Activist and Conservative Rules for Standards*

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Abstract

A manager sets a rejection standard on a noisy signal to reject or accept a candidate who may or may not be qualified. Wrong decisions (Type I and II errors) are costly. Unqualified candidates may exert some effort in order to improve their signal distribution and increase their chances of success. We show that a commitment to a fixed standard is valuable. Furthermore, ex-post harsh (soft) standards are ex-ante optimal when the unqualified candidates' levels of effort are strategic substitutes (complements) of the standard. As a result, the manager can optimally exhibit a conservative or activism attitude in the decision process.

Keywords: Ex-post inefficiency; Costly Persuasion; Conservatism.

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1 Introduction

Several decision problems involve assessing if an alternative is suitable or not. For instance, evaluating if a job candidate or a politician is qualified for a position or if a prospective student is fit for an academic program, the promotion of a worker, etc. Other related problems involve deciding whether an agent took precautionary activities or committed a crime. In all these situations the decision may be made based on evidence that imperfectly unveils the actual state of the world. In the example above, the job candidate, even if she is not qualified, wishes to be hired. Similarly, a bad student wants to be admitted to the program, an untalented worker wants to be promoted, a politician wants to be elected and a guilty defendant wants to be acquitted. They all can make costly efforts so that the evidence observed by the decision maker (i.e., the manager, the director of the program, the employer, the audience, the judge) is swayed to decide in their favor. What is important for the message of this paper is that the cost of this effort is compensated with an increase in the chances of success, which in turn is affected by the standard of the decision maker. It follows that the standard set by the decision maker plays two important roles. First it intends to minimize the prospect of a wrong decision (Type I and Type II errors), given the evidence. Second, it determines the incentives of the individuals to affect the reliability or informativeness of the evidence. Since the quality of the decision maker's information is endogenous, the decision maker faces a trade-off between the ex ante incentive for evidence reliability and ex post optimality given the evidence. Our work analyzes how this second role distorts the standard set by the decision maker and we provide conditions under which it may lead to *harsher* or *softer* standards relative to the ex post efficient standard (given the evidence).[1]

In a related work, Li (2001) defines (ex post) conservatism as a small deviation from the ex post efficient standard against the alternative favored by a committee's prior or preference. The author emphasizes that a committee of multiple agents will *always* benefit from being (a bit) conservative because of the public-good nature of evidence. Conservatism helps mitigate the free riding problem in gathering useful information by increasing the private marginal benefit of collecting more precise evidence. The author shows that the optimal degree of conservatism depends positively on the size of the committee and it is zero for a single decision maker due to the absence of a free riding problem. This conclusion is driven by the critical assumption that only the committee can affect the informativeness of the evidence it collects: the level of precision of the aggregated information is only determined by each committee member's private effort.

However, there is a myriad of real world examples (for instance, advertising, lobbying, political campaigns, etc) that highlight the importance of persuasion. In these settings, agents can generally devote resources to influence the committee's judgement in their favor when their payoffs depend on the decision made. As Li (2001)acknowledges "most of the evidence concerning effectiveness of a new drug is provided by its producer, not by

[1]Ex post inefficiency is a well known phenomenon in economics. A real-life example is the commitment by Economic Inquiry to say "yes or no" to a submission by offering the "no revisions" option to authors. It inevitably leads to more type I and II errors since there are some accepted (rejected) manuscripts that would have clearly received a "revise and resubmit" otherwise. But this inefficiency is justified by the prevention of rounds of revisions, escalating the evaluation business. See McAfee (2010)Refer also to the works by Kolotilin et al. (2013), Prendergast (1993), Gilbert and Kemplerer (2000), Hart and Moore (2007), Matouscheck (2004) and Laux (2008).

the panelists" (page 631). Therefore, we depart from Li's framework by introducing persuasion in our setting.

Specifically, in the context of a recruitment decision, we assume that unqualified candidates can affect the reliability of the evidence the committee uses to make inferences about the state of the world at a cost. More precisely, unqualified candidates choose a costly partially informative signal among a family of distributions over a realization space. Although the chosen signal is not observable, the evidence is nonmanipulable (that is, it is neither concealable nor forgeable). This modification is key in establishing our main result that the optimal degree of conservatism can be positive or negative even for a single decision maker. Since persuasion decreases the quality and value of the decision maker's information, he compromises the ex post efficiency of the decision (given the evidence) to promote the quality of the information (the reliability of the evidence) on which the decision is based. As a result, decisions can be ex post inefficient. But optimal deviations from the ex post efficient standards can be toward (activism) or against (conservatism) the alternative favored by the decision maker's prior or preference. Our analysis shows that whether the induced signal exhibits strict supermodularity (submodularity) over a range determines the strategic substitutability (complementary) of the unqualified candidates' effort and the evidentiary standard in that range and the decision maker's attitude (conservative vs. activist) in the decision process. Furthermore, under certain regular conditions, we show that if the manager ever uses conservative decision rules for standards for some parameter values, then he must also use activist decision rules for standards for other parameter values. In contrast, the converse statement is not true. A manager could perfectly exhibit only an activist attitude in the decision process.

Our main result has two main implications. First, it suggests that the use of conservative decision rules does not always benefit a committee of multiple agents. The committee must balance the incentives that the evidentiary standard provides to both sides in generating more reliable evidence. Although conservatism is beneficial in inducing its members to gather more precise evidence, it may fail in dissuading persuasion (deterring unqualified candidates from mimicking qualified candidates). When the latter effect dominates the former, conservatism reduces the ex ante welfare of the committee. Activism should be encouraged in those scenarios. Given that committees larger in size tend to suffer more from the free riding problem, a second implication of our result is that the committee's attitude towards a particular subject matter may depend on its size. Thus, small or intermediate (in size) committees could show an activist attitude and large committees show a conservative attitude when dealing with the same subject matter despite being equally biased toward a particular alternative. This is consistent with centralized long decision processes (of several stages) within organizations. Important proposals are often approved by several departmental subcommittees before being evaluated by a more hierarchical committee which is usually larger in size. The subsequent stages of the decision process moderates the role of the (sub)committees' biases in decision making by rejecting proposals which has been passed the earlier stages because of biases in favor of approval. Hence, our approach offers a rationalization for centralization[2], an organizational form widely in

[2]Ivanov (2010) also provides an argument in favor of centralization (vs. delegation) in a strategic information transmission game with informational control. In his work, information is manipulable and the receiver faces a trade off between the precision of the sender's primary information and her incentives to reveal it. Restricting the amount

use nowadays.[3]

The article is organized as follows. Section 2 provides a brief literature review. Section 3 outlines the formal model in a recruitment context. Section 4 develops the prior decision as a benchmark. We solve the simultaneous and sequential games in Sections 5 and 6 respectively. Section 7 provides our main results on conservatism. Section 8 highlights examples which illustrate our results. Section 9 concludes with a summary of our results and points out some directions for future research.

2 Related Literature

Our analysis complements Li's study in establishing a theory of conservatism. Both papers highlight the importance of the quality of information for decision making. While Li (2001)focuses on the benefit of conservatism to mitigate the free-riding problem in gathering conclusive evidence, our emphasis is on the positive/negative effects of conservatism on dissuading persuasion.

Furthermore, our paper contributes to the literature on persuasion by analyzing the optimal commitment that the receiver of information (the decision maker) can adopt in order to simultaneously minimize (a weighted sum of Type I and Type II) errors associated with the decision and discourage the sender (the candidate) from controlling the (quality of) information. Therefore, our work can be embodied into two main areas of research on persuasion: a first area examines optimal responses to hard information or

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of sender's information allows the receiver to gain without transferring control over decisions.

