Subjective Performance and the Value of Blind Evaluation*

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Abstract

We investigate the incentive and project screening effects of anonymity in a setting of subjective performance evaluation. If the review process is "blind", then the applicant's (payoff relevant) type is hidden from the reviewer. If the process is nonblind or "informed", then the reviewer observes the applicant's type directly. In either case, the evaluator receives a noisy signal on the quality of the agent's project and decides whether to accept or reject it. We find that if the signal is not verifiable, then informed evaluation results in an excessively steep equilibrium acceptance policy: the standard applied to low-ability applicants is too stringent and the standard applied to high ability applicants is too lenient. Blind review in which all applicants face the same standard often provides better incentives, but it discards valuable information for screening projects. We discover that blind review is more likely to be preferred by the evaluator when (1) the applicant pool is skewed toward high ability types; (2) the stakes from acceptance are relatively high for applicants; (3) both types of errors are relatively less costly; or (4) there is little competition among reviewers. We also discover that under blind review, the evaluator may benefit from a more diverse applicant pool.

Keywords: Subjective performance, blind evaluation, informed evaluation, evaluation trap, evaluation externality

JEL: C73, D02, D81

> General propositions do not decide concrete cases. The decision will depend on a judgment or intuition more subtle than any articulate major premise.
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> –Oliver Wendell Holmes Jr., Lochner v. New York, Apr. 1905.

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1 Introduction

The situations in which an evaluator must rely on only her subjective impressions to pass judgment are diverse and ubiquitous. In cultural environments individuals are asked to evaluate: wine, food, art, poetry, and music. In retail settings experts and panel participants review a vast array of consumer products. In criminal trials and lawsuits juries are charged with weighing evidence. And in academia, faculty evaluate: exams, student projects, grant proposals, and manuscripts. Given that subjective evaluation is necessary in so many significant settings, it is important to understand what elements add or detract from its efficacy. A crucial question in this regard is whether or not the reviewer should be permitted to use supplemental information such as the applicant's identity and prior record in the current evaluation, i.e., should the reviewer be "informed" or "blind"?

At first glance, the answer to this question may appear obvious: given that it is one's work or performance – and not his/her innate ability per se– that is being evaluated, the review process should be blind whenever feasible in order to minimize bias. Note, however, that not all "bias" is bad. Because evaluation is often an inherently noisy process, an effective use of information may well dictate that individuals with stronger track records face lower standards. Indeed, the mode of review, blind or informed, varies both across and within evaluation settings.

Wine tasting, for example, is virtually always performed blind. In 1976 a – now famous – tasting, known as the judgment of Paris, is credited with dispelling the widely held belief that fine French wines were superior to those produced in California.[1] The Wikipedia entry on the Judgment of Paris states, "[the tasting] had a revolutionary impact on expanding the production and prestige of wine in the New World. It also gave the French a valuable incentive to review traditions that were sometimes more accumulations of habit and expediency, and to reexamine convictions that were little more than myths taken on trust." Similarly, in classical music, Goldin and Rouse (2000) note that most major U.S. symphony orchestras adopted some form of blind auditioning to hire new members in the 1970s and 80s. Likewise, consumer products ranging from hi-fi stereo equipment[2] to shampoo[3] are evaluated under conditions of blind review.

Settings in which a mixture of blind and informed review are performed include crim-

[1] See Taber (2005) for a complete story.
[2] http://www.stereophile.com/features/141/index8.html
[3] http://www.consumersearch.com/www/family/shampoo-reviews

inal trials, grading exams, and evaluating scholarly manuscripts for publication. In court proceedings, judges often, but not always, allow jurors to hear evidence on related crimes by the defendant, known as propensity or similar fact evidence.[4] When grading exams, the student's identity is often known to the grader on minor exams but hidden on major ones, e.g., Ph.D. comprehensives. In manuscript evaluations, Blank (1991) reports that among 38 well-known journals in chemistry, biology, physics, mathematics, history, psychology, political science, sociology, and anthropology, 11 used blind review, as did 16 of 38 major economics journals.[5]

Settings in which informed review is the norm include, grant proposals and student recruitment. And, there are, of course, numerous settings of subjective performance in which blind review is simply not feasible such as evaluating figure skaters, gymnasts, actors, and tenure cases.

Most extant studies on the effects of blind versus informed review (summarized below) have been experimental or empirical. While revealing important insights, many of these investigations have presented conflicting evidence, making it difficult – in the absence of a coherent theory – to draw general conclusions or make consistent policy recommendations. In this paper, we present and analyze a simple game-theoretic model featuring three salient aspects of review processes: (1) the "applicant" can improve the quality of his "project" by expending effort; (2) evaluation is typically a noisy process in which the reviewer observes only an imperfect subjective signal of quality; and (3) knowing the identity of the applicant would provide the reviewer with additional information about his ability to produce a high quality project. We assume that whereas the applicant cares only about getting his project accepted, the evaluator is a Bayesian decision maker who weighs her payoffs from implementing the right or the wrong decision.

We examine the equilibrium of this model under two informational regimes: *informed review* in which the evaluator observes the applicant's ability and *blind review* in which the applicant's ability is hidden. In both cases the reviewer follows a simple equilibrium strategy: accept the project if and only if the quality signal is above a certain threshold or *standard*. In general, the degenerate strategies in which the reviewer always rejects and the

[4] R. v. Handy, [2002] 2 S.C.R. 908, 2002 SCC 56, a sexual assault case, is the leading Supreme Court of Canada decision on similar fact evidence. The Court proposed what is known as the Handy test, which weighs the probative value of the evidence against its potential prejudice. For more on similar fact evidence see Strong (1999, ch. 17).

[5] In a more recent survey of 553 journals across 18 disciplines, Bachand and Sawallis (2003) find that 58% employ blind review.

applicant exerts no effort comprise an equilibrium; but there are typically other equilibria. In case of multiplicity, we select the equilibrium with the highest effort by the applicant,[6] and say that the project is "prescreened" if this corresponds to the degenerate equilibrium.

Under informed review, the evaluator – not surprisingly – applies weak standards to high-ability applicants and tough standards to low-ability ones. In fact, these standards are *too* weak and *too* tough when compared with an ideal review process in which the signal is verifiable and the evaluator commits to an acceptance policy *ex ante*. In a sense, an optimally designed review process calls for a more "fair" standard across applicants, even though no direct preference for fairness is assumed in our model.

The reason the optimal acceptance policy is flatter than the one implemented under informed review is that it is designed not only to select good projects but also to provide incentives to produce them. Both weak and tough standards generate poor incentives, albeit for opposing reasons. The marginal return to effort is low to an agent who is either very likely to have his project accepted or very likely to have it rejected. The optimally designed acceptance policy thus creates better incentives for agents at both ends of the type distribution by raising the standards facing high-ability agents and lowering those facing low-ability agents. This policy, however, is not time-consistent. Once the applicant has invested effort in the project and submitted it for evaluation, the reviewer would prefer to renege and apply a steeper (informationally-efficient) acceptance policy. Hence, if the quality signal observed by the evaluator is not verifiable (e.g., because it is subjective or impractical to quantify), then it will not be possible for her to credibly implement the relatively flat optimal acceptance policy. It may, however, be possible for her to commit to remain ignorant about applicant types and apply a completely flat standard; that is, to perform blind review.

Under blind review, the evaluator sets a uniform standard as if performing an informed review over an applicant with the mean ability. This acceptance policy provides good incentives for applicants at both ends of the type distribution, but blind review is also clearly suboptimal when compared with the ideal policy. Specifically, blind review does not allow the evaluator to use any information about applicant ability to mitigate noise in the review process.

Hence, our analysis reveals that both the informed and the blind review procedures are suboptimal, but for different reasons. On one hand, ex post project selection is better under

[6] As will be clear in the analysis, this equilibrium usually Pareto dominates all others.

informed review, and on the other, ex ante incentives are better under blind review. Thus, the evaluator's preference between review procedures will depend on the environment, especially the distribution of ability in the applicant pool. We find that when the distribution of applicants contains a large proportion of high-ability agents who are likely to produce high quality projects in equilibrium, then screening project quality is relatively less important than provision of incentives and the evaluator, therefore, prefers blind review. Conversely, when the applicant pool is skewed toward low ability, then project selection is paramount and the evaluator prefers informed review.

A robust feature of informed review is the prescreening of projects from very low types. Compared to the optimal evaluation policy, equilibrium prescreening may however be excessive or inadequate. In particular, if the evaluator receives a relatively large loss from accepting a bad project, then too many low-type agents are excluded from evaluation – because equilibrium incentives are too weak to provide sufficient motivation for these agents. On the other hand, if the evaluator receives a relatively large loss from rejecting a good project, then she prescreens too little in equilibrium – because knowing the evaluator's payoffs, agents of intermediate ability put just enough effort into their projects to force the evaluator to review them. Interestingly, this may result in an "evaluation trap": the evaluator may actually be worse off reviewing projects from intermediate-type agents than if she could commit herself to prescreen them. Exclusion of projects submitted by these types of agents is, however, not credible for the evaluator– at least without a richer set of policy instruments.

One such policy instrument is to charge an (uniform) application fee. Although the standard justification for such fees is that they help offset the operational costs of evaluation, perhaps an even more important function is that they induce low ability agents to self-select out of the applicant pool. In doing so, application fees eliminate the evaluation trap. Moreover, when chosen optimally along with the review policy, we discover that application fees make the adoption of blind review more attractive , if the evaluator suffers larger losses from accepting bad projects than from rejecting good ones. The intuition derives from the previous observation that there is already too much prescreening in this case under informed review without a fee. But, an application fee helps the evaluator better tailor her standard under blind review by truncating the left tail of the ability distribution and thereby raising the mean ability in the applicant pool. By the same token, application fees make the adoption of informed review more likely, if the evaluator is more concerned about rejecting good projects.

Another important policy that is often used in practice is for an information gatekeeper to control the amount of information used in evaluation, rather than restricting it to be completely informed or completely blind. For instance, as alluded to above, in court trials, judges frequently rule on how much of the defendant's prior record can be heard by the jury, recognizing that such information may introduce undue bias to the verdict. Similarly, a recruiting or admission committee may be given only selective information about a candidate for an effective evaluation. To investigate this issue, we extend the basic model by introducing an information gatekeeper, whose objective coincides with the reviewer's. Despite knowing the applicant's ability, the gatekeeper reveals only a subinterval of types containing the applicant's ability. The partition of subintervals is optimally chosen by the gatekeeper *ex ante* and is publicly observed. We show that consistent with our previous findings, it is typically optimal to perform blind review over the high ability applicants (by pooling them into one large interval) and informed review over the low ability ones (by separating them into a continuum of infinitesimal intervals). In fact, if the proportion of high-ability applicants is sufficiently large, then the range over which informed review is optimal disappears and the preferred information structure corresponds to pure blind review. One important implication of this is that the reviewer may benefit from a single diverse pool of applicants rather than evaluating them in separate groups.

A robust prediction of our theory is that blind review is likely to be chosen when the applicant pool is skewed toward high ability agents. Nevertheless, informed review is practiced in a wide variety of institutional settings. One feature common in these settings but absent from our basic model is that reviewers often compete to attract high-quality applications. To investigate the impact of competition on the choice of review process, we extend the model to allow for a number of ex ante identical evaluators who decide strategically whether to adopt blind or informed review. Our main finding in this context is that competition creates incentives for evaluators to adopt informed review. This is because high ability applicants strictly prefer the lenient standards they face under informed review. Since these applicants are most likely to produce high-quality projects, evaluators adopt informed review in order to attract them. In fact, if at least one evaluator adopts informed review, then any evaluator adopting blind review would suffer adverse selection and attract only the lowest ability applicants.

Related Literature. There is a large empirical and experimental literature on the impact of anonymity on the publication process, which is ably surveyed by Snodgrass (2006). In particular, papers by Blank (1991) in economics, Horrobin (1982) in modern languages, Link (1998) in medicine, Peters and Ceci (1982) in psychology, and Zuckerman and Merton (1971) in physics found compelling evidence that informed review is likely to introduce status, gender, or geographical bias in evaluation of scholarly manuscripts. In fact, several of these studies were initiated in response to concerns raised by young and/or female scholars, and subsequently led some journals such as the *American Economic Review* [Ashenfelter (1992)] and the journals of the modern language association, to change their evaluation policy to blind review.[7]

In the 1970s and 80s, the concern about gender-biased hiring caused most major U.S. symphony orchestras to adopt some form of blind auditioning. Goldin and Rouse (2000) estimate that the switch to blind auditions can explain 25 percent of the increase in female orchestra musicians hired over the intervening years.

The theoretical literature on subjective performance evaluation is relatively small [e.g., Levin (2003) and MacLeod (2003)][8] and almost exclusively addresses contracting problems within an agency setting. Our paper contributes to this literature by considering a complementary setting in which transfers between the parties are not allowed and the principal can remain ignorant of agent's ability to motivate him. In this sense, the interplay between information and incentives at the heart of our analysis is also reminiscent of the potential benefits of imperfect monitoring in an agency context. Most notably, Riordan (1990) and Sappington (1986) argue that while facilitating a more efficient quantity decision by the buyer, closer monitoring of costs may undermine a producer's incentives for cost-reduction, due to the fear of being held up by the buyer. In the same spirit, but within a dynamic model, Cremer (1995) shows that the principal may commit to an *ex ante* inefficient monitoring technology to induce the agent to work harder in case of a negative productivity shock.

[7] To be sure, in recent years the advent of the Internet search engine has all but eliminated the possibility of blindly reviewing journal submissions in many fields. (In the natural sciences, however, researchers rarely post their manuscripts on the web prior to journal publication.) Our analysis suggests that seasoned scholars with established research reputations benefit from the effective abolition of blind review at the expense of their younger less experienced colleagues. Moreover, the demise of blind review means that both highly regarded scholars and very green ones have less incentive to invest effort in manuscript preparation. Hence, the effective abolition of blind review in this context is not without consequence. Indeed, our analysis suggests that it may well behoove the academic societies that publish journal articles to adopt remedial policies aimed at breaking down the rigidities in the publication process associated with observable characteristics such as age, status, or gender.

[8] See Prendergast (1999) for an overview of the earlier literature.

Our paper also relates to the labor literature on statistical discrimination, recognizing the (potential) tension between fairness and efficiency (or incentives). Papers by Norman (2003) and Persico (2002) highlight the fact that it is not a forgone conclusion that a more fair treatment of different groups of individuals interferes with a socially efficient allocation of resources. Depending on the elasticity of each group's production function, insisting on a more equal treatment of groups may also shift equilibrium production toward a more socially efficient level. Perhaps the closest to our investigation in this vein is the paper by Coate and Loury (1993), which builds on Arrow (1973).

