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The Optimal Strictness of Up-or-Out Contracts

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February 11, 2026

1 Introduction

Up-or-out contracts are a central organisational mechanism for motivating performance and allocating long-term positions in environments characterised by uncertainty about individual ability and production outcomes. Famous examples include tenure-track systems in academia and partnership tournaments in professional service firms. Under such arrangements, employees are hired on a probationary basis and are either promoted permanently upon satisfying a specified performance standard or separated from the organisation.

Despite their prevalence, up-or-out systems display considerable heterogeneity across institutions and jurisdictions. In academia, for example, tenure systems vary in multiple dimensions such as probation length, promotion thresholds, evaluation criteria, and the degree of contractual flexibility. While the U.S. tenure-track system is relatively standardised, European and Chinese institutions exhibit greater diversity in both formal rules and informal practices (Schiewer et al., 2014; Huang et al., 2025). Recent evidence from Chinese university reforms suggests that the tenure system can substantially improve research output and risk-taking behaviour among early-career academics, while variations in tenure contracts exist across institutions (Huang et al., 2025). Such variation suggests that the design of up-or-out contracts is not merely copying from top institutions, but involves meaningful trade-offs along multiple dimensions.

This observation raises a fundamental question: what determines the optimal strictness of an up-or-out contract? Existing theoretical work has primarily focused on explaining why up-or-out contracts emerge as an organisational solution, emphasising their role in mitigating "grab and leave" problems, providing effort incentives, and facilitating sorting under asymmetric information (Rebitzer and Taylor, 2007; Ghosh and Waldman, 2010). However, the strictness of these contracts—such as how demanding promotion thresholds should be or how long probation should last—is typically treated as exogenous. In organisations, designing contracts often involves strategic tradeoffs. Stricter rules may sharpen incentives and accelerate selection, but might recruit limited talents. More lenient rules may forgive short-term failure, yet weaken incentives.

This thesis develops a dynamic model of organisational learning and incentive provision to study the optimal design of up-or-out contracts. The organisation faces uncertainty about an agent's latent ability and learns through noisy performance outcomes observed during a probationary period. Promotion decisions are based on posterior beliefs formed via Bayesian updating, while agents can influence the informativeness of these beliefs through their choice of projects. This modelling approach builds on classic analyses of career concerns and reputational incentives, which show that early-career agents may distort risk-taking in response to evaluation criteria (Holmström, 1999; Hermalin, 1993).

The analysis proceeds in steps. As a baseline, the thesis adopts the canonical normal-normal learning mode, a setting in which the organisation commits to a fixed tenure threshold and learns about ability through normally distributed performance signals. In this environment, extending the evaluation horizon improves the precision of posterior beliefs and strengthens selection, holding agent behaviour fixed. Once project choice is endogenised, however, the tenure threshold directly affects the optimal project for the agent. Low thresholds induce agents to select less informative projects that preserve favourable priors, consistent with reputation-preserving behaviour highlighted by Hermalin (1993), whereas high thresholds encourage information-revealing behaviour by increasing the value of distinguishing oneself through performance. As a result, the organisation's screening problem becomes inherently endogenous: promotion rules shape not only posterior selection, but also change the distribution of posterior estimators.

This interaction between learning and incentives generates a non-trivial trade-off in the design of up-or-out contracts. Thresholds that are optimal under exogenous information may become suboptimal once agents respond strategically, while stricter standards may improve learning at the cost of deviating from first-best screening rules. By endogenising these informational responses, the thesis moves beyond the question of whether up-or-out contracts should be used, and instead characterises how they should be designed. In doing so, it provides a theoretical framework for rationalising the observed diversity of tenure and promotion systems across institutions and for evaluating reforms that alter the rigidity, duration, or transparency of probation-based promotion rules.

2 Expected Contribution

This thesis contributes to the literature on career concerns and information design by studying optimal project choice and information generation under an up-or-out promotion regime. The current analysis is conducted within a canonical normal–normal learning framework and delivers new insights into how tenure thresholds shape the signal sender's optimal informativeness.

This study contributes to the career concerns literature by characterising how the strictness of an up-or-out tenure threshold shapes agents' incentives to generate information about their ability. Within a canonical normal–normal learning framework, I show that the optimal informativeness of agents' project choices varies systematically with the position of the tenure threshold relative to the agent's prior mean ability: stricter tenure thresholds motivate more informative project choices, while lower thresholds create a strong aversion for sending a bad signal. Beyond classical career concern literature (Holmström, 1999; Hermalin, 1993), this result identifies the possibility of an informative equilibrium where the agent optimally selects the most informative project and the organisation benefits from setting the threshold slightly higher than the prior mean.