[3]Refer to The Economist, August 5th 2004.

persuasion (Kolotilin et al. (2013), Fishman and Hagerty (1990), Glazer and Rubinstein (2004), Alonso and Matouscheck (2008)) and the second area focuses on Bayesian persuasion through control of the receiver's informational environment (Rayo and Segal (2010), Kamenica and Gentzkow (2011), Kolotilin (2013)). As in Kamenica and Gentzkow's framework, the sender (the candidate for a position) can credibly convey partially informative information to the receiver by choosing a signal (among a family of distributions which generates a distribution of posteriors that is Bayes plausible) whose realization is directly observed by the receiver. But our framework differs from theirs in several key respects: (i) there is asymmetric information in our setting: the sender is perfectly informed about the state of the world; (ii) there is moral hazard in our model: the receiver does not observe the signal chosen by the sender, only its realization; (iii) the sender is restricted to choose among a parameterized subset of signals; (iv) it is costly for the sender to choose a signal other than the signal given by default; and (v) the receiver can control the incentives of the sender who attempts to persuade him.

Ganuza et al. (2011)use a standard model of negligence with imperfect information to analyze the optimal choice of evidentiary (legal) standards to induce adequate (care) behavior in the presence of a diversity of precautionary technologies. While the choice of a (precautionary) technology associated with a particular degree of informativeness is observed by the decision maker (the Court) in their setting, this choice is the hidden action in our work.

3 The Model

Our modeling approach is in the spirit of Li (2001)'s work. In order to isolate the insight emphasized by the author, we depart from his model by assuming that there is only one member in the recruiting committee. For simplicity, we abstract from modeling the manager's choice of effort in collecting more conclusive evidence by assuming that he always uses the optimal level. These assumptions allow us to concentrate on persuasion.

A *manager* decides whether a *candidate* to a position should be *hired* or *rejected*. The candidate is either *qualified* or *unqualified* for the offered position. The manager cannot observe directly the candidate's qualification which is private information. Each candidate is unqualified with (prior) probability $\gamma \in (0, 1)$ and qualified with (prior) probability $1 - \gamma$. The prior is derived from her curriculum-vitae (that is, education and past experience), recommendation letters, transcripts, reputation of the academic programs she has attended, etc. The manager prefers to hire the candidate if she is *qualified*, and to reject her otherwise. The magnitudes of the losses associated to hiring an unqualified candidate (henceforth wrongful hiring) and not hiring a qualified candidate (henceforth wrongful rejection) are normalized to 1. The weights given by the manager to type I and type II errors are denoted by $\lambda_1 > 0$ and $\lambda_2 > 0$ respectively. The recruiting manager's preference is public information (common knowledge).

We assume that the manager makes his decision based on further evidence gathered by conducted interviews, tests scores, job-market seminars, examination of the candidate's previous work quality, etc. We interpret this evidence as information that is detrimental to the candidate: a measure of observable aspects of the candidate such that a higher realization represents greater evidence that the candidate is unqualified.

We further assume that the unqualified candidate has access to a costly technology which lowers the degree of informativeness and reliability of the evidence. The use of this technology is a hidden action which makes the manager's task of distinguishing between qualified and unqualified candidates more difficult. For instance, a job candidate can get special training for interviews, or invest in test-specific training programs that allow her to perform better in the selection process without improving her actual performance in the job.[4,5] Mock interviews or mock job-market seminars are such examples. Instead, we assume that qualified candidates optimally do not invest in these training activities because either such investment cannot help them in the selection process as they already know the right answers to the potential questions or the marginal gain from such a training does not compensate the extra cost.

Formally, the candidate's evidence is represented by a signal realization, $z \in S \subseteq \mathbb{R}$ where S is a compact interval of real numbers $[\underline{s}, \overline{s}]$. The qualified candidate's evidence is a realization of a random variable with cumulative distribution and density functions denoted by $F(z|\overline{\theta})$ and $f(z|\overline{\theta})$ respectively. The unqualified candidate's evidence is a realization of a random variable which follows a cumulative distribution and density functions denoted by $F(z|\theta)$ and $f(z|\theta)$ respectively, with $\theta \in \left[\underline{\theta}, \overline{\theta}\right] =: \Theta$. The parameter θ indexes a family of signal distributions which satisfies the strict Monotone Likelihood Ratio Property (MLRP), i.e., if $\theta' > \theta$, then $\frac{f(z|\theta)}{f(z|\theta')}$

[4] These assumptions are inline with those of Spence's (1973) education game. But in contrast to this signalling game, the manager does not observe whether the candidate undertook these training activities. Thus, the situation involves moral hazard.

[5] Liu and Neilson (2011) distinguish between skill improvement and test preparation by pre-college students, where the later only improves test performance without improving skills.

is strictly increasing in z on S. This condition ensures that more evidence is “bad news" about the candidate’s qualification (Milgrom (1981)): if beliefs are updated according to Bayes’ rule, the higher is the observed signal realization z, the higher is the posterior probability that the candidate is unqualified given the evidence z. We further assume that $F(z|\theta)$ is continuously three time differentiable on the interior of $S \times \Theta$. The strict MLRP implies that $F(z|\theta)$ strictly first-order stochastically dominates (FOSD) $F(z|\theta')$, that is, $F(z|\theta) < F(z|\theta')$ if $\theta' > \theta$ and $z \in (\underline{s}, \overline{s})$ which implies $h(z,\theta) \equiv \frac{\partial F(z|\theta)}{\partial \theta} > 0$ for $z \in int(S)$. Furthermore, $h(z,\theta)$ is assumed to be continuously differentiable and decreasing in θ for all $\theta < \overline{\theta}$.

The value of θ for an unqualified candidate’s signal distribution is determined one to one by the level of effort exerted by the candidate: the higher the level of effort exerted by the unqualified candidate, the higher is the parameter θ and the more alike are the qualified and the unqualified candidates’ signal distributions. We assume that $f(z|\underline{\theta})$ is the unqualified candidate’s signal (distribution) by default, that is, her signal (distribution) when no effort is exerted. The candidate’s disutility of effort (the cost of changing her default signal) is given by the function $C(\theta)$ which is assumed differentiable and it satisfies $C(\underline{\theta}) = 0$, $C'(\theta) > 0$ and $C''(\theta) \geq 0$.

The candidate’s opportunity cost of not being hired is normalized to 1. Both the manager and the candidate wish to minimize their weighted expected losses (disutilities).

The timing of the game is as follows: (1) Nature determines the candidate’s type (whether she is qualified or unqualified) according to a commonly known probability distribution fully described by $Pr(unqualified) = \gamma \in (0,1)$; (2) The manager commits to an evidentiary rejection standard, that is a threshold of evidence; (3) The unqualified candidate chooses her level of effort knowing the manager's evidentiary rejection standard commitment; (4) Nature picks the signal realization z from the set of feasible signals according to the information structure endogenously chosen by the candidate; (5) The manager rejects the candidate if and only if the evidence meets the standard.

We solve the above sequential game (denoted by Γ_1) using backward induction. We first analyze the unqualified candidate's decision for a given standard and then solve the recruiting manager's problem. For a better understanding of the two roles played by the standard commitment, we proceed first to analyze the Nash equilibrium in the simultaneous game, denoted by Γ_2.

4 The Prior Decision

Suppose that the manager cannot get access to further evidence about the candidate's qualification and must take his decision based only on his prior information. The expected weighted loss to the manager is given by:

$$V = \min\{\lambda_1\gamma, \lambda_2(1-\gamma)\} = \lambda_1\gamma min\{1, \kappa\}. \tag{1}$$

The parameter $\kappa := \frac{\lambda_2}{\lambda_1}\frac{1-\gamma}{\gamma} \in [0, \infty)$ measures the relative importance given by the manager to the type II error (wrongful rejection) versus the type I error (wrongful hiring) weighted by their respective priors. When $\kappa = 1$, the manager's concern for wrongful hiring and wrongful rejection are perfectly balanced with the prior. The manager is then indifferent between hiring and rejecting the candidate without further evidence. When $\kappa < 1$ ($\kappa > 1$), the manager's preference and prior are such that he is more (less) concern with wrongful hiring than wrongful rejection. The manager would optimally choose rejection (hiring) if no further evidence were available to make his decision.

