SUBJECTIVE PERFORMANCE AND THE VALUE OF BLIND EVALUATION

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MOTIVATION

Subjective evaluation is used to determine resource allocation in many settings:

- Culture: wine, food, art, poetry, music.
- Academia: exams, grant proposals, manuscripts.
- Justice: propensity evidence.
- Consumer products: hi-fi stereo, shampoo.

THE QUESTION

Should the reviewer be *blind* or *informed* about the agent's ability?

- Blind review is often good for incentives but bad for project selection.
- Informed review is good for project selection but bad for incentives.

LITERATURE

Empirical and Experimental: Blank (1991, AER); Goldin and Rouse (2000, AER), Snodgrass (2006, SIGMOD), Peters and Ceci (1982, BBS).

Subjective performance: Levin (2003, AER), MacLeod (2003, AER), Prendergast (1999, JEL).

Information and Incentives: Cremer (1995, QJE), Riordan (1990, book chapter), Sappington (1986, IEP)

Fairness and Incentives: Coate and Loury (1993, AER), Norman (2003, RES), Persico (2002, AER).

Initial Stages

t=0: Nature selects agent's type $\theta \in [\underline{\theta}, \overline{\theta}]$:

- $\theta \sim G(\theta)$,
- $E[\theta] \equiv \mu < \infty$.

t=1: Principal announces review policy:

- *informed review* $\longrightarrow$ θ observable,
- *blind review* $\longrightarrow$ θ not observable.

Intermediate Stages

t=2: Agent observes θ and exerts effort $p \in [0, 1]$:

- project is high-quality $(q = h)$ with probability p,
- project is low-quality $(q = l)$ with probability $1 - p$,
- effort cost is $C(p, \theta) \equiv \frac{p^2}{2\theta}$.

t=3: Agent submits project to principal for evaluation.

Final Stages

t=4: Principal does not observe p or q but receives non-verifiable signal $\sigma \in [\underline{\sigma}, \overline{\sigma}]$:

- $\sigma \sim F_q(\cdot)$,
- $R(\sigma) \equiv \frac{f_h(\sigma)}{f_l(\sigma)}$.

t=5: Principal decides whether to accept or reject the project.

PAYOFFS

Agent:

$$U = \begin{cases} u - C(p,\theta), & \text{if principal accepts} \\ -C(p,\theta), & \text{if principal rejects.} \end{cases}$$

Principal:

	$q = h$	$q = l$
accept	v	$-\ell$
reject	0	0

Assumption 1: Signal Technology

The Likelihood ratio satisfies:

(i) $R'(\sigma) > 0$,

(ii) $R(\underline{\sigma}) = 0$ and $R(\overline{\sigma}) = \infty$,

(iii) $\lim_{\sigma \to \overline{\sigma}} R(\sigma)(1 - F_q(\sigma)) = \lambda_q$ exists for $q \in \{l, h\}$ and $\lambda_h > 0$.

Example: Triangular Densities

- $\sigma \in [0, 1]$,
- $f_h(\sigma) = 2\sigma$,
- $f_l(\sigma) = 2(1 - \sigma)$,
- $R(\sigma) = \frac{\sigma}{1-\sigma}$,
- $\lambda_h = 2$ and $\lambda_l = 0$.

Agent's Problem

Suppose *w.l.o.g.* the Principal sets a standard s.

Then the Agent chooses p to max

$$U(p, s; \theta) = u[p(1 - F^h(s)) + (1 - p)(1 - F^l(s))] - \frac{p^2}{2\theta}. \qquad (1)$$

Agent's Reaction Function

$$P(s, \theta) = \min\{\theta u(F_l(s) - F_h(s)),\ 1\}. \qquad (2)$$

This is hump-shaped and maximized at $s^* \equiv R^{-1}(1)$:

- $P(\underline{\sigma}, \theta) = 0$,
- $P_s(s, \theta) \geq 0$ for $s < s^*$,
- $P_s(s, \theta) \leq 0$ for $s > s^*$,
- $P(\overline{\sigma}, \theta) = 0$.