Coate and Loury study a model in which two identifiable groups that are ex ante identical invest in human capital. Employers receive noisy subjective signals regarding investment levels and decide who to hire. There are assumed to be multiple equilibria of the investment/evaluation game. Coate and Loury suppose that one group coordinates with employers on an equilibrium with a modest standard and higher investment, while the other group gets stuck in a Pareto inferior equilibrium with a high standard and low investment. In the setting we investigate, by contrast, agent abilities are drawn from a continuum and represent real ex ante differences in productivity. Moreover, we suppose all players coordinate on the equilibrium of the game with the highest effort. Coate and Loury demonstrate that forcing employers to use the same standard across groups can correct inefficient coordination failure. We focus on a very different but complementary question – when is it in the best interest of an evaluator to commit herself not to use fundamentally valuable information in the review process?

The remainder of the paper is organized as follows. In the next section we set out the basic model, followed by equilibrium characterization under informed and blind review in Section 3. In Section 4, we compare these equilibria with the optimal review benchmark for the principal, in which commitment to a standard is possible. Observing the suboptimality of both the informed and blind review processes, we then investigate the preferences of the evaluator and applicant over review procedures in Section 5. In Sections 6, we consider three extensions to the basic model to analyze the screening role of application fees, the optimal amount of information to be provided to the reviewer, and the impact of competition among evaluators on the type of review that is chosen. Finally, we collect some concluding remarks in section 7. All the proofs of formal results are relegated to an appendix.

2 Basic Model

Suppose there are two risk-neutral parties: an agent (applicant) and a principal (evaluator). The agent expends effort, $p \in [0,1]$, to prepare his project, whose quality is either high (h) with probability p or low (l) with $1-p$.[9] The project yields a (gross) payoff $B > 0$ to the agent, if accepted by the principal, and 0 otherwise.[10] The cost of agent's effort is given by $C(p;\gamma) = \frac{p^2}{2\gamma}$, where γ represents his ability or *type*.[11][12] While γ is known by the agent, whether or not it is also known by the principal depends on the review process in place. We consider two possible regimes. Under *informed* review, the principal perfectly observes γ, whereas, under *blind* review, she possesses a commonly known belief that γ is distributed in $[\underline{\gamma}, \overline{\gamma}] \subset \Re_+$ according to a differentiable distribution $G(\gamma)$ with density $g(\gamma) > 0$, and finite mean, μ.

Upon receiving the project, the principal decides whether to accept or reject it without observing its true quality. Her decision may be right or wrong ex post, and we assume she (weakly) prefers being right. Refer to Table 1. Denote by $\pi_a, \pi_r \geq 0$ the principal's payoffs from accepting a high quality project and rejecting a low quality one, respectively. Similarly, denote by $-L_a, -L_r \leq 0$ her losses from accepting a low quality project and rejecting a high quality one, respectively.[13]

decision/quality	high	low
accept	π_a	$-L_a$
reject	$-L_r$	π_r

Table 1: Principal's payoffs

To eliminate the (uninteresting) cases of always accepting or always rejecting projects besides equilibrium "prescreening," we impose

[9] We use the term "project" in an abstract sense to also refer to one's skill acquisition such as in music and PhD training.

[10] It is possible to generalize the agent's payoff structure in a number of dimensions without qualitatively altering the results. For instance, it seems reasonable to suppose that the agent would ultimately receive a larger benefit if a high-quality rather than a low-quality project were accepted , $B_h > B_l$. (The benefit from passing a comprehensive exam is ultimatley higher for a well-trained doctoral student than for a poorly trained one because the well-trained student will write abetter dissertation and get better job offers.) We employ the simpler payoff structure given in the text purely for notational parsimony and expositional ease.

[11] As will become clear from the analysis, our results are also qualitatively robust to a more general effort cost function, $C(p;\gamma) = \frac{c(p)}{\gamma}$, where c', $c'' > 0$ and $\lim_{p\to 0} c'(p) = 0$.

[12] It is critical to interpret the agent's type broadly to reflect not only his innate ability but also his experience in a given context. For instance, a young economist may have tremendous analytical research skills, but he may lack experience in writing and presentation.

[13] We refrain from using terms type I and II errors for the wrong decisions, because such labeling depends on the definition of the null hypothesis, which is context-specific.

Assumption 1. $\pi_r + L_a > 0$ *and* $\pi_a + L_r > 0$.

Although the principal does not observe the quality of the project or the agent's effort, her evaluation yields a subjective signal of project quality, $\sigma \in [\underline{\sigma}, \overline{\sigma}] \subset \Re$.[14] Let $F^q(\sigma)$ denote the signal distribution for $q = l, h$ with a density $f^q(\sigma)$, and define $R(\sigma) \equiv \frac{f^h(\sigma)}{f^l(\sigma)}$ to be the likelihood ratio. We assume the signal technology satisfies the following properties, including monotone likelihood ratio.

Assumption 2 (Signal Technology).

- $f^q(\sigma)$ *is bounded and twice differentiable.*
- $R'(\sigma) > 0$.
- $\lim\limits_{\sigma \to \underline{\sigma}} R(\sigma) = 0$ *and* $\lim\limits_{\sigma \to \overline{\sigma}} R(\sigma) = +\infty$.
- $\lim_{\sigma \to \overline{\sigma}} \{R(\sigma)[F^l(\sigma) - F^h(\sigma)]\}$ *exists.*

Assumption 2 says that a stronger signal is more informative of a high quality project, and this information becomes almost perfect at both extremes. The intuition behind the last limit will be clear, once we determine equilibrium prescreening.[15]

3 Equilibrium Characterization

We begin the analysis by deriving the players' reaction functions, and then characterize equilibria under the informed and blind review regimes, respectively.

3.1 Reaction Functions

It is easy to verify that the principal optimally follows a cutoff strategy: accept the project if $\sigma \geq s$ and reject it if $\sigma < s$, where s is the cutoff signal or the *standard.* Thus, the principal's expected payoff when she adopts standard s and anticipates effort p by the agent is given by

$$V(p, s) = p[1 - F^h(s)]\pi_a + (1 - p)F^l(s)\pi_r - pF^h(s)L_r - (1 - p)[1 - F^l(s)]L_a. \quad (1)$$

[14] Although we assume here that the principal observes the signal for free, we have explored a version of the model with costly signal acquisition. The findings in that setting align closely with the ones presented below.

[15] Assumption 2 is satisfied by a family of signal technologies with $f^h(\sigma) = \frac{(1+\alpha)}{(\overline{\sigma}-\underline{\sigma})^{1+\alpha}}(\sigma - \underline{\sigma})^\alpha$ and $f^l(\sigma) = \frac{(1+\alpha)}{(\overline{\sigma}-\underline{\sigma})^{1+\alpha}}(\overline{\sigma} - \sigma)^\alpha$ for $\alpha > 0$, and by many well-known distributions with appropriate truncations.

The principal maximizes (1) by choosing $s \in [\underline{\sigma}, \overline{\sigma}]$. Under Assumption 2, the unique solution to this maximization is

$$S(p;Q) = R^{-1}(\frac{1-p}{p}Q), \tag{2}$$

where $Q \equiv \frac{\pi_r + L_a}{\pi_a + L_r}$ is the relative gain from rejecting the project to accepting it and $Q \in (0, \infty)$ by Assumption 1. Notice that since $R' > 0$, $S(p;Q)$ decreases in p and increases in Q, as expected.[16]

As for the agent, since he receives B if his project is accepted, and 0 otherwise, his expected payoff is

$$U(p, s; \gamma) = [p(1 - F^h(s)) + (1-p)(1 - F^l(s))]B - \frac{p^2}{2\gamma}. \tag{3}$$

Maximizing (3) with respect to p yields the agent's optimal effort choice:[17]

$$P(s;\gamma) = \min\{\gamma B[F^l(s) - F^h(s)], 1\}. \tag{4}$$

Lemma 1 records some useful properties of $P(s;\gamma)$, and parties' expected payoffs.

LEMMA 1. *Let $\sigma_m \equiv R^{-1}(1)$. Then,*

(i) *the agent's optimal effort increases [resp. decreases] with the standard if the standard is lower [resp. higher] than σ_m.*

(ii) *The agent prefers a lower standard.*

(iii) *There exists a unique standard $\sigma_d \in [\underline{\sigma}, \overline{\sigma}]$ such that the principal prefers a greater [resp. smaller] effort by the agent if the standard is lower [resp. higher] than σ_d.*

Part (i) reveals that the agent's effort choice is nonmonotonic in the standard. In particular, when the standard is close to both extremes, the marginal return to effort is small, because, regardless of their qualities, projects are either very likely to be accepted or very likely to be rejected. But, for intermediate standards, effort can have a significant impact on the decision by generating a favorable signal. Part (ii) indicates that because the agent cares only about the acceptance of his project, he always prefers a lower standard.

[16] Throughout, the reader may keep in mind a more standard Bayesian decision-maker, whose objective is to minimize the losses from type I and type II errors. This case would be equivalent to the setting with $\pi_a = \pi_r = 0$ in our analysis.

[17] Recall that MLRP implies first-order stochastic dominance; hence $F^l(\sigma) - F^h(\sigma) \geq 0$.

The principal, on the other hand, may not always prefer greater effort by the agent, as implied by part (iii). To understand this – somewhat counterintuitive – observation, note that for a fixed standard, greater effort both reduces the chances of accepting a low quality project and increases the chances of rejecting a high quality one. Part (iii) reveals that the latter concern becomes predominant for the principal when the standard is very high. Whether or not the principal evaluates an agent whose effort has a negative marginal return is, however, an equilibrium question, which we turn to next.

3.2 Informed Equilibrium

As alluded to above, under the informed regime, the principal not only observes a subjective (hence nonverifiable) signal σ about quality but also the agent's type γ. Thus, the informed equilibrium is a pair $(p^1(\gamma), s^1(\gamma))$ that solves (2) and (4), where the superscript "1" indicates *informed review.* Refer to Figure 1. Notice the "degenerate" strategies in which the agent exerts no effort and the principal always rejects, i.e., $(p^1(\gamma), s^1(\gamma)) = (0, \overline{\sigma})$, constitute an equilibrium for all γ (point C in Figure 1). In general, there are other equilibria (at points A and B). In such cases, we select the one with the *highest* effort, because this equilibrium typically Pareto dominates others.[18] It is however possible that the degenerate equilibrium is the unique equilibrium, in which case we say that the agent's project is "prescreened" without evaluation.[19] The following result provides the exact condition under which prescreening occurs.

Lemma 2. *Under informed review,*

(i) *the equilibrium is locally stable, and the equilibrium effort and standard are continuous in γ; and*

(ii) *the agent's project is prescreened if and only if his ability is sufficiently low,*

i.e., $\gamma \leq \gamma^1_{\min}$, where $\rho \equiv \lim_{s \to \overline{\sigma}}\{R(s)[F^l(s) - F^h(s)]\}$ and $\gamma^1_{\min} \equiv \frac{Q}{\rho B}$.

Part (i) highlights the fact that the informed equilibrium changes smoothly with the agent's type, and it is locally stable, facilitating meaningful comparative static analysis.

[18] This is the case if, in any nondegenerate equilibrium, the principal has a nonnegative marginal return from the agent's effort; because the principal then prefers greater effort, which leads to a lower equilibrium standard, benefiting the agent.

[19] Though not explicitly shown in Figure 1, it is clear that as γ decreases , $P(s; \gamma)$ shifts down maintaining the same end points and argmax, eventually leaving point C to be the unique equilibrium.

Part (ii) of Lemma 2 provides a necessary and sufficient condition under which the prescreening equilibrium obtains. The condition holds if the agent's ability is so low that even the most favorable signal wouldn't convince the principal to accept the project. Furthermore, prescreening is more pronounced as the evaluation process grows noisier, whereby ρ is smaller and/or the principal's relative gain from rejecting is larger. In the next section, we show that depending on the payoffs, the principal may prescreen too many or too few types in equilibrium compared to an "optimal" evaluation process.

Armed with Lemma 2, we next characterize further informed equilibrium.

PROPOSITION 1. *Suppose a type γ agent's project is evaluated under informed review. Then,*

(i) $p^1(\gamma)$ *strictly increases and converges to* 1 *as* $\gamma \to \infty$.

(ii) $s^1(\gamma)$ *strictly decreases and converges to* $\underline{\sigma}$ *as* $\gamma \to \infty$.

Proposition 1 is intuitive. It says that under informed review, higher type agents are more likely to produce a high quality project and thus are subject to a lower standard. It also says that there is always a residual incentive problem with informed review, as the effort reaches its maximum only in the limit. The reason is that if $p^1(\gamma) = 1$ for some finite γ, then the principal would set the minimum standard, which would then lead to 0 effort.

Next, we investigate the basic properties of equilibrium payoffs.

PROPOSITION 2. *In informed equilibrium,*

(i) *the agent's expected payoff increases in his type; and*

(ii) *there exists a unique type γ_r such that the principal's expected payoff decreases for $\gamma < \gamma_r$ and increases for $\gamma > \gamma_r$.*

According to part (i), a higher type agent receives a greater equilibrium payoff. Given a smaller marginal cost of effort, such an agent invests more into his project, and anticipating this, the principal applies a lower standard. Part (ii) reveals that the principal's payoff is, however, nonmonotonic in the agent's ability (see Figure 2): it decreases for small values of γ and increases for large values, admitting a unique minimum at $\gamma = \gamma_r$. To understand the intuition behind this nonmonotonicity, suppose the principal cares only about making the incorrect decisions ($\pi_a = \pi_r = 0$). Then, by setting a very tough standard she can minimize the probability of a false positive and by setting a very lenient standard she can minimize the probability of a false negative. However, informed equilibrium calls for a standard that is strictly decreasing and an effort that is strictly increasing in the agent's type, implying that both types of errors become more likely as γ increases from $\underline{\gamma}$.

An important implication of part (ii) is that the principal would actually be better off by prescreening projects by some intermediate types. The reason for such an "evaluation trap" is that prescreening is not credible for these types: knowing the principal's fear of rejecting a high quality project and possessing a relatively low marginal cost of effort, such agents exert effort and submit their projects anyway. This means if the principal could credibly discourage these types from applying (along with the prescreened ones), she would do so. While a direct commitment mechanism can be feasible to achieve this goal in some cases, deterrence can also be achieved by requiring an application fee, which we investigate in sections 4 and 6.