Definition 1. The manager is “biased for rejection" if and only if $\kappa < 1$. The manager is “biased for hiring" if and only if $\kappa > 1$. The manager is “unbiased" if and only if $\kappa = 1$.

5 The Simultaneous Game

5.1 Ex Post Optimal Rejection Standard

Assume that the level of effort by the unqualified candidate is given exogenously (ie. take θ as given). The set of strategies for the recruiting manager is the set of all possible standards. The strict MRLP assumption guarantees that the manager's optimal best response is an evidentiary rejection standard, that is, a "threshold" strategy (s) such that the manager hires the candidate if $z < s$ and he rejects her if $z \geq s$ for some real number $s \in S$. For any rejection standard s, the probabilities of wrongful rejection and wrongful hiring are given by $1-F(s|\overline{\theta})$ and $F(s|\theta)$ respectively. Therefore, the manager faces a trade-off: the higher is the rejection standard s, the lower is the Type II error and the higher is the Type I error generated by the standard.

The expected weighted loss to the manager as a function of an arbitrary rejection standard s and a given level of effort θ is given by:

$$V(s,\theta) = \lambda_1 \gamma F(s|\theta) + \lambda_2(1-\gamma)(1-F(s|\overline{\theta}). \tag{2}$$

In the sequel, it is useful to define the function $g_\theta(s) := \frac{f(s|\theta)}{f(s|\overline{\theta})}$ which is strictly increasing in s over S for all $\theta \in \left[\underline{\theta}, \overline{\theta}\right)$ by the strict MLRP.

An ex-post optimal standard minimizes the manager's expected loss: $s^*(\theta,\kappa) \in \arg\min_{s\in S} V(s,\theta)$. An internal solution satisfies

$$g_\theta(s^*(\theta,\kappa)) \;=\; \kappa. \tag{3}$$

More generally, since $sign\left\{\frac{\partial V(s,\theta)}{\partial s}\right\} = sign\left\{g_\theta(s)-\kappa\right\}$ and $g_\theta(z)$ is strictly increasing in z for all $\theta \in [\underline{\theta},\overline{\theta})$, we have that

$$s^*(\theta,\kappa) = \begin{cases} \underline{s} & \text{if } \kappa \le g_\theta(\underline{s}) \\ (3) & \text{if } \kappa \in (g_\theta(\underline{s}), g_\theta(\overline{s})) \\ \overline{s} & \text{if } \kappa \ge g_\theta(\overline{s}) \end{cases} \tag{4}$$

Thus, $s^*(\theta,\kappa)$ is weakly increasing in κ. Assuming $g_\theta(\underline{s}) < 1 < g_\theta(\overline{s})$, then $s^*(\theta,\kappa) < s^*(\theta,1)$ if and only if $\kappa < 1$. Therefore, the ex post optimal standard includes a bias parameter, given by $s^*(\theta,\kappa) - s^*(\theta,1)$, which is negative (positive) if and only if the manager is "biased for rejection" (hiring). The more biased for rejection (hiring) is the manager, that is, the lower (higher) is κ among all $\kappa < 1$ ($\kappa > 1$), the tougher (higher) is his rejection standard relative to the one set by an unbiased manager.

Notice also that for a given s, a lower degree of informativeness (implied by a higher θ) increases the Type I error (wrongful hiring) but leads to no changes in the Type II error (wrongful rejection). By the Implicit Function Theorem and the Envelope Theorem we have that in an interior solution:

$$\frac{\partial s^*(\theta,\kappa)}{\partial\theta} = -\frac{\frac{\partial g_\theta(s^*(\theta,\kappa))}{\partial\theta}}{\frac{\partial g_\theta(s^*(\theta,\kappa))}{\partial s}} \tag{5}$$

$$\frac{\partial V(s^*(\theta,\kappa),\theta)}{\partial\theta} = \lambda_1\gamma h(s^*(\theta,\kappa),\theta) > 0 \tag{6}$$

$$\frac{\partial F(s^*(\theta,\kappa)|\theta)}{\partial\theta} = f(s^*(\theta,\kappa)|\theta)\frac{\partial s^*(\theta,\kappa)}{\partial\theta} + h(s^*(\theta,\kappa),\theta) \tag{7}$$

$$\frac{\partial[1-F(s^*(\theta,\kappa)|\,\overline{\theta})]}{\partial\theta} = -f(s^*(\theta,\kappa)|\,\overline{\theta})\frac{\partial s^*(\theta,\kappa)}{\partial\theta} \tag{8}$$

In the region of the parameter space in which the function $F(z|\theta)$ is strictly submodular, $\frac{\partial g_\theta(s^*(\theta,\kappa))}{\partial\theta} < 0$ and hence $\frac{\partial s^*(\theta,\kappa)}{\partial\theta} > 0$: a lower degree of informativeness unambiguously increases the Type I error and decreases the Type II error. The increase in the Type I error dominates the decrease in the Type II error harming the manager. In the region of the parameter space in which the function $F(z|\theta)$ is strictly supermodular, $\frac{\partial g_\theta(s^*(\theta,\kappa))}{\partial\theta} > 0$ and hence, $\frac{\partial s^*(\theta,\kappa)}{\partial\theta} < 0$: a lower degree of informativeness unambiguously increases the Type II error. If $s^*(\theta,\kappa)$ is not very responsive to θ, the direct effect of a higher θ on the Type I error will dominate its indirect effect by globally increasing it. In either case, the manager is made worse off because of the dominance of the increase in the Type II error.

5.2 The Candidate's Control of Information

The unqualified candidate can persuade the manager to hire her by controlling his informational environment at a cost. An unqualified candidate can make her signal (distribution) $f(z|\theta)$ more similar to that of a qualified candidate $f(z|\overline{\theta})$ by increasing the magnitude of θ. The unqualified candidate's set of strategies is the set of all possible level of efforts $\theta \in \left[\underline{\theta}, \overline{\theta}\right]$.

For a given rejection standard s set by the manager, the unqualified candidate's expected disutility is given by:

$$U(s,\theta) := 1 - F(s|\theta) + C(\theta)$$

The optimal level of effort given s solves $\theta^*(s) \in \arg\min_{\theta\in\left[\underline{\theta},\overline{\theta}\right]} U(s,\theta)$.

An interior solution satisfies:

$$C'(\theta^*(s)) = h(s,\theta^*(s)) \tag{9}$$

where $h(s,\theta) := \frac{\partial F(s|\theta)}{\partial\theta}$ is the marginal increase in the unqualified candidate's probability of being hired by the manager when her level of effort increases marginally for a given s. We assume that $h(\bar{s}, \theta) = h(\underline{s}, \theta) = 0$ for all θ, that is, efforts are redundant if all candidates are hired or rejected. Furthermore $h(s, \cdot)$ satisfies both $h(s, \underline{\theta}) > C'(\underline{\theta})$ and $C'(\bar{\theta}) > h(s, \bar{\theta})$ for all $s \in intS$. In other words, exerting some effort is always valuable. Yet since effort is associated with decreasing marginal returns and nondecreasing marginal costs, a unique interior optimum exists: $\theta^*(s) \in \left(\underline{\theta}, \bar{\theta}\right)$ when $s \in intS$.