Once the effort and more dimensions of the contract are considered as endogenous, this study will contribute to the implicit incentive literature and is expected to explain the variation of tenure contract design mentioned in Huang et al. (2025).

The current analysis focuses on a parametric and tractable information structure. While such a framework allows for a clean characterization of incentives and equilibrium behavior, its normal distribution assumptions might limit the scope of the insights. A natural extension of the normal-normal benchmark will adopt tools from Bayesian persuasion literature to study the optimal signal under more general information structures.

3 Modelling

An organisation employs a risk-neutral agent whose latent ability is denoted by η_i. Ability is fixed over time and initially unknown to both parties. At the beginning of the relationship, η_i is drawn from a common prior distribution $\eta_i \sim \mathcal{N}(B, h_\eta^{-1})$,i.e. $\eta_i = B + \varepsilon_\eta$, $\varepsilon_\eta \sim \mathcal{N}(0, h_\eta^{-1})$ where B is the prior mean and h_η is the prior precision (inverse of the variance). The realization of η_i is never directly observed.

Time is discrete and indexed by $t = 1, 2, \ldots$. The agent is initially hired on a probationary basis. During probation, the organisation observes the agent's performance and updates its beliefs about ability. The length of the probationary period may be chosen by the organisation and is endogenised later. At the end of probation, the organisation grants tenure based on a threshold rule. If tenure is granted, the agent remains with the organisation permanently and receives a constant utility. Tenured agent generates utility equal to her ability for the organisation. If tenure is denied, the relationship terminates, and the organisation receives zero utility.

In each period t of probation, the agent chooses a project p_t from a feasible set of projects. A project is characterised by a pair (μ_p, h_p), where μ_p is a project-specific constant that shifts expected output and h_p is the precision of output, equal to the inverse of its variance. Projects differ in riskiness, with lower precision corresponding to higher risk. Both the agent and the organisation observe (μ_p, h_p) for all available projects.

Conditional on project choice p_t, output is given by

$$x_p = \mu_p + \eta_i + \varepsilon_p = \mu_p + B + \varepsilon_\eta + \varepsilon_p,$$

where $\varepsilon_t \sim \mathcal{N}(0, h_{p_t}^{-1})$. The noise terms ε_t are independent across periods and agents. Output realisations are publicly observed by both the agent and the organisation.

After observing x_t and knowing the chosen project p_t, the organisation obtains a signal about ability with noise equal to $x_t - \mu_{p(t)} - B = \varepsilon_\eta + \varepsilon_{p(t)}$. Given the normal prior and normal noise, posterior beliefs about η_i remain Gaussian. Let $\mathbb{E}_t[\eta_i]$ denote the posterior mean of ability after observing outcomes up to period t. Posterior precision increases with the number of observations and with the precision of the projects chosen during probation.

At the beginning of the relationship, the organisation commits to a tenure threshold η^*. This threshold is fixed over time and cannot be revised. At the moment the probationary period ends, the organisation grants tenure if and only if the posterior mean of ability satisfies $\mathbb{E}_t[\eta_i] \geq \eta^*$. If tenure is granted, the organisation receives the discounted value of future output generated by the agent. For expositional simplicity, this continuation payoff is assumed to be linear in true ability η_i. The organisation evaluates outcomes using expected payoffs and is risk-neutral.

This setup captures a probation-and-tenure environment in which the organisation learns about agent ability through noisy performance outcomes, while the agent influences the informativeness of those outcomes through project choice. Fixing the tenure threshold isolates the role of learning and project risk in shaping selection and provides a baseline for subsequent analysis in which the length of probation and strategic behavior are endogenised.

The organisation's expected payoff from granting tenure depends on the posterior assessment of the agent's ability at the end of probation. Let the organisation's objective be

$$U(t) = \mathbb{E}_0[\, \mathbb{E}_t[\eta_i] \mid \mathbb{E}_t[\eta_i] \geq \eta^* \,] \Pr(\mathbb{E}_t[\eta_i] \geq \eta^*) \,,$$

where $\mathbb{E}_t[\eta_i]$ denotes the posterior mean of ability after observing t outcomes. Since the continuation payoff from tenure is linear in true ability, $U(t)$ is strictly increasing in the posterior mean $\mathbb{E}_t[\eta_i]$ for any fixed acceptance rule. Intuitively, holding the threshold η^* fixed, a higher posterior assessment of ability both raises the likelihood of tenure and increases the expected value conditional on tenure being granted.