Example: The Agent

Suppose: triangular densities, $u = 1$, and $\theta \in \left[\frac{1}{2}, \frac{3}{2}\right]$. The agent chooses p to max

$$U(p, s; \theta) = p(1 - S^2) + (1 - p)(1 - 2s + s^2) - \frac{p^2}{2\theta}.$$

The agent's reaction function is

$$P(s, \theta) = 2\theta s(1 - s).$$

$P(s, \theta)$ is maxed at $s^* = \frac{1}{2}$.

The Commitment Benchmark

If σ was verifiable and the principal had full power of commitment, then for each $\theta \in [\underline{\theta}, \overline{\theta}]$ she would choose s to max

$$V(s,p) = vp(1 - F_h(s)) - \ell(1-p)(1 - F_l(s)) \tag{3}$$

subject to $p = P(s,\theta)$. Substituting the constraint into the objective yields the *f.o.c.*

$$\underbrace{V_s(s, P(s,\theta))}_{\text{Selection Effect}} + \underbrace{V_p(s, P(s,\theta))P_s(s,\theta)}_{\text{Incentive Effect}} = 0. \tag{5}$$

- Denote the solution to (5) by $s_0^C(\theta)$.
- Define the critical type, θ^* by $s_0^C(\theta^*) = s^*$.

Proposition 1: Equilibrium under Commitment

Principal: Under commitment, the principal sets the standard

$$s^C(\theta) \equiv \begin{cases} \overline{\sigma}, & \text{if } \theta < \theta_-^C \\ s_0^C(\theta), & \text{if } \theta \in [\theta_-^C, \theta_+^C] \\ \min\{s \mid P(s,\theta) = 1\}, & \text{if } \theta > \theta_+^C \end{cases}$$

Moreover, $s^C(\theta)$ is continuous, strictly decreasing for $\theta > \theta_-^C$, and $\lim_{\theta\to\infty} s^C(\theta) = \underline{\sigma}$.

Agent: Under commitment, the agent chooses effort level

$$p^C(\theta) \equiv \begin{cases} 0, & \text{if } \theta < \theta_-^C \\ P(s_0^C(\theta), \theta), & \text{if } \theta \in [\theta_-^C, \theta_+^C] \\ 1, & \text{if } \theta > \theta_+^C. \end{cases}$$

Moreover, $p^C(\theta)$ is continuous, and strictly increasing for $\theta \in (\theta_-^C, \theta_+^C)$.

Example: Commitment

Suppose: the triangular densities, $u = v = \ell = 1$, and $\theta \in \left[\frac{1}{2}, \frac{3}{2}\right]$. The prinsipal chooses s to max

$$V(s,p) = p(1-s^2) - (1-p)(1-2s+s^2)$$

subject to

$$p = 2\theta s(1-s).$$

The solution is

$$s^C(\theta) = \frac{1}{3} + \frac{1}{6\theta}.$$

$\theta = 1/2$: $s^C = 2/3 \quad p^C = 2/9$

$\theta^* = 1$: $s^C = 1/2 = s^* \quad p^C = 1/2$

$\theta = 3/2$: $s^C = 4/9 \quad p^C = 20/27.$

Informed Review

If the principal cannot commit, then s and p will be determined in a Nash equilibrium. The principal chooses s to max $V(s,p)$ for a given p; the *f.o.c.* is

$$V_s(s,p) = -[vpR(s) - \ell(1-p)]f_l(s) = 0. \tag{8}$$

Solving for s yields the principal's reaction function

$$S(p) = R^{-1}\left(\frac{(1-p)\ell}{pv}\right). \tag{9}$$

This is decreasing:

- $S(0) = \overline{\sigma}$,
- $S'(p) = -\frac{\ell/v}{p^2R'(s)} < 0$,
- $S(1) = \underline{\sigma}$.

Equilibrium Selection

Solving the agent and principal's reaction functions (2) and (9) results in the equilibrium, $(s^I(\theta), p^I(\theta))$.

A degenerate equilibrium in which $s^I(\theta) = \overline{\sigma}$ and $p^I(\theta) = 0$ always exists. For $\theta > \theta_-^I$, non-degenerate equilibria also exist.

When multiple equilibria exist, the one with the highest effort and lowest standard is Pareto superior and is assumed to obtain.