The Implicit Function Theorem and condition (9) imply

$$\frac{d\theta^*(s)}{ds} = \frac{\frac{\partial h(s,\theta^*(s))}{\partial s}}{C''(\theta^*(s)) - \frac{\partial h(s,\theta^*(s))}{\partial \theta}} \tag{10}$$

for all $s \in intS$. Since we have assumed $h(s, \theta)$ is decreasing in θ for all $s \in intS$, the sign of the effect of the standard on the optimal level of effort exerted by the unqualified candidate is determined by the sign of the numerator: $\frac{\partial h(s,\theta^*(s))}{\partial s}$. Note that an increase in the rejection standard s is a less "aggressive" (ie. a softer) play by the manager, benefiting the candidate ($\frac{\partial U(s,\theta)}{\partial s} < 0$). However, a higher level of effort exerted by the unqualified candidate is a more "aggressive" play by the candidate, harming the manager ($\frac{\partial V(s,\theta)}{\partial \theta} > 0$).

We follow the terminology of Bulow et al. (1985) in establishing the following definition.

Definition 2. The unqualified candidate's effort is a strategic substitute of the manager's standard s if $\frac{d\theta^*(s)}{ds} > 0$ and it is a strategic complement of s if $\frac{d\theta^*(s)}{ds} < 0$.

Intuitively, when the unqualified candidate becomes more aggressive in the face of a more aggressive (ie. a harsher) play by the manager, we say that her effort is a strategic complement of the rejection standard set by the manager. Likewise, when the unqualified candidate responds to a less aggressive (ie. a softer) play by the manager with more aggression, then we say that her effort is a strategic substitute of the rejection standard set by the manager.

Proposition 3. *In the region of the parameter space in which the function $F(z|\theta)$ is strictly supermodular (submodular), the unqualified candidate's effort is a strategic substitute (complement) of the manager's standard*

Proof. In the region of the parameter space in which the function $F(z|\theta)$ is strictly supermodular (submodular), exerting effort is more (less) valuable at softer standards since $\frac{\partial h(s,\theta^*(s))}{\partial s} > 0$ (< 0). By condition (10) the unqualified candidate responds to softer standards with higher (lower) levels of effort $\frac{d\theta^*(s)}{ds} > 0$ (< 0). □

5.3 Nash Equilibrium

Proposition 4. Γ_2 *has a unique Nash equilibrium in pure strategies. In the equilibrium outcome, the manager's standard is weakly increasing in* κ.

Proof. Both U and V are continuous in (s, θ). The MRLP guarantees that $-V(\cdot, \theta)$ is quasiconcave. Finally, since $h(s, \cdot)$ is decreasing and $C'' \geq 0$, we have that $-U(s, \cdot)$ is quasiconcave. By Theorem 2.2 in Reny(2005), Γ_2 has at least one Nash equilibrium in pure strategies. Each Nash equilibrium (s_{NE}, θ_{NE}) satisfies equations (4) and (9) simultaneously. When it is an interior solution, the following condition is satisfied:

$$g_{\theta^*(s_{NE})}(s_{NE}) = \kappa. \tag{11}$$

Uniqueness follows from the fact that $g_{\theta^*(s)}(s)$ is strictly increasing in s:

$$\begin{aligned}\frac{dg_{\theta^*(s)}(s)}{ds} &= \frac{\partial g_{\theta^*(s)}(s)}{\partial s} + \frac{\partial g_{\theta^*(s)}(s)}{\partial \theta}\frac{d\theta^*(s)}{ds} \\ &= \frac{\partial g_{\theta^*(s)}(s)}{\partial s} + \frac{1}{f(s|\overline{\theta})}\frac{\partial h(s,\theta^*(s))}{\partial s}\frac{d\theta^*(s)}{ds} > 0 \qquad (12)\end{aligned}$$

The first term is positive due to the strict MLRP. The second term in the last equality follows from Young's Theorem and it is nonnegative by condition (10). The fact that $g_{\theta^*(s)}(s)$ is strictly increasing in s implies that the manager's standard is weakly increasing in κ in the equilibrium outcome. □

By Proposition 4, we can define $s^*(\kappa)$ as the (ex-post optimal) Nash equilibrium standard in game Γ_2 for any given $\kappa \geq 0$.

6 The Sequential Game

In this section we show that the manager can benefit from the opportunity to make a binding self-commitment in the game. As in the Stackelberg's leadership model, the commitment is achieved simply by moving earlier than the candidate in the game. A real life example of such a commitment could be the promotion/tenure decision of an employee by her company or institution. For instance, consider the university tenure system. The university must decide whether to give tenure (accept) or fire (reject) a candidate at the end of a probationary period. It is well known that some universities commit to an explicit tenure standard. In a recruiting context, the civil service examinations used by the Public Administrations could be used as an example of such a commitment in a game with competition among candidates for the offered position.[6]

By committing to a rejection standard, the manager can affect the unqualified candidate's incentives to control his informational environment. The standard selected minimizes the manager's ex ante expected weighted loss.

We formalize this by analyzing the two-stage game Γ_1 described previously. In the first stage, the manager commits to a standard denoted by $s_{co} \in S$. In the second stage, the unqualified candidate chooses her level of effort denoted by $\theta^*(s_{co})$. The set of strategies for the unqualified candidate is the set of all functions $\theta : S \to [\underline{\theta}, \overline{\theta}]$, which we denote by $\overline{\Theta}$. Therefore, the recruiter optimally chooses $s_{co} \in \arg\min_{s \in S} V_{co}(s) := \lambda_2(1-\gamma)(1-F(s|\ \overline{\theta})) + \lambda_1 \gamma F(s|\theta^*(s))$. An equilibrium for Γ_1 is a duplet $(s^*_{co}, \theta^*) \in S \times \overline{\Theta}$ such that $V_{co}(s^*_{co}) \leq V_{co}(s)$ for all $s \in S$ and $U(s, \theta^*(s)) \leq U(s, \theta)$ for all $\theta \in [\underline{\theta}, \overline{\theta}]$ and $s \in S$. The following result shows that this game always has at least one subgame perfect equilibrium (in pure strategies).

Proposition 5. Γ_1 *has at least one subgame perfect equilibrium in pure strategies.*

Proof. Since $U(s, \cdot)$ is continuous and strictly convex on $[\underline{\theta}, \overline{\theta}]$ for all $s \in intS$, we have a unique number $\theta^*(s)$ such that $U(s, \theta^*(s)) < U(s, \theta)$. Furthermore, $\theta^*(s)$ is continuous in s. It follows that V_{co} is continuous on S. Then, the Weirestrass Theorem yields the result. □

Since standards play both a decision role and an incentive role in our framework, equilibrium standards are not ex post efficient in general.

[6]Refer to the conclusion section for a discussion about how competition would affect the outcome of the game.

$$\begin{aligned}\frac{dV(s,\theta^*(s))}{ds} &= \frac{\partial V(s,\theta^*(s))}{\partial s} + \frac{\partial V(s,\theta^*(s))}{\partial \theta}\frac{\partial \theta^*(s)}{\partial s} \\ &= \lambda_1 \gamma f(s|\overline{\theta})\left[g_{\theta^*(s)}(s) - \kappa + \frac{h(s,\theta^*(s))}{f(s|\overline{\theta})}\frac{d\theta^*(s)}{ds}\right]\end{aligned} \tag{13}$$

In setting his evidentiary rejection standard, the manager must consider not only its direct effect (the first term on the right hand side of the above equation which implies a higher Type I error and lower Type II error) but also the strategic effect that arises through induced changes in the candidate's incentives to exert effort (the second term on the right hand side of the above equation).

The following definition classifies deviations of optimal standard commitments from ex post optimal standards.

Definition 6. A manager is *harsh* (*soft*) at $(s^*_{co}, \theta^*(s^*_{co}))$ if $s^*_{co} < (>)argmin_s V(s, \theta^*(s^*_{co}))$.

A harsh (soft) manager is a relatively more (less) aggressive manager: his rejection standard is strictly lower (higher) than the standard that would have been set optimally ex post given the level of effort exerted by the unqualified candidate. Consequently, a harsh (soft) manager generates relatively less (more) Type I error (wrongful hiring) and more (less) Type II error (wrongful rejection).