3.3 Blind Equilibrium

Under blind review, the principal does not observe the agent's type, but she knows its distribution, $G(\gamma)$. As a result, when evaluating applications, the principal must adopt a uniform standard based on her beliefs. Let s^0 be this standard, where the superscript "0" indicates *blind review*. It is clear from (4) that for any $s^0 \in (\underline{\sigma}, \overline{\sigma})$, some sufficiently high types will exert the maximum effort, i.e., $P(s^0; \gamma) = 1$. Though interesting, such corner solutions under blind review arise not only because of equilibrium behavior but also because of quadratic effort costs. For expositional clarity, we avoid the complications associated with a corner solution by imposing the following condition.[20]

ASSUMPTION 3. $\overline{\gamma}B[F^l(\sigma_m) - F^h(\sigma_m)] < 1$.

LEMMA 3. *The standard and effort under blind equilibrium are the same as the ones for the mean ability agent under informed equilibrium, i.e.,* $s^0 = s^1(\mu)$ *and* $p^0(\gamma, \mu) = \gamma B[F^l(s^1(\mu)) - F^h(s^1(\mu))]$. *Hence, the principal's expected equilibrium payoff under blind review is equal to her expected equilibrium payoff for the mean type under informed review, i.e.,* $E_\gamma V^0(\gamma, s^0) = V^1(\mu)$.

[20] Note that Assumption 3 guarantees the maximum effort for the highest type, which, by Lemma 1, occurs at $s = \sigma_m$, is less than 1. In light of Lemma 3, a weaker condition would be $\overline{\gamma}B[F^l(s^1(\mu)) - F^h(s^1(\mu))] < 1$, which is, however, harder to check.

Hence, from the principal's perspective, conducting a blind review is the same as conducting an informed review over the mean type of agent. One implication of this is that the principal may adjust the standard by affecting the pool of potential applicants through such policies as application fees and diversity, which are topics considered in section 6. Another implication is that unlike informed review, prescreening occurs for either all types or none: no prescreening takes place under blind review if and only if the mean type is not subject to prescreening under informed review. From the agent's perspective, blind review introduces an evaluation "externality" by applying the same standard to both high and low types.

Before we compare the equilibrium outcomes of the two review processes and determine the principal's preference over them, we next introduce a benchmark in which (1) the signal is verifiable, and (2) the principal commits to the standard that will face each type of agent. Although we will utilize this benchmark primarily to identify the costs and benefits of the blind and informed review procedures, it also has practical appeal in certain settings. For instance, a Ph.D. advisor may lay out exactly which findings will make for a viable thesis, or a supervisor may set clear goals for her subordinates to be promoted.

4 Benchmark: verifiable standard

Suppose for now that the principal uses an informed review for all γ, but unlike in section 3.2, she acts as a Stackelberg leader and commits to her standard $s^c(\gamma)$ before the agent chooses his effort $p^c(\gamma)$. Then, the pair $(p^c(\gamma), s^c(\gamma))$ solves the following program:

$$\max_{p,s} V(p,s) \text{ subject to } p = P(s,\gamma). \tag{5}$$

Let $V^c(\gamma) \equiv V(p^c(\gamma), s^c(\gamma))$ be the principal's commitment payoff. It is immediate that $V^c(\gamma) \geq \pi_r$ because, unlike informed equilibrium, $s = \overline{\sigma}$ can now be applied without the credibility problem. This simple observation has two important implications. First, under commitment, there is no evaluation trap – the reviewer can reject projects that yield an expected payoff less than the payoff of rejecting a bad project, π_r. Second, if $\pi_a \leq \pi_r$, then it is optimal to prescreen all types, i.e., $s^c(\gamma) = \overline{\sigma}$ for all γ. Hence, for the evaluation process to be beneficial to the reviewer, a necessary condition is that her payoff from accepting a good project be greater than rejecting a bad one.

A third, but less obvious, implication is that under commitment, the reviewer evaluates projects from only those types whose effort has a nonnegative marginal return to her:

Lemma 4. *Under commitment equilibrium, the evaluator always prefers greater effort by the agent.*

This finding contrasts with the informed equilibrium at which there are typically some intermediate type agents whose effort has a negative marginal return to the principal, but are still evaluated.

To characterize the commitment equilibrium further, suppose the solution is interior, i.e., $(p^c(\gamma), s^c(\gamma)) \neq (1, \overline{\sigma})$. Substituting for $p = P(s, \gamma)$ in $V(p, s)$, the FOC for s is given by:

$$\underbrace{V_p(P(s,\gamma), s) P_s(s,\gamma)}_{\text{Incentive Effect}} + \underbrace{V_s(P(s,\gamma), s)}_{\text{Selection Effect}} = 0. \tag{6}$$

Eq.(6) identifies two effects that the principal takes into account when setting her commitment standard. The first is an *incentive* effect to motivate the agent, and the second is a *selection* effect to screen out low quality projects. Notice that the incentive effect alone would maximize effort and lead to a type-independent standard $\overline{s}^c(\gamma) = \sigma_m$ by Lemma 1. Notice also that the selection effect alone guides the choice of standard under the informed and blind equilibria. Nonetheless, the fear of rejection does provide some incentives in these equilibria.

Let $\overline{s}^c(\gamma)$ be a solution to (6).[21] We assume this solution is unique by imposing the following.

Assumption 4. *Let* $A = \{s | \; P(s;\gamma) \neq 1$ *and* $V(P(s,\gamma), s) > \pi_r\}$. *Then,* $V(P(s,\gamma), s)$ *is strictly quasi-concave in* s *for all* $s \in A$.

If $P(\overline{s}^c(\gamma), \gamma) = 1$ however, $\overline{s}^c(\gamma)$ is not optimal, in which case because $V(1, s)$ is strictly decreasing in s, the principal chooses the minimum standard that induces $p = 1$. Thus, the optimal solution must be the smallest root to $P(s;\gamma) = 1$, which is uniquely defined by Lemma 1 (also see the proof of Proposition 2). Denote this root by $\underline{s}^c(\gamma)$.

The following result characterizes the commitment equilibrium.

Proposition 3. *Under Assumption 4, there is a unique commitment equilibrium and it has the following properties:*

(i) $p^c(\gamma) = \begin{cases} 0, & \text{if} \quad \gamma \leq \gamma^c_{\min} \\ \overline{p}^c(\gamma), & \text{if} \quad \gamma^c_{\min} < \gamma \leq \gamma^c_{\max} \\ 1, & \text{if} \quad \gamma^c_{\max} < \gamma \end{cases}$

[21] Existence of $s^c(\gamma)$ is due to the fact that $V(P(s;\gamma), s)$ is continuous on $[\underline{\sigma}, \overline{\sigma}]$.

where $\gamma^c_{\max} < \infty$ *uniquely solves* $\overline{p}^c(\gamma) = 1$.

(ii) $s^c(\gamma) = \begin{cases} \overline{\sigma}, & \text{if} \quad \gamma \leq \gamma^c_{\min} \\ \overline{s}^c(\gamma), & \text{if} \quad \gamma^c_{\min} < \gamma \leq \gamma^c_{\max} \\ \underline{s}^c(\gamma), & \text{if} \quad \gamma^c_{\max} < \gamma \end{cases}$

where $\overline{s}^c(\gamma^c_{\min}) \leq \sigma_d$.

(iii) *For* $\gamma > \gamma^c_{\min}$, $s^c(\gamma)$ *strictly decreases and converges to* $\underline{\sigma}$ *as* $\gamma \to \infty$.

(iv) *For* $\gamma > \gamma^c_{\min}$, $V^c(\gamma)$ *strictly increases.*

Several insights emerge from Proposition 3. First, similar to the informed equilibrium, a higher type agent is subject to a lower standard since he is more likely to produce a better project. However, unlike the informed equilibrium, the agent's effort under commitment can reach its maximum, i.e., $p^c(\gamma) = 1$ for a sufficiently high type. Although the selection effect calls for setting the lowest standard for such a type, the incentive effect induces the principal to set a strictly higher one. In a sense, the principal intentionally commits to rejecting some high quality projects ex post in order to provide incentives ex ante. Of course, this behavior is not time-consistent, which highlights why $p^c(\gamma) = 1$ cannot arise in the informed equilibrium where commitment to a standard is not possible.

Second, unlike the informed equilibrium, the commitment equilibrium is typically *not* continuous in γ (see Figure 3). The reason is that under commitment, the principal prescreens those types who are unlikely to produce a high quality project. Once she is convinced otherwise, the principal then sharply reduces the standard. Finally, since the principal doesn't allow for an evaluation trap, her commitment payoff monotonically increases with the agent's ability. Again, this contrasts with the informed equilibrium payoff to the principal that can decrease with the agent's ability.

To gain further insight into the role of commitment, we compare the informed and the commitment equilibria in the next two propositions. Intuition suggests that the reviewer should lean toward less prescreening under commitment, because she can better motivate the agent (see eq.(6)). The following result indicates that this intuition is incomplete.

Proposition 4.

(i) $\gamma^c_{\min} < \gamma^1_{\min}$ *if and only if* $V^c(\gamma^1_{\min}) - \pi_r > 0$.

(ii) $V^c(\gamma^1_{\min}) - \pi_r$ *increases in* π_r, L_a, *and decreases in* π_a, L_r, *and* B.

That is, the informed equilibrium may result in too much or too little prescreening. To understand this ambiguity, note that under commitment, the optimal management of both types of error requires that the reviewer deal with only those agents who are sufficiently likely to produce a high quality project. This means that if the reviewer is a lot more sensitive to rejecting a good project than accepting a bad one, then she is more likely to prescreen under commitment to ensure that the evaluated projects are of high quality. Conversely, if the reviewer cares only about her acceptance decision, then she is likely to be more inclusive under commitment.[22]

Next, we compare the commitment and informed standards for those agents whose projects are evaluated in both cases.

PROPOSITION 5. *Suppose that a type γ agent's project is evaluated under both the informed and the commitment regimes in equilibrium. Then, with respect to the case of commitment,*

(i) *the informed standard is too high for $\gamma < \gamma_m$, and too low for $\gamma > \gamma_m$,*

where γ_m is the unique type that satisfies $s^1(\gamma_m) = \sigma_m$; and

(ii) *the informed effort is too low.*

Part (i) of Proposition 5 is a key result of this investigation. Refer to Figure 3. It says that the principal adopts a *steeper* standard profile under informed equilibrium than under commitment. In particular, under informed equilibrium, while the standard is *too stringent* for low types, it is *too lenient* for high types. Given that the principal receives a payoff only from evaluating the project in hand–and not from evaluating the agent's ability– we can say that commitment calls for a more *fair* standard schedule between high and low types than does the informed review. To see the intuition, first consider a low type $\gamma < \gamma_m$. For such an agent, the selection effect results in a relatively high standard, but if commitment is possible, then the incentive effect leads the principal to reduce the standard to help motivate the agent [Lemma 1]. On the other hand, for a high type $\gamma > \gamma_m$ informed review results in a relatively low standard, and if commitment were possible, then the incentive effect would lead the principal to raise it. The standards with and without commitment coincide for $\gamma = \gamma_m$, because the informed standard already induces the maximum effort for this type.

[22]Refer to Example 1 for an explicit characterization of the prescreening conditions.

Part (ii) states that the equilibrium effort under commitment is –not surprisingly– greater than the one under informed equilibrium, because, under commitment, the principal provides additional incentives for effort.

Our observation that the optimal review policy can be more fair than the equilibrium one is consistent with Norman (2003) and Persico (2002). As alluded to above, these authors show that optimally designed task assignment and policing rules can be less discriminatory between groups than equilibrium ones. Our result also complements the work of Coate and Loury (1993) and MacLeod (2003), who argue that data may under represent discrimination between groups because they face different incentive schemes to start with. Although in our model, productivity differences are real (as opposed to being generated by the principal's beliefs), a lower ability agent – anticipating too stringent a standard – is also less motivated to produce a good project.

When formulating the commitment benchmark, we supposed that the principal elected to be completely informed about the agent's type. Intuition suggests that this should be optimal for her. Otherwise, if the principal adopted blind review for any subset of types and thus used a uniform standard, the same standard would be available under an informed review, but, by Proposition 3, not be optimal, except for one type. The following result formalizes this intuition.

Proposition 6. *Under commitment, informed review over all types is optimal for the principal.*

Proposition 6 is important in two respects. First, even though the principal's only objective is to evaluate the project, the information about the agent's ability is valuable. Given that the signal of project quality is noisy, knowing the agent's type helps reduce selection errors. Second, relative to the case of full commitment, blind review is also suboptimal for the principal. Hence, the only reason for adopting blind review must be that it improves the principal's ability to commit to a standard.

Now, we return to our basic setup in which the signal is not verifiable (so that commitment is not possible) and directly compare the equilibrium outcomes of the blind and informed review procedures.

5 Informed vs. Blind Review

A major insight from the benchmark analysis is that the blind and informed review processes are suboptimal, albeit for different reasons. Whereas blind review is likely to outperform informed review in providing incentives, informed review is more likely to minimize selection errors through use of additional information. It is, therefore, intuitive that the principal's preference between review procedures will depend critically on whether the incentive or the selection effect is more important in a given environment. To investigate this issue, we first compare the equilibrium standards and efforts under both review procedures.

Proposition 7. *Compared to blind review,*

(i) *the agent is subject to a higher [resp. lower] standard under informed review if his ability is below [resp. above] average;*

(ii) *the informed review induces a greater effort if the agent's ability belongs to a uniquely defined intermediate interval,* (γ_l, γ_h).

Part (i) of Proposition 7 is a direct consequence of Lemma 4. Since blind review is equivalent to an informed review over the mean type, the principal applies a weaker standard under informed review to types above the mean, and a tougher standard to types below it. Part (ii) implies that in general, one review process does not uniformly induce a greater effort than the other. In particular, while blind review is better at motivating agents with extreme types, the opposite is true for intermediate types. To understand this, note that the high types, $\gamma > \gamma_h$, are subject to a more stringent standard under blind review, which, by Lemma 1, induces them to work harder. The low types, $\gamma < \gamma_l$ also work harder under blind review, but because the standard is weaker for them.

Of course, when choosing the review process, the principal's objective is not only to raise average quality (or effort) but also to reduce losses from incorrect decisions. Her expected payoffs from informed and blind reviews are $E_\gamma[V^1(\gamma)]$ and $V^1(\mu)$, respectively. Evidently, if $V^1(\gamma)$ is convex or concave everywhere, then Jensen's inequality will suffice to compare the two payoffs irrespective of the type distribution. However, in general, this is not the case, as the following lemma records.

Lemma 5. *For* $p^1(\gamma) \neq 0$, *there exist two cutpoints* $\gamma_L \leq \gamma_H$ *such that* $V^1(\gamma)$ *is strictly convex for* $\gamma < \gamma_L$ *and strictly concave for* $\gamma > \gamma_H$.