Belief updating follows standard normal–normal learning. Conditional on the sequence of projects chosen and the corresponding outcomes, the posterior distribution of η_i after t observations is Gaussian. By DeGroot's Theorem 1, the posterior mean can be written as a precision-weighted average of the prior mean and the observed signals,

$$\hat{\eta}_{i,t} := \mathbb{E}_t[\eta_i] = \frac{h_\eta B + \sum_{s=1}^{t} h_{p(s)} \Big(x_{i,s} - \mu_{p(s)} \Big)}{h_\eta + \sum_{s=1}^{t} h_{p(s)}},$$

and the posterior variance is

$$\mathrm{Var}_t(\eta_i) = \frac{1}{h_\eta + \sum_{s=1}^{t} h_{p(s)}}.$$

Both expressions highlight that additional observations enter symmetrically through their contribution to total precision. As t increases, the posterior mean places relatively more weight on realised outcomes and less weight on the prior, while posterior uncertainty shrinks at rate $(h_\eta + th_\varepsilon)^{-1}$.

The informational content of a longer probationary period can be seen directly from the law of total variance. For any t,

$$\mathrm{Var}(\eta_i) = \mathrm{Var}(\hat{\eta}_{i.t}) + \mathbb{E}[\mathrm{Var}_t(\eta_i)] \,.$$

Since $\mathrm{Var}_t(\eta_i)$ decreases monotonically in t, the variance of the posterior mean $\mathrm{Var}(\mathbb{E}_t[\eta_i])$ must increase correspondingly. Thus, a longer probationary period produces a more precise estimate of ability: posterior beliefs place greater weight on the realised performance signals and less weight on residual noise. This improvement in precision sharpens the organisation's ability to distinguish high-ability agents from low-ability agents at the fixed threshold η^*, thereby increasing the expected posterior assessment of those agents who meet the tenure criterion. As a result, extending the length of probation weakly increases the organisation's expected payoff from its tenure decision.

3.1 Agent's choice on projects

Consider the agent's project choice during probation, taking as given the tenure threshold η^* and the firm's belief-updating rule. In the oversimplified one-period game, the firm grants tenure immediately after the first project outcome is revealed if and only if the posterior mean of ability $\hat{\eta}_{p(i)} := \hat{\eta}_{i,1}$ exceeds η^*. The agent's continuation payoff is a fixed prize $W > 0$ upon tenure and zero otherwise, while, in the simplest setting, per-period effort costs are exogenous and constant. The agent therefore chooses a project p to maximise the probability of meeting the tenure threshold,

$$\max_{p \in \mathcal{P}} \; U_A(p) \equiv \Pr(\hat{\eta}_p \geq \eta^*).$$

Under normal learning and by adopting Hermalin's (1993) result, the posterior estimator after observing performance on project p is given by

$$\hat{\eta}_p = \delta_p x + (1 - \delta_p) B, \qquad \delta_p = \frac{h_p}{h_\eta + h_p},$$

where $x = B + \varepsilon_\eta + \varepsilon_p$. Since $\hat{\eta}_p$ is a weighted average of a sum of two normally distributed noises and a constant, it is normally distributed with mean $\mathbb{E}[\hat{\eta}_p] = B$ and variance

$$\mathrm{Var}(\hat{\eta}_p) = \delta_p^2 \left(\frac{1}{h_\eta} + \frac{1}{h_p} \right) = \frac{h_p}{h_\eta (h_p + h_\eta)}.$$

Project choice thus affects only the dispersion of posterior beliefs through the precision parameter h_p.

The probability of obtaining tenure can be written as

$$\Pr(\hat{\eta}_p \geq \eta^*) = 1 - \Phi\left(\frac{\eta^* - B}{\sqrt{\mathrm{Var}(\hat{\eta}_p)}}\right),$$

where $\Phi(\cdot)$ denotes the standard normal distribution function. A direct implication of this expression, which is consistent with Hermalin (1993), is that when the tenure threshold lies below the prior mean, $\eta^* < B$, the agent is ex ante favoured and optimally selects the least informative project to maintain the prior mean, i.e, the project with the lowest precision h_p. In this case, the posterior estimator of ability is less dispersed around the prior mean, and the agent therefore minimises the risk of failure due to a bad project outcome.

By contrast, when the tenure threshold exceeds the prior mean, $\eta^* > B$, the agent starts with a less favourable position and will not benefit from maintaining the principal's belief at the prior mean. In this case, the probability of tenure is increasing in $\mathrm{Var}(\hat{\eta}_p)$ and hence in project precision h_p. The agent then optimally chooses the most informative projects, as greater dispersion in posterior beliefs increases the right-tail probability of crossing the threshold. Intuitively, a high standard induces the agent to distinguish herself through performance, whereas a low standard induces information-hiding behaviour. This contrast highlights how promotion standards fundamentally shape the informativeness of agents' project choices.