Substituting for p from (2) into (8) gives

$$V_s(s, P(s,\theta)) = -[vP(s,\theta)R(s) - \ell(1 - P(s,\theta))]f_l(s) = 0. \qquad (10)$$

Define $s_0^I(\theta)$ to be the smallest root to (10).

Proposition 2: Equilibrium under Informed Review

Principal: Under informed review, the principal sets the standard

$$s^I(\theta) \equiv \begin{cases} \overline{\sigma}, & \text{if } \theta < \theta^I_- \\ s^I_0(\theta), & \text{if } \theta \geq \theta^I_-. \end{cases}$$

Moreover, $s^I(\theta)$ is strictly decreasing for $\theta > \theta^I_-$, and $\lim_{\theta \to \infty} s^I(\theta) = \underline{\sigma}$.

Agent: Under informed review, the agent chooses effort level

$$p^I(\theta) \equiv \begin{cases} 0, & \text{if } \theta < \theta^I_- \\ P(s^I_0(\theta), \theta), & \text{if } \theta \geq \theta^I_-. \end{cases}$$

Moreover, $p^I(\theta)$ is strictly increasing for $\theta > \theta^I_-$, and $\lim_{\theta \to \infty} p^I(\theta) = 1$.

Proposition 3: Commitment vs. Informed Review

The equilibrium profile of standards is 'flatter' under commitment than under informed review and effort is higher.

$$s^C(\theta) \begin{cases} < s^I(\theta), & \text{if } \theta < \theta^* \\ = s^I(\theta), & \text{if } \theta = \theta^* \\ > s^I(\theta), & \text{if } \theta > \theta^*, \end{cases}$$

and $p^C(\theta) \geq p^I(\theta)$ with strict inequality if $\theta \neq \theta^*$.

Example: Informed Review

Suppose: the triangular densities, $u = v = \ell = 1$, and $\theta \in \left[\frac{1}{2}, \frac{3}{2}\right]$, . From (9) the principal's reaction function is

$$S(p) = 1 - p.$$

Solving this with the agent's reaction function (2)

$$P(s, \theta) = 2\theta s(1 - s)$$

yields the equilibrium standard,

$$s^I(\theta) = \frac{1}{2\theta}.$$

$$\begin{aligned} \theta = 1/2&: \ s^I = 1 > 2/3 = s^C \quad p^I = 0 < 2/9 = p^C \\ \theta = 1&: \ s^I = 1/2 = s^C \quad p^I = 1/2 = p^C \\ \theta = 3/2&: \ s^I = 1/3 < 4/9 = s^C \quad p^I = 2/3 < 20/27 = p^C. \end{aligned}$$

Blind Review

Because the principal does not observe θ, the equilibrium standard is a best response to the agent's expected effort:

$$s^B = R^{-1}\left(\frac{(1 - E[p^B(\theta)])\ell}{E[p^B(\theta)]v}\right). \tag{12}$$

Similarly, in equilibrium the agent's effort is a best response to the standard,

$$p^B(\theta) = \theta u(F_l(s^B) - F_h(s^B)). \tag{13}$$

Taking the expectation of (13) over θ gives

$$E[p^B(\theta)] = \mu u(F_l(s^B) - F_h(s^B)). \tag{14}$$

These three equations define the equilibrium standard and effort under blind review.

Proposition 4: Equilibrium under Blind Review

Principal: Under blind review, the principal sets the standard equal to the one she would have set for the mean type of agent under informed review, $s^B = s^I(\mu)$.

Agent: Under blind review, the agent chooses effort level $p^B(\theta) = P(s^I(\mu), \theta)$.

Proposition 5: Comparing Outcomes

(i) Agents with less than average ability face a lower standard under blind review than under informed review and agents with greater than average ability face a higher standard:

$$s^B \begin{cases} < s^I(\theta), & \text{if } \theta < \mu \text{ and } \mu > \theta^I_- \\ > s^I(\theta), & \text{if } \theta > \mu. \end{cases}$$

(ii) Expected effort is higher under blind review than under informed review if the mean type is sufficiently close to the critical type; i.e., there exists $\epsilon > 0$ such that

$$|\mu - \theta^*| < \epsilon \;\Rightarrow\; E[p^B(\theta)] > E[p^I(\theta)].$$

Discussion

- Agents with $\theta > \mu$ prefer informed review.
- Agents with $\theta < \mu$ prefer blind review.
- If $\mu \neq \theta^*$, then there is a band of types around θ^* for whom $p^I(\theta) > p^B(\theta)$.
- By pooling types, blind review makes it credible to raise standards for $\theta > \mu$ and lower standards for $\theta < \mu$.
- Diversity in the applicant pool is, therefore, valuable.