The following result reveals that a particular property of the unqualified candidate's signal distribution determines the harshness or softness of optimal standards.

Proposition 7. *If $F(s|\theta)$ is striclty supermodular (strictly submodular) at $(s^*_{co}, \theta^*(s^*_{co}))$ and $s^*_{co} \in (\underline{s}, \overline{s})$ then, the manager is harsh (soft) at $(s^*_{co}, \theta^*(s^*_{co}))$.*

Proof. An interior minimizer of V_{co} satisfies

$$\frac{h(s^*_{co}, \theta^*(s^*_{co}))}{f(s^*_{co}|\overline{\theta})}\frac{d\theta^*(s^*_{co})}{ds} + g_{\theta^*(s^*_{co})}(s^*_{co}) = \kappa. \tag{14}$$

Notice that since h is assumed to be positive in the interior of S, the sign of the first term in the left hand side is determined by the sign of $\frac{d\theta^*(s^*_{co})}{ds}$, which in turn, is determined by the sign of $\frac{\partial h(s,\theta^*(s))}{\partial s}$ by condition (10). It follows that $g_{\theta^*(s^*_{co})}(s^*_{co}) < \kappa$ if $F(s|\theta)$ is strictly supermodular at $(s^*_{co}, \theta(s^*_{co}))$. Furthermore, since $g_{\theta^*(s^*_{co})}(s)$ is strictly increasing in s, we have that either $g_{\theta^*(s^*_{co})}(s) = \kappa$ for some $s > s^*_{co}$, or that the value of s that minimizes $V(s, \theta^*(s^*_{co}))$ is $\overline{s}$. In either case, $s^*_{co} < argmin_s V(s, \theta^*(s^*_{co}))$. $\square$

Commitment standards are harsh (soft) when the unqualified candidate's effort is a strategic substitute (complement) of the manager's standard. Intuitively, when higher standards lead to higher (lower) levels of effort by unqualified candidates, the manager is prone to decrease (increase) his standard with respect to the ex post optimal standard to induce a lower level of effort by the candidate. This strategy makes the evidence be more reliable since it reflects more accurately the actual type of the candidate but it inevitably leads to ex post inefficiencies. Hence, the manager's commitment enhances the distinction between qualified and unqualified candidates but it is costly ex post. The optimal degree of deviation balances this trade off.

Let $\rho(s) := 1 + \frac{h(s,\theta^*(s))}{f(s|\theta^*(s))}\frac{d\theta^*(s)}{ds}$ for all $s \in S$. Condition (14) can be rewritten as:

$$g_{\theta^*(s^*_{co})}(s^*_{co})\rho(s^*_{co}) = \kappa. \tag{15}$$

The second term in the function $\rho(s)$ determines the size of the optimal standard distortion. The higher is the ratio $\frac{h(s,\theta^*(s))}{f(s|\overline{\theta})}$ or the responsiveness of the unqualified candidate's effort to the standard in absolute values, the greater is the deviation on the standard.

If $g_{\theta^*(s)}(s)\rho(s)$ is strictly increasing in s, condition (15) implies uniqueness of the optimal standard so we can define $s^*_{co}(\kappa)$ as the optimal equilibrium standard in game Γ_1 for $\kappa \geq 0$.

Corollary 8. *Suppose the function $g_{\theta^*(s)}(s)\rho(s)$ is strictly increasing in s. Then, there is an upward (downward) distortion on the evidentiary standard in equilibrium if and only if the unqualified candidate's effort is a strategic complement (substitute) of the standard in equilibrium.*

As it is shown in the next section, standard distortions are classified as either conservative or activist attitudes depending on the direction of the manager's bias. The following lemma will be useful for us in this analysis.

Lemma 9. *The function $g_{\theta^*(s)}(s)\rho(s)$ crosses $g_{\theta^*(s)}(s)$ at least once.*

Proof. The strict MLRP implies strict FOSD which in turn implies that (i) the c.d.f. $F(z|\theta)$ exhibits strict supermodularity at z sufficiently close to $\underline{s}$; and (ii) $h(z|\theta) > 0$ for $z \in int(S)$. Hence, the manager is harsh at $(s^*_{co}, \theta^*(s^*_{co}))$ being s^*_{co} sufficiently close to $\underline{s}$ by Proposition 7. By the assumption $h(\overline{s}, \theta) = 0$ and $h(z|\theta) > 0$ for $z \in int(S)$, the c.d.f. $F(z|\theta)$ must exhibit strict submodularity at z sufficiently close to $\overline{s}$ and hence, the manager is soft at $(s^*_{co}, \theta^*(s^*_{co}))$ being s^*_{co} sufficiently close to $\overline{s}$ by Proposition 7. As a result, $g_{\theta^*(s)}(s)\rho(s) > g_{\theta^*(s)}(s)$ for s sufficiently close to $\underline{s}$ and $g_{\theta^*(s)}(s)\rho(s) < g_{\theta^*(s)}(s)$ for s sufficiently close to $\overline{s}$. □

7 Activism and conservatism

Following Li (2001), we now study whether deviations of standard commitments from ex post optimality sway the manager toward (activism) or against (conservatism) the alternative favored by his prior or preference.

Corollary 10. *Assume $s^*_{co} \in (\underline{s}, \overline{s})$. If $F(s|\theta)$ is striclty supermodular at $(s^*_{co}, \theta^*(s^*_{co}))$ and $\kappa > 1$ or if $F(s|\theta)$ is strictly submodular at $(s^*_{co}, \theta^*(s^*_{co}))$*

and $\kappa < 1$, the optimal degree of conservatism is positive. If $F(s|\theta)$ is striclty submodular at $(s^*_{co}, \theta^*(s^*_{co}))$ and $\kappa > 1$ or if $F(s|\theta)$ is strictly supermodular at $(s^*_{co}, \theta^*(s^*_{co}))$ and $\kappa < 1$, the optimal degree of activism is positive (or equivalently, the optimal degree of conservatism is negative).

Definition 11. A manager is a pure activist (conservative) if he satisfies three requisites: i) he is harsh (soft) only if $\kappa < 1$; ii) he is soft (harsh) only if $\kappa > 1$; and iii) he is either harsh or soft for some $\kappa \geq 0$.

Intuitively, a pure activist (conservative) manager never uses conservative (activist) decision rules for standards whereas he uses activist (conservative) decision rules for standards for some parameter values.

Our next results reveal that simple conditions on the the strategic relationship between the standard and effort allow for pure activism or for partial activism and conservatism. Define $\underline{\kappa} \equiv g_{\theta^*(\underline{s})}(\underline{s})$ and $\overline{\kappa} \equiv g_{\theta^*(\overline{s})}(\overline{s})$.

Proposition 12. *A manager cannot be a pure conservative.*

Proof. The strict MLRP implies strict FOSD which in turn implies that $F(z|\theta)$ exhibits strict supermodularity at z sufficiently close to $\underline{s}$. By Proposition 7 the manager is harsh at $(s^*_{co}, \theta^*(s^*_{co}))$ being s^*_{co} sufficiently close to $\underline{s}$. As a result, he is harsh for κ sufficiently close to $\underline{\kappa}$. Therefore, a necessary condition for the manager to be a pure conservative is $\underline{\kappa} \geq 1$ or equivalently, $f(\underline{s}|\underline{\theta}) \geq f(\underline{s}|\overline{\theta})$ which violates strict FOSD. □

Let $\hat{S} \equiv \{s \in int(S) : \frac{\partial\theta^*(s)}{\partial s} = 0\}$ and define $\hat{\kappa} \equiv g_{\theta^*(\hat{s})}(\hat{s})$ for each $\hat{s} \in \hat{S}$. Since we assumed that $\theta^*(s) \in \left(\underline{\theta}, \overline{\theta}\right)$ when $s \in intS$, the set $\hat{S}$ contains as many elements as times the function $g_{\theta^*(s)}(s)\rho(s)$ crosses $g_{\theta^*(s)}(s)$. In addition, define the set $\tilde{K} \equiv (\min\{\hat{\kappa}, 1\}, \max\{\hat{\kappa}, min\{1, \overline{\kappa}\}\}) \cup \{1\}$.