The intuition behind Lemma 5 is that for very high types, effort is close to its maximum, and so is the principal's payoff. Thus, doubling agent's ability less than doubles her expected payoff. For very low types however, the principal's payoff through a higher ability agent is compounded by the fact that she also avoids a loss due to a wrong decision.

It is thus clear that the principal's choice between the two review procedures will depend on the distribution of ability. If, for instance, all types are above γ_H so that the payoff is strictly concave, then Jensen's inequality implies that blind review dominates informed review. The intuition is that when facing high types, the principal cares more about motivating them ex ante than making a wrong decision ex post, since the probability of making a wrong decision is relatively low. In other words, for high types, the incentive effect is more pronounced than the selection effect, which favors blind review. On the other hand, because low types exert low effort, project selection becomes more important than providing incentives. Hence, when faced with a large proportion of low ability agents, the principal prefers informed review. We now note this key result under a less restrictive distributional assumption.

PROPOSITION 8. *Suppose that the support of the ability distribution is sufficiently inclusive so that the principal's expected informed payoff has both convex and concave regions. More formally, $\underline{\gamma} < \gamma_L \leq \gamma_H < \overline{\gamma}$, where the types γ_L and γ_H are as defined in Lemma 5. Then, the principal prefers blind [resp. informed] review if*

- *the ability distribution is sufficiently skewed toward high [resp. low] types; and/or*
- *stakes from acceptance are sufficiently large [resp. small] for the agent.*

The second part of Proposition 8 states that, fixing the type distribution, the principal is also more likely to prefer blind review, as the agent's stakes from acceptance, B increase. Note from (4) that an increase in B is equivalent to an increase in γ. Hence, agents with high stakes will act like those with high ability, in which case blind review is the principal's preferred mode of evaluation. This finding is consistent with the example mentioned in the Introduction that a student's identity is often revealed to the grader in minor exams, but not on major ones.

Although, in most settings, it is the principal who decides on the review policy, the agent's feedback plays a significant role in this decision. To this end, the following result investigates the agent's preference over the two review procedures.

Proposition 9. *The agent prefers blind [resp. informed] review if his ability is below [resp. above] average.*

The intuition behind Proposition 9 follows from part (i) of Proposition 7 in that a low (resp. high) type is subject to a more stringent (resp. lenient) standard under informed review. There is evidence in support of this finding – as mentioned in the Introduction, the review policies of many scholarly journals have been re-examined in response to the requests by young or female scholars, who indicated a strong preference for blind review.[23]Similarly, Goldin and Rouse (2000) note that blind auditioning for symphony orchestras was advocated more by young and female musicians.

This raises an interesting policy question: why not let agents, instead of the principal, choose the mode of review when they apply? Though not obvious, the answer to this question is that under such a self-selection policy, *all* agents including the low types would ultimately opt for informed review, even when the principal prefers blind review. The reason is that once the highest types select informed review in order to face a lower standard, the highest remaining types in the applicant pool will do likewise, until unraveling causes the pool of agents preferring blind review to vanish.[24] It is interesting to note in this regard that young and female scholars advocated for blind review of manuscripts and not a system of self-selection.[25]

We now illustrate the main findings derived above in a simple example.

Example 1. Let the signal technology be given by $f^h(\sigma) = 2\sigma$ and $f^l(\sigma) = 2(1-\sigma)$ for $\sigma \in [0,1]$, whereby $R(\sigma) = \frac{\sigma}{1-\sigma}$. Since the case with $\pi_a \leq \pi_r$ results in no evaluation under commitment, we suppose $\pi_a > \pi_r$, and w.o.l.g. set $\pi_r = 0$ and $\pi_a = 1$. We further assume $Q = 1$ in this example, or equivalently $L_a = L_r + 1 = L$. Finally, let $B = 1$. From (2) and (4), we find players' reaction functions to be

$$S(p) = 1 - p \text{ and } P(s,\gamma) = \min\{2\gamma s(1-s), 1\}.$$

Commitment Equilibrium:

[23] See, e.g., Altman et al. (1991) in Statistics, Blank (1991) in Economics, and Glenn and Georges (2006) in Medicine.

[24] This is similar to the unraveling that leads to the full voluntary disclosure of product quality by a monopolist. See Grossman (1981) and Milgrom (1981).

[25] In fact, to our knowledge, only a small number of psychology journals offer this choice to authors.

When the principal can commit to the standard, recall that she optimally performs an informed review, in which the equilibrium standard is as follows. For $L < 9$,

$$s^c(\gamma; L) = \begin{cases} 1, & \text{if } \gamma \leq \gamma^c_{\min}(L) \\ \overline{s}^c(\gamma; L) \equiv \frac{1}{2} + \frac{2\gamma + L - \sqrt{4(3L^2+1)\gamma^2 - 4L(3L-5)\gamma + L^2}}{12\gamma L}, & \text{if } \gamma^c_{\min}(L) < \gamma \leq \gamma^c_{\max}(L) \\ \underline{s}^c(\gamma; L) \equiv \frac{1}{2} - \frac{\sqrt{\gamma^2 - 2\gamma}}{2\gamma}, & \text{if } \gamma > \gamma^c_{\max}(L), \end{cases}$$

where $\gamma^c_{\min}(L) = \frac{3L^2 - L + 2L\sqrt{2L(L-1)}}{2L^2}$ and $\gamma^c_{\max}(L)$ uniquely solves $\overline{s}^c(\gamma; L) - \underline{s}^c(\gamma; L) = 0$.

For $L \geq 9$,

$$s^c(\gamma; L) = \begin{cases} 1, & \text{if } \gamma \leq \widetilde{\gamma}^c_{\min}(L) \\ \underline{s}^c(\gamma; L) \equiv \frac{1}{2} - \frac{\sqrt{\gamma^2 - 2\gamma}}{2\gamma} & \text{if } \gamma > \widetilde{\gamma}^c_{\min}(L) \end{cases}$$

where $\widetilde{\gamma}^c_{\min}(L) = \frac{L}{2(\sqrt{L}-1)}$.

It is readily verified that (1) $\gamma^c_{\min}(1) = \frac{1}{4}$, $\gamma^c_{\max}(1) = 1 + \frac{3\sqrt{2}}{4}$, and both $\gamma^c_{\min}(L)$ and $\gamma^c_{\max}(L)$ strictly increase; (2) $\widetilde{\gamma}^c_{\min}(L)$ strictly increases without bound, and $\gamma^c_{\min}(9) = \gamma^c_{\max}(9) = \widetilde{\gamma}^c_{\min}(9) = \frac{9}{4}$. Several remarks are in order. First, the principal finds it optimal to prescreen agents whose types are sufficiently low. The region for these types widens as the principal expects larger losses from wrong decisions. Second, for $L > 1$, the standard is discontinuous at $\gamma = \gamma^c_{\min}(L)$ and $\gamma = \widetilde{\gamma}^c_{\min}(L)$; and third the principal is able to provide incentives for sufficiently high types, $\gamma \geq \gamma^c_{\max}(L)$ or $\gamma \geq \widetilde{\gamma}^c_{\min}(L)$, to produce high quality projects with certainty by committing to reject such projects with positive probability. In fact, when $L \geq 9$, the principal evaluates only those agents who will produce a high quality project with certainty.

Informed and Blind Equilibria:

The equilibrium standards under informed and blind reviews are, respectively,

$$s^1(\gamma) = \begin{cases} 1, & \text{if } \gamma \leq \frac{1}{2} \\ \frac{1}{2\gamma}, & \text{if } \gamma > \frac{1}{2}, \end{cases} \quad \text{and} \quad s^0 = s^1(\mu) = \begin{cases} 1, & \text{if } \mu \leq \frac{1}{2} \\ \frac{1}{2\mu}, & \text{if } \mu > \frac{1}{2}. \end{cases}$$

Observe that unlike the case of the commitment benchmark, the equilibrium standards and the prescreening regions are independent of L. This is because in equilibrium, the principal cares only about the ratio of the payoffs, Q associated with her accept and reject decisions, which, in this example, is assumed to be constant. Moreover, it can be verified that $\gamma^c_{\min}(L) \leq \frac{1}{2}$ if and only if $L \leq \frac{\sqrt{2}+1}{2}$. That is, informed review leads to too much prescreening for small L, and too little for large L. Whether this is also true for blind review depends on the mean type. If it is sufficiently low, then all types are prescreened and vice versa.

Using (1) and (4), we can also determine the principal's informed payoff:

$$V^1(\gamma) = \begin{cases} 0 & \text{if} \quad \gamma \leq \frac{1}{2} \\ \frac{(2\gamma-1)(2\gamma-L)}{4\gamma^2} & \text{if} \quad \gamma > \frac{1}{2}. \end{cases}$$

For $L = 1$ so that $L_r = 0$, $V^1(\gamma)$ is strictly positive and increasing for all $\gamma > \frac{1}{2}$. For $L > 1$, $V^1(\gamma)$ is decreasing in $\gamma \in (\frac{1}{2}, \frac{L}{L+1})$ and increasing in $\gamma \in (\frac{L}{L+1}, \infty)$, attaining its minimum at $\gamma_r = \frac{L}{L+1}$. Moreover, $V^1(\gamma) < 0$ if $\gamma \in (\frac{1}{2}, \frac{L}{2})$ and $V^1(\gamma) \geq 0$ otherwise. It also follows that $V^1(\gamma)$ is strictly convex for $\gamma \in (\frac{1}{2}, \frac{3L}{2(L+1)})$ and strictly concave for $\gamma \in (\frac{3L}{2(L+1)}, \infty)$.

Principal's Review Preference:

To examine the principal's choice between informed and blind review, we assume a uniform type distribution with support $[\frac{1}{2}, \overline{\gamma}]$, where $\overline{\gamma} < 2$ to ensure Assumption 2.[26] It follows that $E_\gamma[V^1(\gamma)] < V^1(\mu)$ if and only if $\overline{\gamma} \in (\overline{\gamma}(L), 2)$, where $\overline{\gamma}(L)$ is strictly increasing, with $\overline{\gamma}(1) = 1.09435$ and $\overline{\gamma}(L) \geq 2$ for $L \geq 2.2256$. Namely, the principal prefers blind review if there is a sufficiently large proportion of high ability agents. However, blind review becomes less appealing as the principal becomes more sensitive to wrong decisions. □

6 Extensions

We now extend the basic model to investigate three important issues: (1) the impact of application fees on the mode of review, (2) the properties of an optimal review policy including a hybrid regime, and (3) the implications of competition among evaluators on the choice of review policy.

6.1 Application Fee as a Screening Device

A common feature of many subjective review settings is the presence of application fees. It is often argued that these fees are intended to offset operating costs of the review process

[26] For ease of exposition, we assume that the support of the type distribution does not admit prescreening. Incorporating this possibility is straightforward but somewhat tedious.

and that they are not a significant source of revenue for evaluators. Yet, they can be a significant cost for a potential applicant. For instance, if the agent is unlikely to produce a high quality project and anticipates a stringent standard, then even a small fee might be enough to deter him from applying. Here, we investigate whether the ability to set an (uniform) application fee makes blind review more or less likely to be adopted.

Let $k \geq 0$ be the application fee. Since agent's expected payoff under both review regimes is increasing in his type γ, there are unique and increasing cut-off types $\gamma_1(k)$ and $\gamma_0(k)$ that are indifferent between applying and not under informed and blind review, respectively. This means that by choosing k, the principal is essentially choosing γ_1 and γ_0 – the lower bounds of type distribution. Her expected payoffs from informed and blind reviews are then given, respectively, by

$$\widehat{V}^1(\gamma_1) = \int_{\gamma_1}^{\overline{\gamma}} V^1(\gamma) dG(\gamma) \tag{7}$$

and

$$\widehat{V}^0(\gamma_0) = [1 - G(\gamma_0)] V^1(m(\gamma_0)), \tag{8}$$

where $m(\gamma_0) \equiv E_\gamma[\gamma | \gamma \geq \gamma_0]$.

Let $\Delta(\gamma_0, \gamma_1) \equiv \widehat{V}^0(\gamma_0) - \widehat{V}^1(\gamma_1)$ represent the principal's expected gain from blind review. We say that blind review becomes more likely to be adopted with an application fee than without it if and only if $\Delta(\gamma_0^*, \gamma_1^*) \geq \Delta(\underline{\gamma}, \underline{\gamma})$, where γ_0^* and γ_1^* maximize (8) and (7), respectively. Note that $\widehat{V}^1(\gamma_1^*)$, $\widehat{V}^0(\gamma_0^*) \geq \pi_r$ because the reviewer can now secure π_r by posting a large application fee. And since for $\pi_r \geq \pi_a$, the reviewer is better off rejecting all applications, this is exactly what she will do irrespective of the review process. Hence, the following result considers the case with $\pi_r < \pi_a$ so that evaluation has a bite with a fee.

PROPOSITION 10. *Suppose $\pi_r < \pi_a$.*

(i) *If the evaluator is concerned only about her acceptance decision, then she is more likely to adopt blind review in the presence of an application fee. That is, if $\pi_r + L_r = 0$, then $\Delta(\gamma_0^*, \gamma_1^*) \geq \Delta(\underline{\gamma}, \underline{\gamma})$.*

(ii) *If, on the other hand, the evaluator cares about both of her decisions, and the average ability is sufficiently high, then she is more likely to adopt an informed review in conjunction with an application fee. More formally, if $\pi_r + L_r > 0$, and μ is sufficiently large, then $\Delta(\gamma_0^*, \gamma_1^*) \leq \Delta(\underline{\gamma}, \underline{\gamma})$.*

According to Proposition 10, whether the availability of an application fee leads to a more frequent adoption of blind review depends crucially on the principal's concern about her rejection decision. In particular, if she is not worried about it, then part (i) indicates that blind review is more likely to be used in conjunction with an application fee. To understand this, notice that for $\pi_r + L_r = 0$, the principal's informed payoff is weakly positive for all γ (i.e., $\gamma_r = \gamma^1_{\min}$ in Figure 2), making free application optimal under the informed regime, i.e., $\gamma^*_1 = \underline{\gamma}$. Though feasible, free application may, however, not be optimal under blind review, because despite yielding a positive payoff, the principal may want to exclude some low types to better tailor the standard for the rest by shifting the mean type. This means an application fee can only boost the principal's payoff under blind review, making it more likely to be adopted.

For $\pi_r + L_r > 0$, free application is unlikely to be optimal under informed review, because the principal is better off discouraging some intermediate types who may lead to an evaluation trap, i.e., who may yield a payoff less than π_r. Hence, setting an application fee will improve the principal's informed payoff in this case. Although a similar exclusion incentive is also present under blind review, there is a countervailing incentive to include low types under this regime: encourage more low types to raise the standard for high types via a lower mean. In particular, if the proportion of high types becomes large enough, then the principal may opt to charge no fee under blind review.