The Principal's Equilibrium Payoffs

The principal's equilibrium payoff under informed review is $V^I(\theta) \equiv V(s^I(\theta), p^I(\theta))$. The principal's expected equilibrium payoff under blind review is $V^I(\mu)$. Hence, when deciding between informed and blind review she compares $E[V^I(\theta)]$ with $V^I(\mu)$. $V^I(\theta)$ is convex for $\theta < \theta_L$ and concave for $\theta > \theta_H$.

Proposition 6: Blind vs. Informed Review

Suppose $\underline{\theta} < \theta_L \leq \theta_H < \overline{\theta}$. Then, the principal prefers blind [resp. informed] review if

(i) the ability distribution is sufficiently skewed toward high [resp. low] types, and/or

(ii) the payoff from acceptance for the agent, u, is sufficiently large [resp. small].

Example: The Tradeoffs

Suppose: the triangular densities, $u = v = \ell = 1$, and $\Pr\{\theta = 1/2\} = \Pr\{\theta = 3/2\} = 1/2$. Then $\mu = 1 = \theta^*$.

	INFORMED	BLIND
STANDARD: $\theta = 1/2$	1	$1/2$
STANDARD: $\theta = 3/2$	$1/3$	$1/2$
EFFORT: $\theta = 1/2$	0	$1/4$
EFFORT: $\theta = 3/2$	$2/3$	$3/4$
$\Pr\{\text{ACCEPT} \mid q = 0\}$	$1/9$	$1/4$
$\Pr\{\text{REJECT} \mid q = 1\}$	$1/9$	$1/4$

1 Graph = 1000 Words

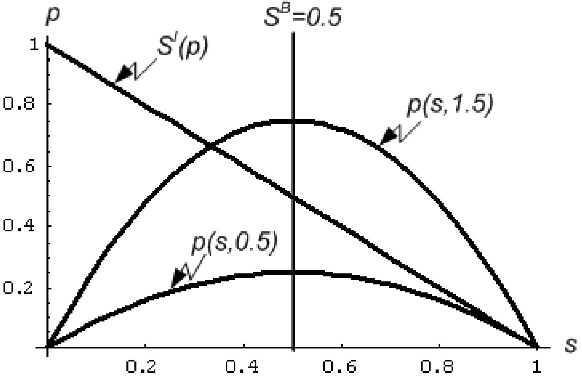

Figure: Solutions for Informed and Blind Review

Example: the Optimal Review Policy

Suppose: the triangular densities, $u = v = \ell = 1$, and $\Pr\{\theta = 1/2\} = \Pr\{\theta = 3/2\} = 1/2$.

- $V^I(\theta) = \left(1 - \frac{1}{2\theta}\right)^2$.
- S-shaped with an inflection point at $\theta_H = \theta_L = \frac{3}{4}$.
- $E[V^I(\theta)] = \frac{2}{9} < \frac{1}{4} = V^I(\mu)$.

Proposition 8: Equilibrium with Competing Evaluators

- Consider 2 *ex ante* identical evaluators, and let $\frac{\phi}{2}$ be the fraction of applicants *attached* to each.
- Suppose $\frac{1}{2}V^I(\mu) < E[V^I(\theta)] < V^I(\mu)$.
- Then, there exist two cutpoints, $0 < \phi^* \leq \phi^{**} < 1$, such that for $\phi < \phi^*$, the unique equilibrium has $\tau_1 = \tau_2 = I$, whereas for $\phi > \phi^{**}$, the unique equilibrium has $\tau_1 = \tau_2 = B$.
- For $\phi \in [\phi^*, \phi^{**}]$, both symmetric and asymmetric review policies may occur in equilibrium.

FUTURE RESEARCH

- Endogenous u.
- Heterogeneous Reviewers.
- Dynamic Evaluation and Career Concerns.