Proposition 13. *Suppose that $g_{\theta^*(s)}(s)\rho(s)$ is continuous, strictly increasing in s and single crosses $g_{\theta^*(s)}(s)$. Then the manager is a pure activist if and only if $\hat{\kappa} = 1$. If $\hat{\kappa} \neq 1$, the manager uses conservative decision rules for standards if and only if $\kappa \in (\min\{\hat{\kappa}, 1\}, \max\{\hat{\kappa}, min\{1, \overline{\kappa}\}\})$ and activist decision rules for standards if and only if $\kappa \in (\underline{\kappa}, \overline{\kappa}) \setminus \tilde{K}$.*

Proof. The single crossing condition implies that $\widehat{S}$ contains only one element. The strict FOSD implies that $F(z|\theta)$ exhibits strict supermodularity at s sufficiently close to $\underline{s}$. By Proposition 3 the unqualified candidate's effort is a strategic substitute of the manager's standard at $s^*_{co} \in (\underline{s}, \hat{s})$. Hence, $\theta^*(s)$ must be concave in s when $s \in int(S)$, reaching its maximum value at $\hat{s}$. By condition (14): (i) the manager is harsh ($s^*_{co}(\kappa) < s^*(\theta^*(s^*_{co}(\kappa)))$ if and only if $\kappa \in (\underline{\kappa}, \hat{\kappa})$; (ii) the manager is neither soft nor harsh ($s^*_{co}(\kappa) = s^*(\theta^*(s^*_{co}(\kappa)))$ if $\kappa = \hat{\kappa}$ or if $\kappa \in [0, \underline{\kappa}] \cup [\overline{\kappa}, \infty)$; (iii) the manager is soft ($s^*_{co}(\kappa) > s^*(\theta^*(s^*_{co}(\kappa)))$ if and only if $\kappa \in (\hat{\kappa}, \overline{\kappa})$. Therefore, the manager is; (i) harsh while biased for rejection if and only if $\kappa \in (\underline{\kappa}, \min\{\hat{\kappa}, 1\})$; (ii) soft while biased for rejection if and only if $\hat{\kappa} < 1$ and $\kappa \in (\hat{\kappa}, \min\{1, \overline{\kappa}\})$; (iii) soft while biased for hiring if and only if $\overline{\kappa} > 1$ and $\kappa \in (\max\{\hat{\kappa}, 1\}, \overline{\kappa})$; and (iv) harsh while biased for hiring if and only if $\hat{\kappa} > 1$ and $\kappa \in (1, \hat{\kappa})$. □

The most relevant assumption in Proposition 13 is that $g_{\theta^*(s)}(s)\rho(s)$ single-crosses $g_{\theta^*(s)}(s)$. The manager would never be a pure activist under multiple crossings. Instead, he would exhibit a partial conservative and a partial activist attitude for different values of κ.

Lemma 14. *Suppose that $g_{\theta^*(s)}(s)\rho(s)$ is continuous, strictly increasing in s and single crosses $g_{\theta^*(s)}(s)$. The manager's commitment harms the candidate if and only if $\kappa \in (\underline{\kappa}, \hat{\kappa})$ and it benefits her if and only if $\kappa \in (\hat{\kappa}, \overline{\kappa})$.*

Proof. By the Envelope Theorem, we have that the higher is the rejection standard set by the manager, the lower is the unqualified candidate's expected disutility and the better off she is:

$$\frac{dU(s,\theta^*(s))}{ds} = -\frac{\partial F(s|\theta^*(s))}{\partial s} = -f(s|\theta^*(s)) < 0$$

In addition, the higher the rejection standard, the lower the probability of wrongful rejection (Type II error) and the better off is the qualified candidate. By the proof of Proposition 13, the manager is harsh if and only if $\kappa \in (\underline{\kappa}, \hat{\kappa})$ and soft if and only if $\kappa \in (\hat{\kappa}, \overline{\kappa})$. This gives the result. $\square$

Recall that the parameter κ is decreasing in the prior belief γ about the candidate and it is increasing in the manager's relative weights on wrongful rejection vs. wrongful hiring.

Lets define the following priors: $\underline{\gamma} \equiv \left(1 + \frac{\lambda_1}{\lambda_2}\overline{\kappa}\right)^{-1}$; $\hat{\gamma} \equiv \left(1 + \frac{\lambda_1}{\lambda_2}\hat{\kappa}\right)^{-1}$; and $\overline{\gamma} \equiv \left(1 + \frac{\lambda_1}{\lambda_2}\underline{\kappa}\right)^{-1}$. Candidates with sufficiently low priors or sufficiently high priors of being unqualified (that is, when $\gamma \leq \underline{\gamma}$ or $\gamma \geq \overline{\gamma}$) are either automatically hired or automatically rejected respectively in both (the simultaneous and the sequential) games, no matter the evidence generated in the recruiting process. Hence, the evidence gathered by the manager is valuable to him if only if $\gamma \in (\underline{\gamma}, \overline{\gamma})$. Among the candidates whose priors belong to this range, those deemed to be relatively more likely qualified ($\gamma \in (\underline{\gamma}, \hat{\gamma})$) are made better off by the manager's ability to commit since it leads to an upward distortion on the evidentiary standard in equilibrium. On the contrary, those deemed to be relatively more likely unqualified ($\gamma \in (\hat{\gamma}, \overline{\gamma})$) are made worse off by the manager's commitment as a downward distortion is set on the evidentiary standard in equilibrium.

If we compare the rejection standard applied to candidates of the same prior prospects by managers with different weights on wrongful hiring and wrongful rejection, we conclude that managers with greater (lower) relative weights on wrongful hiring are more demanding: i) less candidates are automatically hired and more candidates are automatically rejected; and ii) some candidates who are harmed by experimenting a downward distortion were experimenting an upward distortion with their counterparts.

8 Examples

We now use particular parameterizations to illustrate our results. The main purpose of the examples is to show that the mechanics of activism and conservatism are rather simple.

8.1 Pure Activism

Assume that the candidate's disutility of effort is given by the function $C(\theta) = \frac{1}{2}\theta^2$ for the following two examples. The region of the parameter space for which the c.d.f. $F(z|\theta)$ is modular only depends on the value of z and not on the value of θ in both of them. This guarantees a single crossing at the value of z for which $F(z|\theta)$ is modular.

Example 1: Consider the cumulative distribution functions indexed by $\theta \in \Theta = [0,1]$, $F(z|\theta) = z\left[z^2 + \theta^{1/2}(1-z^2)\right]$ for $z \in [0,1]$. Note that $F(z|\theta)$ is strictly supermodular (submodular) if and only if $z < (1/3)^{1/2}$ ($z > (1/3)^{1/2}$). The probability density functions are given by $f(z|\theta) = 3z^2 + \theta^{1/2}(1-3z^2)$. Let $f(z|\overline{\theta}) = 1$ be the standard uniform. As a result, $g_\theta(z) = f(z|\theta)$ and $h(z,\theta) = (1/2)\theta^{-1/2}z(1-z^2)$.