6.2 Optimal Information Structure and the Value of Diversity

A key aspect of our analysis so far is that the same review process, blind or informed, applies to all types. This is a reasonable restriction if institutional rules and/or the review technology render it infeasible to tailor the information structure to agents' types. For instance, the fear of being perceived as "unfair" may force organizations to use blind review for all applications, or it may be prohibitively costly to supply different amounts of information about each job candidate to a recruiting committee. Yet, in many important settings, it may be possible to implement hybrid information structures that are neither fully blind nor fully informed. Consider, for example, a court proceeding. At a pre-trial stage, the judge often decides how much of the defendant's criminal and personal history can be revealed to the jury at trial. Arguably, such information, known as propensity or similar fact evidence, is relevant to the case in so far as it helps to ascertain the defendant's propensity to commit the crime. In the same spirit, privacy regulations restrict the type of information that can be disclosed in a credit report to a potential lender, employer, or landlord.

What type of hybrid information structure maximizes the evaluator's expected payoff? To answer this question, we extend our basic model as follows. Before any application is submitted, an information gatekeeper whose objective coincides with the evaluator's partitions the agent's type space $[\underline{\gamma}, \overline{\gamma}]$ into an arbitrary number of subintervals, $\underline{\gamma} \leq ... \leq \gamma_j \leq .... \leq \overline{\gamma}$, by choosing cutpoints, γ_j's. Once this information structure becomes public, the agent prepares his project and submits it to the gatekeeper. The gatekeeper forwards the project to the evaluator, but, despite knowing the agent's type, the gatekeeper reveals only the subinterval to which it belongs.[27] Consistent with the intuition developed in Section 5, the optimal information structure crucially depends on the evaluator's payoff under completely informed review. In particular, we would expect that the very high types optimally should be subject to some kind of blind review, and very low types optimally should face informed review. Since the payoff function, and especially its curvature, is endogenous to the environment, i.e., type distribution, signal technology etc., a complete characterization of the optimal information structure will be sensitive to the primitives of the model. Nonetheless, the following result lays out some basic general properties of an optimal information structure.

Proposition 11. *Under an optimal information structure,*

(i) *if the evaluator's informed payoff is strictly concave for all* $\gamma \in [\gamma_j, \gamma_{j+1}] \cup [\gamma_{j+1}, \gamma_{j+2}]$, *then* $\gamma_j = \gamma_{j+1}$ *or* $\gamma_{j+1} = \gamma_{j+2}$;

(ii) *if the evaluator's informed payoff is strictly convex for all* $\gamma \in [\gamma_j, \gamma_{j+1}]$ *for some* j, *then* $\gamma_j = \gamma_{j+1}$.

Part (i) of Proposition 11 indicates that under an optimal information structure, all types that lie on the concave part of the principal's payoff function are subject to blind review, i.e., it is optimal to pool them together. Part (ii) reveals that informed review can be optimal only for types that are on the convex portion of the payoff function. But it is possible that these types may also be subject to blind review along with the types on the concave part. These observations make sense, because the principal's payoff function under pure informed review tends to be concave for high types and convex for low types

[27] The role of the gatekeeper here resembles that of information intermediaries who decide the amount of quality disclosure for products [e.g., Biglaiser (1993) and Lizzeri (1999)].

[Lemma 5]. One implication of Proposition 11 is that the maximum number of cutpoints that separate blind and informed reviews is equal to the number of inflection points of the payoff function at which it changes curvature.

Proposition 11 also has an interesting policy implication favoring diversity in the application pool. To be specific, suppose there are two groups of potential applicants, whose types lie in intervals $[\gamma_j, \gamma_{j+1}]$ and $[\gamma_{j+1}, \gamma_{j+2}]$, respectively. Moreover, suppose, if evaluated separately, the evaluator prefers blind review for each group. Then, part (i) implies that the evaluator would be better off pooling all applications, and using blind review over the entire interval. We now extend Example 1 to illustrate an optimal information structure.

Example 1(w/ optimal information structure)

Since $V^1(\gamma)$ has one inflection point (which is at $\gamma = \frac{3L}{2(L+1)}$), the optimal information structure entails informed review for types $\gamma \in (\frac{1}{2}, \gamma_1)$ and blind review for $\gamma \in [\gamma_1, \overline{\gamma}]$ for some γ_1. That is, if $\gamma \in [\gamma_1, \overline{\gamma}]$, the evaluator is only told that γ is in this region, otherwise she is told the actual value of γ. The evaluator's expected payoff under this hybrid regime is

$$V^{opt}(\gamma_1) = \int_{\frac{1}{2}}^{\gamma_1} V^1(\gamma)\, dG(\gamma) + [1 - G(\gamma_1)]V^1(m(\gamma_1))$$

where $m(\gamma_1) = \frac{\gamma_1 + \overline{\gamma}}{2}$ given that γ is distributed uniformly in $[\frac{1}{2}, \overline{\gamma}]$.

Maximizing $V^{opt}(\gamma_1)$ with respect to γ_1 yields

$$\gamma_1(\overline{\gamma}; L) = \begin{cases} \overline{\gamma} & if \quad \frac{1}{2} < \overline{\gamma} \leq \frac{3L}{2(L+1)} \\ \phi(\overline{\gamma}; L), & if \quad \frac{3L}{2(L+1)} < \overline{\gamma} < \frac{4L-1}{2} \\ \frac{1}{2} & if \quad \frac{4L-1}{2} \leq \overline{\gamma} < 2. \end{cases}$$

where $\phi(\overline{\gamma}; L) = \frac{5L - 2(L+1)\overline{\gamma} + \sqrt{[5L-2(L+1)\overline{\gamma}]^2 + 8L(L+1)\overline{\gamma}}}{8}$. It is readily verified that $\phi(\overline{\gamma}; L)$ increases in L and decreases in $\overline{\gamma}$.

Two remarks are in order. First, if types are sufficiently low, pure informed review is optimal. If some higher types are added to the pool, i.e., $\frac{3L}{2(L+1)} < \overline{\gamma} < \frac{4L-1}{2}$, those types are subject to blind review. More interestingly, the cutoff between blind and informed reviews is not the inflection point, as $\phi(\overline{\gamma}; L) < \frac{3L}{2(L+1)}$. When there are high types that are subject to blind review, some low types are also included in the pool to raise the standard for high types. Indeed, given that $\phi(\overline{\gamma}; L)$ is strictly decreasing in $\overline{\gamma}$, the region of blind review expands as more high types join the group, and eventually pure blind review becomes optimal for $\overline{\gamma} \geq \frac{4L-1}{2}$. Note, however, that the region of blind review shrinks as the evaluator becomes more wary of a wrong decision (i.e., $\gamma_1(\overline{\gamma}; L)$ weakly increases in L).

Second, pure informed and pure blind reviews can emerge as optimal procedures without any institutional or technological limitations on the information structure. In particular, consistent with Proposition 6, pure blind (resp. informed) review is likely to be optimal when there is sufficient weight on high (resp. low) types. □

6.3 Competing Evaluators and Informed Review Bias

Up to now, we have considered only one evaluator. Yet, in practice there are often multiple evaluators, e.g., schools, companies, and academic journals, that compete for (high-quality) applications. In this section, we explore how such competition may affect the choice of review process. Let there be n ex ante *identical* evaluators to which agents may apply, and suppose that before agents exert effort, evaluators *simultaneously* and *publicly* announce their review policies, i.e, blind or informed review.[28] Each agent then applies to one evaluator. In case of indifference, we assume the agent selects one evaluator at random. Finally, we assume there are no application fees and re-applications are not feasible. The following result summarizes our findings in this section.

PROPOSITION 12. *In equilibrium,*

(i) *all evaluators adopt the same review policy.*

(ii) *they all use informed review if and only if* $\frac{V^1(\mu)}{n} \leq E_\gamma[V^1(\gamma)]$.

That is, in equilibrium either all evaluators adopt blind review or all adopt informed review. Moreover, more intense competition makes informed review more likely to be adopted. The first observation is a direct consequence of the fact that high type agents, anticipating a more lenient standard, strictly prefer informed review [Proposition 7]. Once these types are out of reach for blind reviewers, the highest remaining types in the pool would also have a strict preference for informed review. Such unraveling would continue until all types apply to an informed reviewer, giving blind reviewers a strict incentive to deviate. Hence, there can only be two types of equilibria: pure informed and pure blind.

[28] Our results in this section are robust to a more general announcement game in which each evaluator decides on the review process as well as the period to announce this decision.

Suppose all evaluators adopt blind review. It is immediate that all of them must have the same equilibrium standard. Otherwise, all agents would strictly prefer the reviewer with the lowest standard. Thus, in a pure blind equilibrium, agents must be indifferent between reviewers, implying that the mean type for reviewer i is simply the unconditional mean μ and her expected payoff is $\frac{V^1(\mu)}{n}$. For pure blind review to be an equilibrium however, reviewer i should not have a unilateral incentive to adopt informed review. If she did, then, by our previous argument, she would capture all applicants, and receive the same expected payoff as a single informed reviewer, i.e., $E_\gamma[V^1(\gamma)]$. Hence, pure blind review is an equilibrium if and only if $\frac{V^1(\mu)}{n} > E[V^1(\gamma)]$.

In sum, competition is likely to bias the evaluation process to be informed, or said differently, blind review is likely to be prevalent in settings with little or no reviewer competition. This finding is consistent with the fact that historically leading journals across various disciplines have disproportionately adopted informed review, and that blind review is widely pronounced in court proceedings.

7 Concluding Remarks

The issue at the heart of this paper concerns the tradeoff between the effective use of information and the provision of incentives in a setting where ex ante commitment to a review standard is infeasible. It was shown in this context that when the evaluator observes the innate ability of the applicant, the equilibrium review policy is unduly biased – the standards facing high ability applicants are too weak and those facing low-ability applicants are too tough. While this policy uses information optimally ex post, it provides poor incentives ex ante. In particular, if the evaluator could commit to a review procedure, then she would implement a flatter (less biased) one. Commitment to such a policy is, however, often impractical or impossible because of the subjective nature of many performance measures: the taste of a fine wine, the skill of a classical musician, the quality of an essay. Although it is not possible to commit to a highly tailored acceptance procedure in such environments, it is often possible to commit to remain ignorant of the identity (and hence the ability) of the applicant; that is, to perform blind review.

The uniform standard implemented under blind review provides good incentives for agents at both ends of the ability distribution but it sacrifices too much information at the project selection stage. Hence, whether the evaluator prefers blind or informed review depends critically on whether incentives or project selection is more important to her. Blind review was shown to be the preferred mode of evaluation if: the applicant pool contains a high proportion of high ability agents, the applicant's stakes from acceptance are relatively high, wrong decisions are relatively less costly, or there is limited competition among evaluators.

In some settings (e.g., a jury trial) it may be possible to implement a hybrid review procedure in which the evaluator learns only qualitative information about the applicant's ability (e.g., high, medium, or low). It was shown that the optimally designed information partition typically pools all applications at the top of the ability distribution and separates types at the bottom.

There are a number of intriguing issues not addressed here. For instance, it would be interesting to study the role of peer effects in a setting where an applicant's benefit from acceptance, B is determined endogenously. Specifically, the status or prestige enjoyed by an agent whose project is accepted might well depend on the average quality of other projects accepted by the evaluator. It would also be edifying to study a dynamic version of the model presented here in which the "ability" of an agent corresponds to his history of prior acceptances and rejections. In particular, it would be interesting to explore the interaction between the review policies of evaluators and the career concerns of agents in such a setting. While these and other avenues for further research in this area appear fruitful, it seems quite likely that the basic message of this paper will remain in tact. Fairness is not the only reason to level the playing field – often it is also the best thing the evaluator can do.

A Appendix

Proof of Lemma 1. Parts (i) and (ii) follow by simply differentiating (4) and (3) with respect to s. To prove part (iii), note that

$$V_p(p,s) = [1 - F^h(s)]\pi_a - F^l(s)\pi_r - F^h(s)L_r + [1 - F^l(s)]L_a \tag{A-1}$$

and

$$V_{ps}(p,s) = -[(\pi_a + L_r)f^h(s) + (\pi_r + L_a)f^l(s)] < 0. \tag{A-2}$$

Given $V_p(p,\underline{\sigma}) = \pi_a + L_a \geq 0$ and $V_p(p,\overline{\sigma}) = -(\pi_r + L_r) \leq 0$, (A-2) implies that there exists a unique $\sigma_d \in [\underline{\sigma},\overline{\sigma}]$ such that $V_p(p,s) > 0$ for $s \in [\underline{\sigma},\sigma_d)$ and $V_p(p,s) < 0$ for $s \in (\sigma_d,\overline{\sigma}]$. Finally, it is obvious that $\sigma_d > \underline{\sigma}$ iff $\pi_a + L_a > 0$, and $\sigma_d < \overline{\sigma}$ iff $\pi_r + L_r > 0$. ■

Proof of Lemma 2. The continuity of the pair $(p^1(\gamma), s^1(\gamma))$ follows from the fact that both $P(s;\gamma)$ and $S(p,Q)$ are continuous in s and γ.

To show local stability of equilibrium, suppose $s^1(\gamma) \neq \overline{\sigma}$. Given $S_s^{-1}(s^1(\gamma), Q) < 0$, it follows that $S_s^{-1}(s^1(\gamma), Q) - P_s(s^1(\gamma), \gamma) < 0$, whenever $P_s(s^1(\gamma), \gamma) \geq 0$. Now, consider $P_s(s^1(\gamma), \gamma) < 0$, and suppose, on the contrary, that $S_s^{-1}(s^1(\gamma), Q) - P_s(s^1(\gamma), \gamma) \geq 0$. If $S_s^{-1}(s^1(\gamma), Q) - P_s(s^1(\gamma), \gamma) = 0$ for some γ, then by continuity, there is a sufficiently small $\varepsilon > 0$ such that $s^1(\gamma) = s^1(\gamma + \varepsilon)$. But, from (4), this would imply $p^1(\gamma) < p^1(\gamma + \varepsilon)$, and thus $s^1(\gamma) \neq s^1(\gamma + \varepsilon)$, yielding a contradiction. Hence, $S_s^{-1}(s^1(\gamma), Q) - P_s(s^1(\gamma), \gamma) > 0$. However, if this were the case, then, by continuity, we must have $S^{-1}(s^1(\gamma) - \varepsilon, Q) - P(s^1(\gamma) - \varepsilon, \gamma) < 0$ for some $\varepsilon > 0$. Given $S^{-1}(\underline{\sigma}, Q) - P(\underline{\sigma}, \gamma) > 0$, this would generate another equilibrium with a greater effort, contradicting our equilibrium selection. Thus, for $s^1(\gamma) \neq \overline{\sigma}$, it must be that $S_s^{-1}(s^1(\gamma), Q) - P_s(s^1(\gamma), \gamma) < 0$.

