an equilibrium with low effort, the principal learns less about the ability of agents than in an equilibrium with high effort. This favors the agent with highest prior expected ability because he is most likely to keep his leading position. The opposite is true in an equilibrium where both agents exert high effort. Hence, if we frequently observe that the agent with ex-ante highest ability turns out to be the one with the lowest ex-post one, it means that the screening process has provided a great deal of information. This occurs when both agents exert high effort in the screening tasks, which is something valuable for the organization.

## 4 Some further comments

From this stylized model of screening and job allocation, we have been able to obtain some interesting insights. We have shown that if screening is costless but the procedure has to be delegated to the incumbent, then it may not always be optimal to hire the most capable individuals. Ability translates into performance, but it may also lead to inefficiently low levels of information revelation. The model also shows that organizations should systematically bias contests in favor of outsiders and junior agents relative to incumbents and senior ones, because the former have greater implicit (career concern type) incentives than the latter to perform efficiently.

Several extensions besides those exposed in Remark 2 would be desirable in order to improve our understanding of screening and job allocation. First, it would be interesting to study competition between more than two agents.[20] Second, we could determine the optimal selection rule when the principal can commit. Last, we could investigate a more realistic situation in which agents can be valuable at some tasks and worthless at some others (i.e. a multidimensional ability setting). These and other issues are left for future work.

[20]For example, if three agents compete for one job, it is relatively costless for the agent with highest expected ability to delegate some screening tasks to the agent with lowest expected ability. This suggests that increasing the number of competitors could affect qualitatively the current results.

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