The unqualified candidate solves the following problem:

$$\min_{\theta\in\Theta} U(s,\theta) = 1 - s\left[s^2 + \theta^{1/2}(1-s^2)\right] + C(\theta).$$

The unqualified candidate's optimal level of effort as a function of the manager's standard is given by:

$$\theta^*(s) = \left(\frac{s(1+s)(1-s)}{2} \right)^{2/3}$$

Note that $\theta^*(s)$ is concave in s, reaching its maximum at $s = (1/3)^{1/2} = \hat{s}$. Given that $f((1/3)^{1/2}|\theta) = 1$ for all θ, $\hat{\kappa} = 1$. Furthermore, both $g_{\theta^*(s)}(s)$ and $g_{\theta^*(s)}(s)\rho(s)$ are both continuous and strictly increasing in s, crossing each other only once. The manager is a pure activist by Proposition 13: he does not make use of conservative decision rules for standards for any $\kappa \geq 0$ while he uses activist decision rules if and only if $\kappa \in (0, 3) \setminus \{1\}$.[7] By Lemma 14 the candidate is made strictly worse off by the manager's commitment if and only if $\kappa \in (0, 1)$ and strictly better off if and only if $\kappa \in (1, 3)$.

Example 2: Consider the cumulative distribution functions indexed by $\theta \in \Theta = [0, 1]$, $F(z|\theta) = z \left[1 - \frac{(1-\theta)^2}{1+\alpha}(1 - z^\alpha) \right]$ for $z \in [0, 1]$ and $\alpha > 0$. Note that $F(z|\theta)$ is strictly supermodular (submodular) if and only if $z < (1+\alpha)^{-1/\alpha}$ $(z > (1+\alpha)^{-1/\alpha})$. The probability density functions are given by $f(z|\theta) = 1 - (1-\theta)^2 \left[(1+\alpha)^{-1} - z^\alpha\right]$. Let $f(z|\overline{\theta}) = f(z|1) = 1$ be the standard uniform. As a result, $g_\theta(z) = f(z|\theta)$ and $h(z, \theta) = 2 \left(\frac{1-\theta}{1+\alpha} \right) z(1 - z^\alpha)$.

The unqualified candidate solves the following problem:

$$\min_{\theta \in \Theta} U(s, \theta) = 1 - s \left[1 - \frac{(1-\theta)^2}{1+\alpha}(1 - s^\alpha) \right] + C(\theta).$$

The unqualified candidate's optimal level of effort as a function of the manager's standard is given by:

[7] Note that i) $s^*(\kappa) = s^*_{co}(\kappa) = 0$ if $\kappa = 0$ and $s^*(\kappa) = s^*_{co}(\kappa) = 1$ if $\kappa \geq 3$; ii) $s^*(\kappa) > s^*_{co}(\kappa)$ if and only if $\kappa \in (0, 1)$ and $s^*(\kappa) < s^*_{co}(\kappa)$ if and only if $\kappa \in (1, 3)$.

$$\theta^*(s) = \frac{2s(1-s^\alpha)}{(1+\alpha)+2s(1-s^\alpha)}$$

Note that $\theta^*(s)$ is concave in s, reaching its maximum at $s = (1+\alpha)^{-1/\alpha} = \hat{s}$ and $\hat{\kappa} = 1$. Furthermore, both $g_{\theta^*(s)}(s)$ and $g_{\theta^*(s)}(s)\rho(s)$ are strictly increasing in s, crossing each other only once. Hence, the manager is a pure activist by Proposition 13: he does not make use of conservative decision rules (for standards) for any $\kappa \geq 0$ while he uses activist decision rules if and only if $\kappa \in \left(\frac{\alpha}{1+\alpha}, 1+\frac{\alpha}{1+\alpha}\right) \setminus \{1\}$.[8] By Lemma 14, the manager's commitment does not benefit the candidate for almost all values of κ as $\alpha \to 0$ whereas it does not harm the candidate for almost all values of κ as $\alpha \to \infty$.

8.2 Partial Conservatism and Activism

Consider the exponential cumulative distribution functions (c.d.f.) indexed by $\theta \in \Theta = [0,1]$, $F(z|\theta) = 1-\exp\{-\theta z\}$ for $z \geq 0$ and let $F(z|\overline{\theta}) = 1-\exp\{-z\}$ for $z \geq 0$. Thus, $g_\theta(z) = \theta\exp\{(1-\theta)z\}$ for $z \geq 0$ and $F(z|\theta)$ is supermodular (submodular) if and only if $\theta z > (<)1$. Assume that the disutility of effort satisfies $C(0) = 0$, $C'(\theta) > 0$ for $\theta > 0$, $C'(1) > \exp\{-1\}$ and $C''(\theta) \geq 0$. For any given rejection standard s, the optimal level of effort by the unqualified candidate satisfies $s\exp\{-\theta^*(s)s\} = C'(\theta^*(s))$. Therefore $\theta^*(s) \in (0,1)$ for s>0. As a result,

$$\frac{d\theta^*(s)}{ds} = \frac{(1-\theta^*(s)s)\exp\{-\theta^*(s)s\}}{C''(\theta^*(s)) + s^2\exp\{-\theta^*(s)s\}}$$

[8]Note that i) $s^*(\kappa) = s^*_{co}(\kappa) = 0$ if $\kappa \leq \frac{\alpha}{1+\alpha}$ and $s^*(\kappa) = s^*_{co}(\kappa) = 1$ if $\kappa \geq 1+\frac{\alpha}{1+\alpha}$; ii) $s^*(\kappa) > s^*_{co}(\kappa)$ if and only if $\kappa \in \left(\frac{\alpha}{1+\alpha}, 1\right)$ and $s^*(\kappa) < s^*_{co}(\kappa)$ if and only if $\kappa \in \left(1, 1+\frac{\alpha}{1+\alpha}\right)$.

Note that there is a unique number $\hat{s}$ that satisfies $\hat{s}\exp\{-1\} = C'(1/\hat{s})$. Furthermore, $\hat{s} > 1$ so that $\hat{\kappa} = \frac{\exp\{\hat{s}-1\}}{\hat{s}} > 1$. In addition, notice that the elasticity between the unqualified candidate's effort and the standard is always greater than -1 (ie. $\epsilon_{\theta^*(s),s} > -1\ \forall s$). Since $\epsilon_{\theta^*(s),s} > -1\ \forall s$, $\theta^*(s)s$ is increasing in s. Therefore, $\theta^*(s)$ is concave in s.[9] If $g_{\theta^*(s)}(s)\rho(s)$ is increasing[10] in s, Proposition 13 can then be applied and we conclude that the manager uses conservative standards if and only if $\kappa \in (1, \widehat{\kappa})$ and activist standards if and only if $\kappa \in (0,1) \cup (\widehat{\kappa}, \infty)$. For instance, when $C(\theta) = 2[1-(1+\theta)\exp\{-\theta\}]$, $\hat{s} = 1,7530482$ and $\hat{\kappa} = 1,211297499$. Figures 1 and 2 show the unqualified candidate's optimal strategy and manager's optimal choice of standard in the simultaneous and sequential game under this specification of the disutility of effort.

9 Concluding Remarks

In any decision making process, the quality of the manager's information clearly determines the efficiency of the decisions he makes. Since candidates' abilities affect the prospectives of getting a job, there are benefits from being perceived as qualified. Thus, unqualified candidates have an incentive to influence the manager's learning of their abilities by exerting costly effort. But more effort by unqualified candidates decreases the accuracy of the manager's observation. Evidentiary standards accomplish

[9]We can prove this statement by contradiction. Suppose that $\frac{d\theta^*(s)}{ds} < 0$ for $s < \hat{s}$ and hence $\theta^*(s)s > 1$. This suggests that eventually $\theta^*(\hat{s})\hat{s} > 1$, which is a contradiction by definition of $\hat{s}$. Thus, $\frac{d\theta^*(s)}{ds} > 0$ for $s < \hat{s}$. A similar reasoning can be applied for $s > \hat{s}$.