Finally, suppose $s^1(\gamma) = \overline{\sigma}$ so that $p^1(\gamma) = 0$. In this case, if $S_s^{-1}(s^1(\gamma), Q) - P_s(s^1(\gamma), \gamma) > 0$, then, once again by continuity, we would find another equilibrium with $p^1(\gamma) > 0$ – a contradiction. Hence, $S_s^{-1}(\overline{\sigma}, L) - P_s(\overline{\sigma}, \gamma) \leq 0$.

To prove part (ii), notice that since $V(p,s)$ is strictly quasi-concave in s under Assumption 2, setting $s = \overline{\sigma}$ is optimal for the principal if and only if $\lim_{s \to \overline{\sigma}} V_s(p,s) \geq 0$; or equivalently $\lim_{s \to \overline{\sigma}} f^l(s)(\pi_a + L_r)[-pR(s) + (1-p)Q] \geq 0$. Furthermore, since, by (4), $P(s;\gamma) = \gamma B[F^l(s) - F^h(s)]$ for $s \to \overline{\sigma}$, the inequality holds if and only if $\gamma \leq \frac{Q}{\rho B} \equiv \gamma^1_{\min}$, where $\rho \equiv \lim_{s \to \overline{\sigma}} \{R(s)[F^l(s) - F^h(s)]\}$, proving part (ii). ■

Proof of Proposition 1. Suppose $\gamma > \gamma^1_{\min}$ so that $(p^1(\gamma), s^1(\gamma) \neq (0, \overline{\sigma})$. From (2) and (4), we have $S^{-1}(s^1(\gamma), Q) - P(s^1(\gamma), \gamma) = 0$. Differentiating this with respect to γ yields

$$s^{1\prime}(\gamma) = \frac{P_\gamma(s^1(\gamma), \gamma)}{S_s^{-1}(s^1(\gamma), Q) - P_s(s^1(\gamma), \gamma)} < 0,$$

where $S_s^{-1}(s^1(\gamma), Q) - P_s(s^1(\gamma), \gamma) < 0$ by Lemma 2.

Next, we show $p^1(\gamma) < 1$ for all γ. Clearly, if $p^1(\widehat{\gamma}) = 1$ for some $\widehat{\gamma} < \infty$, then the best response by the principal would be $s^1(\widehat{\gamma}) = \underline{\sigma}$, to which the agent would reply by $p^1(\widehat{\gamma}) = 0$, contradicting $p^1(\widehat{\gamma}) = 1$.

Now, observe from (2) that $p^1(\gamma) = \frac{Q}{Q + R(s^1(\gamma))}$, which, by differentiating with respect to γ, implies

$$p^{1\prime}(\gamma) = -\frac{QR'(.)}{[Q + R(.)]^2} s^{1\prime}(\gamma) > 0.$$

Finally, as $\gamma \to \infty$, suppose $p^1(\gamma) \to \overline{p}^1 < 1$. From (2), this implies $s^1(\gamma) \to \underline{s}^1 > \underline{\sigma}$.

But then, since $F^l(\underline{s}^1) - F^h(\underline{s}^1) > 0$, it must be that $\overline{p}^1 = 1$ by (4), yielding a contradiction. Hence, $\overline{p}^1 = 1$ and $\underline{s}^1 = \underline{\sigma}$.■

PROOF OF PROPOSITION 2. Suppose $\gamma > \gamma^1_{\min}$. Part (i) easily follows by differentiating $U^1(\gamma) \equiv U(p^1(\gamma), s^1(\gamma); \gamma)$. To see part (ii), we differentiate $V^1(\gamma) \equiv V(p^1(\gamma), s^1(\gamma))$,

$$V^{1\prime}(\gamma) = V_p(p^1(\gamma), s^1(\gamma))p^{1\prime}(\gamma) =^S V_p(p^1(\gamma), s^1(\gamma)).$$

From Lemma 1, $V_p(p^1(\gamma), s^1(\gamma)) =^S \sigma_d - s^1(\gamma)$, and since $s^{1\prime}(\gamma) < 0$, there exists a unique $\gamma_r \geq \gamma^1_{\min}$ such that $\sigma_d - s^1(\gamma) =^S \gamma - \gamma_r$, . Moreover, since $\sigma_d = \overline{\sigma}$ iff $\pi_r + L_r = 0$, we have $\gamma_r = \gamma^1_{\min}$ iff $\pi_r + L_r = 0$. Together, $V^{1\prime}(\gamma) < 0$ for $\gamma \in [\gamma^1_{\min}, \gamma_r)$, and $V^{1\prime}(\gamma) > 0$ for $\gamma \in (\gamma_r, \overline{\gamma}]$. ■

PROOF OF LEMMA 3. The principal chooses s^0 to maximize her expected payoff $E_\gamma[V(p, s^0)] = E_\gamma[V^0(\gamma, s^0)]$ which, from (1), is equal to $V(E_\gamma(p), s^0)$. This means s^0 has to satisfy (2), where p is replaced with $E_\gamma(p)$. In addition, in equilibrium, $E_\gamma(p) = E_\gamma[P(s^0; \gamma)]$ by (4), and $P(s^0; \gamma) = \gamma B[F^l(s^0) - F^h(s^0)]$ for all γ by Assumption 3 and (4). Hence, $E_\gamma(p) = \mu B[F^l(s^0) - F^h(s^0)]$, implying that the solution to (2) is $s^0 = s^1(\mu)$ and $p^0(\gamma, \mu) = P(s^0; \gamma) = \gamma B[F^l(s^1(\mu)) - F^h(s^1(\mu))]$. As a result, $E_\gamma[V^0(\gamma, s^0)] = V^1(\mu)$. ■

PROOF OF LEMMA 4. Note that for $p \neq 1$,

$$V(p, s) = pV_p(.) + F^l(s)\pi_r - [1 - F^l(s)]L_a. \tag{A-3}$$

Since $V^c(\gamma) \geq \pi_r$, for $(p^c(\gamma), s^c(\gamma)) \neq (1, \overline{\sigma})$, (A-3) reveals that $pV_p(.) \geq [1 - F^l(s)](\pi_r + L_a)$. Given $\pi_r + L_a > 0$ by Assumption 1, it follows that $V_p(.) > 0$ whenever $(p^c(\gamma), s^c(\gamma)) \neq (1, \overline{\sigma})$. ■

PROOF OF PROPOSITION 3. Suppose Assumption 4 holds. The existence and uniqueness of $\overline{s}^c(\gamma)$ is clear from the exposition in the text. The same holds for $\underline{s}^c(\gamma)$ because of the strict quasi-concavity of $P(s; \gamma)$ by Lemma 1. Moreover, since $V^c(\gamma) \geq \pi_r$, we have $s^c(\gamma) \leq \sigma_d$ by Lemmas 1 and 4.

Next, differentiating (6)with respect to γ, we obtain

$$\overline{s}^{c\prime}(\gamma) = -\frac{V_p(.)P_{s\gamma}(.) + V_{sp}(.)P_\gamma(.)}{V_p(.)P_{ss}(s, \gamma) + 2V_{sp}(.)P_s(s, \gamma) + V_{ss}(.)}.$$

Note that the denominator is strictly negative due to Assumption 4. Furthermore, using (6), $V_p(.)P_{s\gamma}(.) = \frac{V_p(.)P_s(.)}{\gamma} = -\frac{V_s(.)}{\gamma}$, and $P_\gamma(.) = \frac{P(.)}{\gamma}$, we have

$$V_p(.)P_{s\gamma}(.) + V_{sp}(.)P_\gamma(.) = \frac{1}{\gamma}[V_{ps}(.)p - V_s(.)].$$

Given that $V_{ps}(p,s) = -[(\pi_a + L_r)f^h(s) + (\pi_r + L_a)f^l(s)]$ and $V_s(p,s) = -pf^h(s)(\pi_a + L_r) + (1-p)f^l(s)(\pi_r + L_a)$, it follows that $V_{ps}(.)p - V_s(.) = -f^l(s)(\pi_r + L_a) < 0$, and thus $\overline{s}^{c\prime}(\gamma) < 0$.

To sign $\underline{s}^{c\prime}(\gamma)$, we differentiate $P(\underline{s}^c(\gamma),\gamma) = 1$ with respect to γ,

$$\underline{s}^{c\prime}(\gamma) = -\frac{P_\gamma(.)}{P_s(.)} < 0,$$

where $P_s(.) > 0$ because $\underline{s}^c(\gamma) < \sigma_m$.

To complete the proof of part (iii), suppose that as $\gamma \to \infty$, $s^c(\gamma) \to y > \underline{\sigma}$. Since $\gamma B[F^l(s^c(\gamma)) - F^h(s^c(\gamma))] \to \infty$ in this case, (4) implies $P(s^c(\gamma),\gamma) \to 1$. But then, the principal could be strictly better off by slightly reducing $s^c(\gamma)$, which contradicts optimality. Hence, $s^c(\gamma) \to \underline{\sigma}$ as $\gamma \to \infty$.

We now turn to part (i). First, note that if $p^c(\gamma_0) = 1$ for some γ_0, then $p^c(\gamma) = 1$ for all $\gamma \geq \gamma_0$. Otherwise, if $p^c(\gamma_1) < 1$ for some $\gamma_1 > \gamma_0$, then the principal could choose $s^c(\gamma_1) = \underline{s}^c(\gamma_1) < \overline{s}^c(\gamma_1)$, and be strictly better off by inducing $p^c(\gamma_1) = 1$. Second, suppose, on the contrary, that $p^c(\gamma) < 1$ for all γ, which means (6) holds for all γ. Since, as $\gamma \to \infty$, $s^c(\gamma) \to \underline{\sigma}$, we have $V_p(.) \to \pi_a + L_a$, $P_s(.) \to +\infty$, and $V_s(.) \geq 0$, yielding a contradiction to (6). Hence, $p^c(\gamma) = 1$ for all $\gamma \geq \gamma^c_{\max}$, where $p^c(\gamma^c_{\max}) = \overline{p}^c(\gamma^c_{\max}) = 1$.

Finally, for $\gamma^c_{\min} < \gamma < \gamma^c_{\max}$, $V^{c\prime}(\gamma) = V_p(.)P_\gamma(.) > 0$ by Lemma 4, and for $\gamma \geq \gamma^c_{\max}$, $V^c(\gamma) = V(1, \underline{s}^c(\gamma))$ and hence $V^{c\prime}(\gamma) > 0$.■

Proof of Proposition 4. Note that part (i) follows from the fact that type $\gamma^1_{\min}$ is not prescreened under commitment if and only if $V^c(\gamma^1_{\min}) > \pi_r$. Moreover, since $V^{c\prime}(\gamma) > 0$ whenever $V^c(\gamma) > \pi_r$, it must be that $\gamma^c_{\min} < \gamma^1_{\min}$, where, by definition, $V^c(\gamma^c_{\min}) = \pi_r$. To prove part (ii), recall from Lemma 2 that $\gamma^1_{\min} = \frac{Q}{\rho B}$. Simply differentiating $V^c(\gamma^1_{\min}) - \pi_r$ with respect to each parameter, the result obtains. ■

Proof of Proposition 5. Let γ_m be the critical type such that $s^1(\gamma_m) = \sigma_m$, and suppose $\gamma > \max\{\gamma^c_{\min}, \gamma^1_{\min}\}$. We first argue that $\gamma^c_{\max} > \gamma_m$: if $\gamma^c_{\max} \leq \gamma_m$, then there would be some $\gamma \geq \gamma^c_{\max}$ for which $P(s^1(\gamma);\gamma) = p^1(\gamma) = 1$, contradicting Proposition 1.

Suppose $\gamma < \gamma_m$, but, on the contrary, $s^c(\gamma) = \overline{s}^c(\gamma) \geq s^1(\gamma)$. Since $s^1(\gamma) > s_m$, it follows that $V_s(P(s^1(\gamma),\gamma), s) = 0$ and $P_s(s^1(\gamma);\gamma) < 0$, which, together with Lemma 4, imply $\frac{d}{ds}V(P(s,\gamma),s)\big|_{s=s^1(\gamma)} < 0$, and by Assumption 4 reveal $s^c(\gamma) < s^1(\gamma)$ – a contradiction. Thus, $s^c(\gamma) < s^1(\gamma)$ for $\gamma < \gamma_m$. Given $\gamma^c_{\max} > \gamma_m$, a similar line of argument shows that $s^c(\gamma_m) = s^1(\gamma_m)$, and $s^c(\gamma) > s^1(\gamma)$ for $\gamma_m < \gamma \leq \gamma^c_{\max}$. Finally, for $\gamma > \gamma^c_{\max}$, we have $s^c(\gamma) = \underline{s}^c(\gamma)$. If , on the contrary, $\underline{s}^c(\gamma) \leq s^1(\gamma)$, then since $\gamma > \gamma^c_{\max}$,

$1 = P(s_1^c(\gamma);\gamma) \leq P(s^1(\gamma);\gamma)$ because $P_s(.) > 0$ in this region. But this implies $p^1(\gamma) = 1$, contradicting Proposition 1. Hence, $s^c(\gamma) > s^1(\gamma)$ for $\gamma > \gamma^c_{\max}$, completing the proof of part (i).

The proof of part (ii) uses exact lines of argument in part (i) along with Lemma 1.■

Proof of Proposition 6. Suppose, on the contrary, that the principal adopts blind review for some interval of types, and by definition, all types in this interval are subject to the same uniform standard. Notice, however, that this standard is also feasible under informed review for each γ in the interval. But, since $s^c(\gamma)$ is strictly decreasing, it is chosen for at most one type, which, by revealed preference, implies that the principal is strictly better off under informed review in this interval than under blind review. Thus, there is no type interval over which the principal uses blind review.■

Proof of Proposition 7. Part (i) is a direct implication of Lemma 3 along with part (ii) of Proposition 1. To prove part (ii), observe that $F^l(s) - F^h(s)$ is strictly quasi-concave in s, achieving its maximum at $s = \sigma_m$. Since $F^l(\sigma_m) - F^h(\sigma_m) \geq F^l(s^0) - F^h(s^0)$ (with $>$ for $\sigma_m \neq s^0$), it follows that there exist cutpoints $\sigma_l \leq \sigma_m \leq \sigma_h$ such that

$$F^l(s) - F^h(s) \begin{cases} < F^l(s^0) - F^h(s^0), \text{ if } s < \sigma_l \text{ or } s > \sigma_h, \\ = F^l(s^0) - F^h(s^0), \text{ if } s = \sigma_l \text{ or } s = \sigma_h, \\ > F^l(s^0) - F^h(s^0), \text{ if } \sigma_l < s < \sigma_h. \end{cases}$$

From here, defining γ_l and γ_h such that $s^1(\gamma_l) = \sigma_h$ and $s^1(\gamma_h) = \sigma_l$, and recalling $p^1(\gamma) = \gamma B[F^l(s^1(\gamma)) - F^h(s^1(\gamma))]$, the desired result obtains.■

Proof of Lemma 5. To save on notation, let $p = p^1(\gamma)$ and $s = s^1(\gamma)$ in this proof. We first prove two claims.