[10]The necessary and sufficient condition for this is $\left[1-\theta^*(s) + (1/s - \theta^*(s))\epsilon_{s,\theta^*(s)}\right](1+\epsilon_{s,\theta^*(s)}) + \frac{\partial \epsilon_{s,\theta^*(s)}}{\partial s} > 0$.

the dual job of maximizing efficiency (that is, minimizing errors or wrong decisions given the evidence) and simultaneously, dissuading or at least, mitigating persuasion (that is, deterring effort by unqualified candidates). Therefore, this paper highlights a trade-off: the manager gives up ex-post efficiency for better information ex ante. The benefits from inducing a better quality of information distorts the evidentiary standard below (above) its ex post efficient level when the unqualified candidates' efforts are strategic substitutes (complements) of the standard. In turn, strategic substitutability (complementarity) develops in the region of the parameter space in which the induced signal exhibits strict supermodularity (submodularity).

Our work can be extended in a number of dimensions. It may be interesting to address the committee's compromise between inducing its members to gather more precise evidence and dissuading persuasion. Modeling the committee member's choice of effort in collecting more conclusive evidence might affect the evidentiary standard and the candidates' efforts. Yet the basic insights are likely to be robust to such specifications. In addition, there is asymmetric information only on one side in our model. By assuming the manager's preference to be private information (for example, the candidates may not know the budget of his department for the recruiting process), one can analyze the role played by the presence of information asymmetries on both sides of the market and its impact on the evidentiary optimal standard.

More importantly, our model does not address competition among candidates for a given position. In reality, managers choose from a pool of candidates using a recruiting process of several rounds. In a parallel work, we examine how the candidates' strategies are distorted by these two dimensions. Competition is introduced in our setting by running up a tournament among the candidates. The purpose of an evidentiary standard is to help in selecting further the pool of candidates. The candidate who leads to the highest posterior belief given the evidence among the selected candidates wins the tournament. The competition between the selected candidates for the offered position tend to distort the candidates' levels of effort upward. Hence, dissuading persuasion is a priori more difficult (in the sense of a greater compromise by the decision maker) in this environment, making inferences weaker. But if there are several rounds associated with the decision process, then several pieces of hard evidence will be available for each candidate. The provision of more than one piece of hard evidence may make the decision maker be "softer" in establishing the evidentiary standard. In turn, this softness leads to less persuasion by the pool of candidates. Our work shows how these two opposite effects on persuasion are marginally balanced in equilibrium.

Competition could alternatively be introduced by modeling search efforts by the manager. In this case, the weights λ_i for $i = 1, 2$ given to the loss due to Type I and II errors by the manager could be made endogenous since they depend on the availability of qualified candidates.

Skaperdas and Vaidya (2012) model competition using a court setting. The prosecution (Plaintiff) and the defense (Defendant) compete to gather costly evidence so as to influence the verdict of the court in their favor. In contrast to our work, the incentives of the parties attempting to influence the decision maker (the judge) are assumed to be outside his control. Exploring the theoretical implications of relaxing this assumption in a court setting would also be a natural next step.

We leave all these issues for future work.

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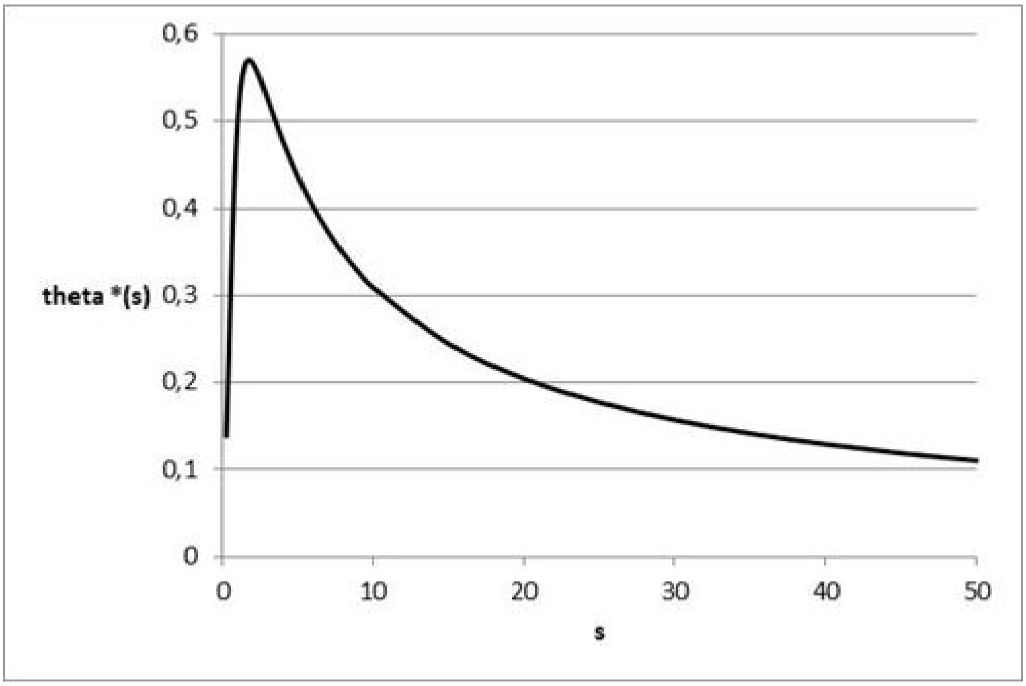

Figure 1: The unqualified candidate's optimal strategy

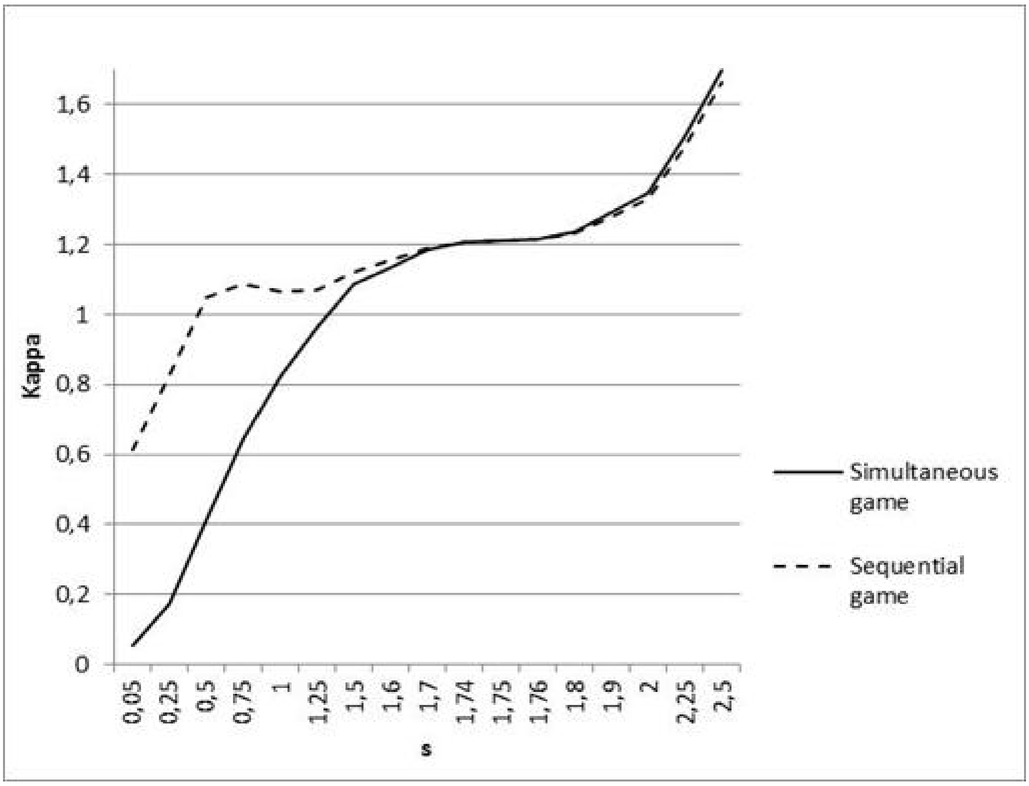

Figure 2: The manager's optimal standard in equilibrium