Claim 1. $p'' < 0$ *as* $\gamma \to \gamma^1_{\min}$.

Proof. Note that since $\lim_{\sigma\to\overline{\sigma}}\{R(\sigma)[F^l(\sigma) - F^h(\sigma)]\}$ exists by Assumption 2, by L'Hospital rule, so does $\lim_{\sigma\to\overline{\sigma}} \frac{f^l(\sigma)-f^h(\sigma)}{-\frac{R'(\sigma)}{R^2(\sigma)}}$. This implies (1) $\lim_{\sigma\to\overline{\sigma}} R'(\sigma) = \infty$, and (2) $\lim_{\sigma\to\overline{\sigma}} \frac{R'(\sigma)}{R^2(\sigma)}$ exists. Using L'Hospital rule for the latter limit, we further have $\frac{R'}{R^2} \approx \frac{R''}{2RR'}$ for $\sigma \approx \overline{\sigma}$, or equivalently $(R')^2 \approx RR''$.

Given $\lim_{\gamma\to\gamma^1_{\min}} s' \neq 0$, it follows that

$$\lim_{\gamma\to\gamma^1_{\min}} \frac{R(s)s'}{R^2(s)s'} = \lim_{\gamma\to\gamma^1_{\min}} \frac{R''(s)(s')^2 + R'(s)s''}{2R(s)R'(s)(s')^2 + R^2(s)s''}.$$

Hence, $s'' > 0$ as $\gamma \to \gamma^1_{\min}$.

Now, by (2) and $p < 1$, we have $p = \frac{Q}{Q+R(s)}$. Differentiating this twice with respect to γ yields

$$p'' =^S -\left[(R''(s)(s')^2 + R'(s)s'')(Q+R) - 2(R'(s)s')^2\right].$$

For $\gamma \to \gamma^1_{\min}$ and thus $s \to \overline{\sigma}$, since $(R')^2 \approx RR''$ and $s'' > 0$, it follows that $p'' < 0$ for $\gamma \to \gamma^1_{\min}$. ■

Claim 2. *$\frac{p''}{p's'} \to \infty$, as $\gamma \to \infty$.*

Proof. Since $p < 1$, $p = \gamma B[F^l(s) - F^h(s)]$ by (4). Differentiating with respect to γ, we obtain

$$p' = B\{[F^l(s) - F^h(s)] + \gamma[f^l(s) - f^h(s)]s'\}$$

and

$$p'' = B\{[f^l(s) - f^h(s)](2s' + \gamma s'') + [f^{l\prime}(s) - f^{h\prime}(s)]\gamma(s')^2\}.$$

From Proposition 1, recall that $p \to 1$ and $s \to \underline{\sigma}$ as $\gamma \to \infty$. Suppose $\gamma s' \to a < 0$. Then, $p' \to B[f^l(\underline{\sigma}) - f^h(\underline{\sigma})]a < 0$, which contradicts $p' > 0$, because $f^l(\underline{\sigma}) - f^h(\underline{\sigma}) > 0$. Thus, $\gamma s' \to 0$ and $s' \to 0$.

Next, note that $\frac{p'}{\gamma s'} = B[\frac{F^l(s)-F^h(s)}{\gamma s'} + f^l(s) - f^h(s)]$. Moreover, by L'Hospital rule, $\lim_{\gamma\to\infty} \frac{F^l(s)-F^h(s)}{\gamma s'} = \lim_{\gamma\to\infty} \frac{[f^l(s)-f^h(s)]s'}{s'+\gamma s''}$. This means for a sufficiently large γ, $\frac{p'}{\gamma s'} \approx B[f^l(\underline{\sigma}) - f^h(\underline{\sigma})]\frac{2s'+\gamma s''}{s'+\gamma s''}$. Since $\frac{p'}{\gamma s'} < 0$, $f^l(\underline{\sigma}) - f^h(\underline{\sigma}) > 0$ and $s' < 0$, we must have $s' + \gamma s'' > 0$ and $2s' + \gamma s'' < 0$.

Finally, note that since $s' \to 0$ and $s'' > 0$, it follows $s'' \to 0$. Using L'Hospital rule, $\frac{s'}{s''} \approx \frac{s''}{s'''}$ for a sufficiently large γ, implying that $s''' < 0$. A similar limit argument shows that $\frac{F^l(s)-F^h(s)}{s'} \approx \frac{[f^l(\underline{\sigma})-f^h(\underline{\sigma})]s'}{s''} \approx \frac{[f^{l\prime}(\underline{\sigma})-f^{h\prime}(\underline{\sigma})](s')^2+[f^l(\underline{\sigma})-f^h(\underline{\sigma})]s''}{s'''}$. Given $s''' < 0$, the numerator of the last ratio must be positive, or, equivalently $\frac{f^{l\prime}(\underline{\sigma})-f^{h\prime}(\underline{\sigma})}{f^l(\underline{\sigma})-f^h(\underline{\sigma})} > -\frac{s''}{(s')^2}$.

Now, consider the following ratio.

$$\frac{p''}{p's'} = \frac{\{[f^l(s) - f^h(s)](2s' + \gamma s'') + [f^{l\prime}(s) - f^{h\prime}(s)]\gamma(s')^2}{p's'}.$$

Dividing the r.h.s. by $\gamma(s')^2$, we obtain

$$\begin{aligned}
\frac{p''}{p's'} &= \frac{[f^l(s) - f^h(s)]\frac{2s'+\gamma s''}{\gamma(s')^2} + [f^{l\prime}(s) - f^{h\prime}(s)]}{\frac{p'}{\gamma s'}} \\
&\approx \frac{[f^l(\underline{\sigma}) - f^h(\underline{\sigma})]\frac{2s'+\gamma s''}{\gamma(s')^2} + [f^{l\prime}(\underline{\sigma}) - f^{h\prime}(\underline{\sigma})]}{[f^l(\underline{\sigma}) - f^h(\underline{\sigma})]\frac{2s'+\gamma s''}{s'+\gamma s''}} \text{ for a large } \gamma,
\end{aligned}$$

$$\begin{aligned} &= \frac{s' + \gamma s''}{\gamma (s')^2} + \frac{[f^{l\prime}(\underline{\sigma}) - f^{h\prime}(\underline{\sigma})]}{[f^{l}(\underline{\sigma}) - f^{h}(\underline{\sigma})]} \frac{s' + \gamma s''}{2s' + \gamma s''} \\ &> \frac{s' + \gamma s''}{\gamma (s')^2} - \frac{s''}{(s')^2} \frac{s' + \gamma s''}{2s' + \gamma s''} \\ &= \frac{s' + \gamma s''}{2s' + \gamma s''} [\frac{2}{\gamma s'}] \\ &= +\infty, \end{aligned}$$

where the last line follows because $p' = -\frac{p^2 R'(s)}{Q} s'(\gamma)$ and $R'(\underline{\sigma}) < \infty$, revealing $\frac{p'}{\gamma s'} = -\frac{p^2 R'(s)}{\gamma Q} \to 0^-$ as $\gamma \to \infty$. Furthermore, given $\frac{p'}{\gamma s'} \approx B[f^l(\underline{\sigma}) - f^h(\underline{\sigma})]\frac{2s'+\gamma s''}{s'+\gamma s''}$, we have $\frac{s'+\gamma s''}{2s'+\gamma s''} \to -\infty$, which, together with $\frac{2}{\gamma s'} \to -\infty$, proves the claim.■

Now, note that

$$V^{1\prime\prime}(\gamma) = V_{ps}(.) s' p' + V_p(.) p'', \tag{A-4}$$

where the expressions for $V_p(.)$ and $V_{ps}(.)$ are given in (A-1) and (A-2), respectively.

Observe that since $\gamma \to \gamma^1_{\min}$, and $s \to \overline{\sigma}$, it follows that $V_{ps}(.) \to -[(\pi_a + L_r) f^h(\overline{\sigma}) + (\pi_r + L_a) f^l(\overline{\sigma})] < 0$ and $V_p(.) \to -(\pi_r + L_r) \leq 0$. Moreover, given that $p' > 0$, $s' < 0$, and $p'' < 0$ by Claim 1, we obtain $V^{1\prime\prime}(\gamma) > 0$.

Next, we determine the sign of $V^{1\prime\prime}(\gamma)$ for a sufficiently large γ. Since as $\gamma \to \infty$, $s \to \underline{\sigma}$, we have $V_{ps}(.) \to -[(\pi_a + L_r) f^h(\underline{\sigma}) + (\pi_r + L_a) f^l(\underline{\sigma})] < 0$ and $V_p(.) \to \pi_a + L_a \geq 0$. Moreover, since, by Claim 2, $\frac{p''}{p's'} \to +\infty$, the second term in (A-4) dominates, and given $p'' < 0$, implies $V^{1\prime\prime}(\gamma) < 0$.

Overall, there exist two cutpoints $0 < \gamma_L \leq \gamma_H < \infty$ such that $V^{1\prime\prime}(\gamma)$ is strictly convex for $\gamma < \gamma_L$ and strictly concave for $\gamma > \gamma_H$. ■

Proof of Proposition 8. Suppose $\underline{\gamma} < \gamma_L \leq \gamma_H < \overline{\gamma}$, where γ_L and γ_H are as defined in Lemma 5, and define $G_L(\gamma;\varepsilon)$ and $G_H(\gamma;\varepsilon)$ to be families of type distributions such that $G_L(\gamma;\varepsilon) = \{G(\gamma) \text{ s.t. } G(\gamma_L) \geq 1 - \varepsilon \text{ for } \varepsilon > 0\}$ and $G_H(\gamma;\varepsilon) = \{G(\gamma) \text{ s.t. } G(\gamma_H) \leq \varepsilon \text{ for } \varepsilon > 0\}$.

Let type distribution be $G_H(\gamma;\varepsilon)$. The principal's expected payoffs from informed and blind reviews are, respectively,

$$E_\gamma[V^1(\gamma)] = \int_{\underline{\gamma}}^{\gamma_H} V^1(\gamma) dG_H(\gamma;\varepsilon) + \int_{\gamma_H}^{\overline{\gamma}} V^1(\gamma) dG_H(\gamma;\varepsilon), \text{ and } V^1(\mu) = V^1(\int_{\underline{\gamma}}^{\gamma_H} \gamma dG_H(\gamma;\varepsilon) + \int_{\gamma_H}^{\overline{\gamma}} \gamma dG_H(\gamma;\varepsilon)).$$

Note that given $V^1(\gamma_r) \leq V^1(\gamma) \leq \max\{\pi_r, \pi_a\}$, we have $V^1(\gamma_r) G_H(\gamma_H;\varepsilon) \leq \int_{\underline{\gamma}}^{\gamma_H} V^1(\gamma) dG_H(\gamma;\varepsilon) \leq$

$\max\{\pi_r, \pi_a\}G_H(\gamma_H;\varepsilon)$ and $0 \leq \int_{\underline{\gamma}}^{\gamma_H} \gamma dG_H(\gamma;\varepsilon) \leq \gamma_H G_H(\gamma_H;\varepsilon)$. Hence, as $\varepsilon \to 0$, it follows $E_\gamma[V^1(\gamma)] \to \int_{\gamma_H}^{\overline{\gamma}} V^1(\gamma)dG_H(\gamma;0)$, and $V^1(\mu) \to V^1(\int_{\gamma_H}^{\overline{\gamma}} \gamma dG_H(\gamma;0))$. Moreover, since $V^1(\gamma)$ is strictly concave for all $\gamma > \gamma_H$, Jensen's inequality implies $\int_{\gamma_H}^{\overline{\gamma}} V^1(\gamma)\frac{dG_H(\gamma;\varepsilon)}{1-G(\gamma_H;\varepsilon)} < V^1(\int_{\gamma_H}^{\overline{\gamma}} \gamma \frac{dG_H(\gamma;\varepsilon)}{1-G(\gamma_H;\varepsilon)})$, which, in turn, implies $\int_{\gamma_H}^{\overline{\gamma}} V^1(\gamma)dG_H(\gamma;0) < V^1(\int_{\gamma_H}^{\overline{\gamma}} \gamma dG_H(\gamma;0))$. From here, it follows that $E_\gamma[V^1(\gamma)] < V^1(\mu)$ for a sufficiently small ε, i.e., the principal prefers blind review. A similar line of argument shows that the principal strictly prefers informed review under $G_L(\gamma;\varepsilon)$.

Now fix a type distribution $G(\gamma)$, and let $X \equiv \gamma B$ so that $H_B(x) \equiv \Pr\{X \leq x\} = G(\frac{x}{B})$ where $x \in [B\underline{\gamma}, B\overline{\gamma}]$. Clearly, there exists some $B_L < \infty$ and $\varepsilon(B_L) > 0$ such that $H_{B_L}(x_L) \geq 1 - \varepsilon(B_L)$ for a fixed x_L. Similarly, there exist some $B_H < \infty$ and $\varepsilon(B_H) > 0$ such that $H_{B_H}(x_H) \leq \varepsilon(B_H)$ for a fixed x_H. Note that the cutpoints γ_L and γ_H identified in Lemma 5 are independent of B. Hence, applying the result from the first part, it follows that for fixed $G(\gamma)$, there exists a sufficiently large (resp. small) $B < \infty$ under which the principal strictly prefers blind (resp. informed) review.■

Proof of Proposition 9. The result easily follows by using the facts (1) $s^0 = s^1(\mu)$, (2) $s^{1\prime}(\gamma) < 0$ from Proposition 1, and (3) $\frac{d}{ds}U(P(s;\gamma), s) < 0$ from Lemma 1. ■

Proof of Proposition 10. Suppose Assumption 3 holds and $\pi_r < \pi_a$. Let $\pi_r + L_r = 0$. By Proposition 2, this implies $V^1(\gamma) \geq \pi_r = 0$ for all γ, which in turn implies $\gamma_1^* = \underline{\gamma}$. Since, by definition, $\Delta(\gamma_0^*, \gamma_1^*) = \Delta(\gamma_0^*, \underline{\gamma}) \geq \Delta(\underline{\gamma}, \underline{\gamma})$, part (i) follows. To show part (ii), let $\pi_r + L_r > 0$. Using Proposition 1, observe that $V^{1\prime}(\gamma) \to 0$ as $\gamma \to \infty$, because $V^1(\gamma) \to \pi_a$ as $\gamma \to \infty$, and $V^{1\prime}(\gamma) > 0$ for sufficiently large γ. Next, note that by definition, $\gamma_0^* = \arg\max_{\gamma_0} \widehat{V}^0(\gamma_0)$, and the corresponding FOC must hold: $\widehat{V}^{0\prime}(\gamma_0^*) = -g(\gamma_0^*)V^1(m(\gamma_0^*)) + [1 - G(\gamma_0^*)]V^{1\prime}(m(\gamma_0^*))m'(\gamma_0^*) \leq 0$. Since $m(\gamma_0^*) \geq \mu$, it must be that for sufficiently large μ, $V^{1\prime}(m(\gamma_0^*))$ gets arbitrarily small, leading to $\widehat{V}^{0\prime}(\gamma_0^*) < 0$ and thus $\gamma_0^* = \underline{\gamma}$. This means $\Delta(\gamma_0^*, \gamma_1^*) = \Delta(\underline{\gamma}, \gamma_1^*) \leq \Delta(\underline{\gamma}, \underline{\gamma})$, completing the proof. ■

Proof of Proposition 11. Define $G_i(\gamma) = \frac{G(\gamma)-G(\gamma_i)}{G(\gamma_{i+1})-G(\gamma_i)}$ and $m(\gamma_i, \gamma_{i+1}) = E_\gamma[\gamma|\gamma_i \leq \gamma \leq \gamma_{i+1}]$, respectively. Since, by assumption, blind review is applied in each interval, $\gamma \in [\gamma_i, \gamma_{i+1}]$, the principal's unconditional expected payoff is

$$\overline{V}(\underline{\gamma}, \gamma_1, ..., \gamma_i, \gamma_{i+1}, ..., \overline{\gamma}) = \sum_i [G(\gamma_{i+1}) - G(\gamma_i)]V^1(m(\gamma_i, \gamma_{i+1})).$$

To prove part (i), suppose $V^{1\prime\prime}(\gamma) < 0$ for all $\gamma \in [\gamma_j, \gamma_{j+1}] \cup [\gamma_{j+1}, \gamma_{j+2}]$, but, on the contrary, $\gamma_j \neq \gamma_{j+1}$ and $\gamma_{j+1} \neq \gamma_{j+2}$. By definition,

$$\begin{aligned}\overline{V}(\underline{\gamma}, \gamma_1, ..., \gamma_i, \gamma_{i+1}, ..., \overline{\gamma}) &= \sum_{i \neq j, j+1} [G(\gamma_{i+1}) - G(\gamma_i)] V^1(m(\gamma_i, \gamma_{i+1})) \\ &\quad + [G(\gamma_{j+1}) - G(\gamma_j)] V^1(m(\gamma_j, \gamma_{j+1})) \\ &\quad + [G(\gamma_{j+2}) - G(\gamma_{j+1})] V^1(m(\gamma_{j+1}, \gamma_{j+2})).\end{aligned}$$

Notice that since $\frac{G(\gamma_{j+1})-G(\gamma_j)}{G(\gamma_{j+2})-G(\gamma_j)} + \frac{G(\gamma_{j+2})-G(\gamma_{j+1})}{G(\gamma_{j+2})-G(\gamma_j)} = 1$, and $V^{1\prime\prime}(\gamma) < 0$, Jensen's inequality implies

$$\begin{aligned}& [G(\gamma_{j+1}) - G(\gamma_j)] V^1(m(\gamma_j, \gamma_{j+1})) + [G(\gamma_{j+2}) - G(\gamma_{j+1})] V^1(m(\gamma_{j+1}, \gamma_{j+2})) \\ < \; & [G(\gamma_{j+2}) - G(\gamma_j)] V^1\left(\frac{G(\gamma_{j+1}) - G(\gamma_j)}{G(\gamma_{j+2}) - G(\gamma_j)} m(\gamma_j, \gamma_{j+1}) + \frac{G(\gamma_{j+2}) - G(\gamma_{j+1})}{G(\gamma_{j+2}) - G(\gamma_j)} m(\gamma_{j+1}, \gamma_{j+2})\right) \\ = \; & [G(\gamma_{j+2}) - G(\gamma_j)] V^1(m(\gamma_j, \gamma_{j+2})),\end{aligned}$$

which implies the principal is strictly better off by applying blind review over $[\gamma_j, \gamma_{j+2}]$, contradicting the optimality of initial policy. Hence, $\gamma_j = \gamma_{j+1}$ or $\gamma_{j+1} = \gamma_{j+2}$.

To prove part (ii), suppose, for an optimal information policy, $V^{1\prime\prime}(\gamma) > 0$ for all $\gamma \in [\gamma_j, \gamma_{j+1}] \subset [\underline{\gamma}, \overline{\gamma}]$, but, on the contrary, $\gamma_j \neq \gamma_{j+1}$. Applying Jensen's inequality, notice that

$$\begin{aligned}\overline{V}(\underline{\gamma}, \gamma_1, ..., \gamma_i, \gamma_{i+1}, ..., \overline{\gamma}) &= \sum_{i \neq j} [G(\gamma_{i+1}) - G(\gamma_i)] V^1(m(\gamma_i, \gamma_{i+1})) + [G(\gamma_{j+1}) - G(\gamma_j)] V^1(m(\gamma_j, \gamma_{j+1})) \\ &< \sum_{i \neq j} [G(\gamma_{i+1}) - G(\gamma_i)] V^1(m(\gamma_i, \gamma_{i+1})) + [G(\gamma_{j+1}) - G(\gamma_j)] \int_{\gamma_i}^{\gamma_{i+1}} V^1(\gamma) dG_j(\gamma).\end{aligned}$$

That is, the principal can strictly increase her payoff by adopting an informed policy for types $\gamma \in [\gamma_j, \gamma_{j+1}]$, which, once again, violates the optimality hypothesis. Hence, $\gamma_j = \gamma_{j+1}$. ■

Proof of Proposition 12. To avoid repetition, here we only give a formal proof of the fact that a mixed equilibrium in which evaluators adopt different review processes cannot arise, and refer the reader to the discussion in the text for the rest.

Suppose, on the contrary, that in equilibrium, some evaluators adopt blind review whereas others adopt informed review, both without application fees. We argue in this case that some evaluator i with blind review would have a strict incentive to deviate. Let

μ^i be the mean ability for agents who apply to i. If $\mu^i > \underline{\gamma}$, then, by definition, there is some agent of type $\widehat{\gamma} > \mu^i$, who strictly prefers applying to i over to an evaluator with informed review, i.e., $U(P(\widehat{\gamma}, s(\widehat{\gamma})), s(\widehat{\gamma})) < U(P(\widehat{\gamma}, s(\mu^i)), s(\mu^i))$. Since, from Lemma 1, $U(P(\gamma, s), s)$ is strictly decreasing in s, this implies $s(\widehat{\gamma}) > s(\mu^i)$, or equivalently $\widehat{\gamma} < \mu^i$, yielding a contradiction. Hence, $\mu^i = \underline{\gamma}$. This means the agent with the lowest type is the only potential applicant to evaluator i. On the other hand, if i switched to an informed review, higher types too would apply to her, and strictly increase her expected payoff, contradicting the equilibrium hypothesis. Thus, all evaluators must choose the same review process in equilibrium. ■

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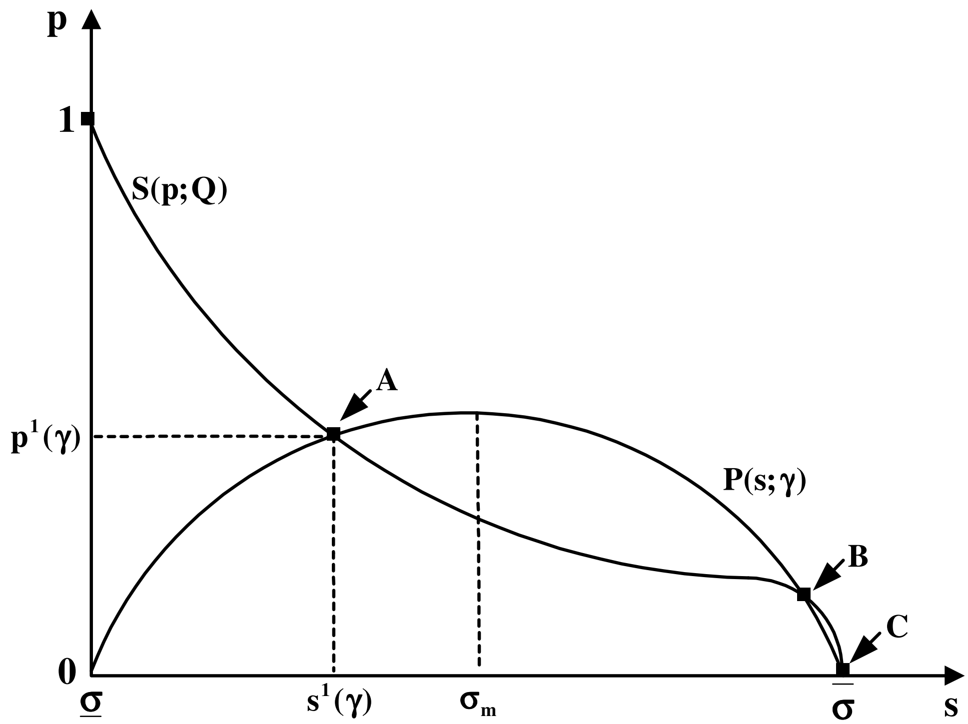

Figure 1

Reaction Functions and Equilibrium Selection

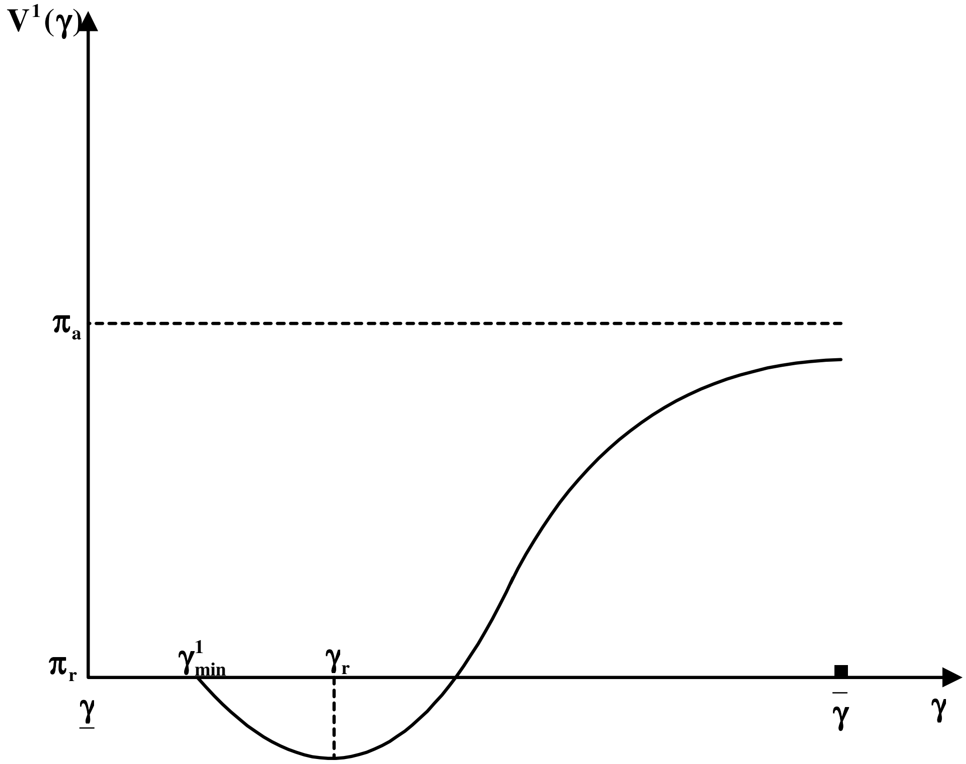

Figure 2

Principal's Informed Payoff

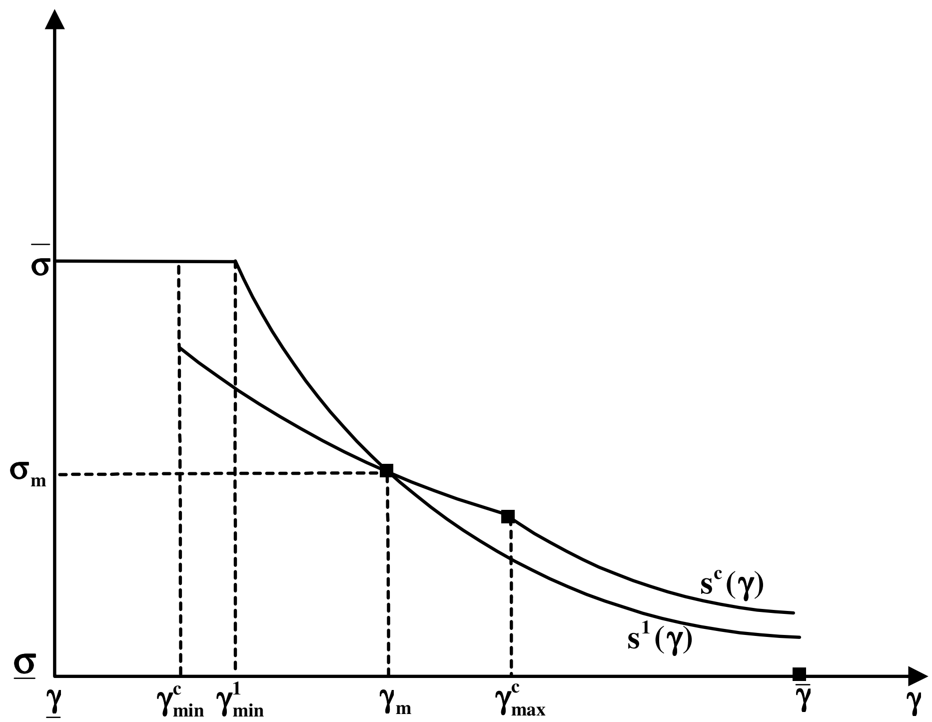

Figure 3

Standard Schedules under Informed and Commitment Equilibria