A problem occurs when the tenure threshold is exactly identical to the prior mean $\eta^* - B = 0$. If the agent is allowed to send an extremely noisy signal, she could maintain the prior mean as the only support in the posterior distribution. By doing so, $\Pr(\hat{\eta}_p \geq \eta^*) = \Pr(\hat{\eta}_p = \eta^*) = 1$, the agent could guarantee the tenure position, whereas all other projects with strictly positive precision only give a $\frac{1}{2}$ probability.

Accordingly, the agent's optimal project choice depends on the promotion requirement: higher tenure standards induce the selection of more informative projects, whereas lower standards induce information-hiding behaviour. This result follows directly from the agent's objective and the properties of Bayesian updating, and provides the foundation for the principal's trade-off analysed in the subsequent sections.

Lemma 3.1 (Agent's best–response correspondence)**.** *The agent chooses a project p from a finite set $\{(\mu_1, h_1), \ldots, (\mu_n, h_n)\}$, where $h_p \in [\underline{h}, \overline{h}]$ denotes project precision and μ_p is publicly known. Given a tenure policy that grants tenure if and only if the posterior estimator $\hat{\eta}_p = \mathbb{E}[\eta \mid x_p]$ exceeds a threshold η^*, the agent's best–response correspondence $h_p^*(\eta^*)$ satisfies:*

1. *If $\eta^* < B$, then $h_p^*(\eta^*) = \underline{h}$.*

2. *If $\eta^* > B$, then $h_p^*(\eta^*) = \overline{h}$.*

3. If $\eta^* = B$, then:

(a) for all $h_p > 0$, $\Pr(\hat{\eta}_p \geq B) = \frac{1}{2}$; hence if $\underline{h} > 0$ the agent is indifferent over $h_p \in [\underline{h}, \overline{h}]$ absent other payoffs;

(b) if $\underline{h} = 0$ and tenure is granted under the weak inequality $\hat{\eta}_p \geq B$, then $h_p = 0$ implies $\hat{\eta}_p \equiv B$ almost surely and $\Pr(b_0 \geq B) = 1$, so $h_p^*(B) = 0$ uniquely.

Moreover, for all $h_p > 0$, $\Pr(\hat{\eta}_p \geq \eta^*)$ is monotone in h_p with sign $\operatorname{sign}(\eta^* - B)$.

This best response correspondence could be generalised to the stage decision rule in multi-stage games following DeGroot's Theorem 1 (1970, p. 167). The formation of the posterior estimator puts a (weakly) lower weight on the prior mean if the organisation could observe one extra project outcome. Thus, even if the agent keeps sending extremely noisy signals, the posterior estimator will not move to the disadvantage position unless there is a negative signal. It could explain that by the end of the probationary period, agents prefer safer projects that does not change the estimated ability much if they have obtained good enough records.

With the agent's best response correspondence, we could look at the principal side. The principal commits to a tenure threshold η^*, and values retained agents according to their estimated ability.

$$U_p(\eta^*) = \mathbb{E}_0[E_t\eta \mid E_t\eta \geq \eta^*] \Pr(E_t\eta \geq \eta^*) = \mathbb{E}_0[E_t\eta \, \mathbf{1}\{E_t\eta \geq \eta^*\}],$$

For a fixed project precision h_p, the posterior mean satisfies $\hat{\eta}_p \sim \mathcal{N}(B, \sigma_b^2(h_p))$, and the principal's payoff can be written as

$$U_p(h_p, \eta^*) = B\Big(1 - \Phi(z)\Big) + \sigma_b(h_p)\phi(z), \qquad z = \frac{\eta^* - B}{\sigma_b(h_p)}, \qquad \sigma_b(h_p) = \sqrt{\frac{h_p}{h_\eta(h_p + h_\eta)}}$$

and it has the first derivative with respect to η^*

$$\frac{\partial U}{\partial \eta^*} = -\frac{\eta^*}{\sigma_b(h_p)}\phi(z)$$

with $\Phi(\cdot)$ and $\phi(\cdot)$ denoting the cdf and pdf of the standard normal distribution. Holding h_p fixed, this objective is single-peaked in η^* and is maximised at $\eta^* = 0$. Since there is no explicit cost function or the cost of granting tenure is low enough that any agents with positive ability bring benefit to the firm, without a quota, the firm will grant tenure to as many agents with positive estimated ability as possible.

This truncated normal utility function increases with the precision of the project conducted, following the first derivative with respect to the precision.

$$\begin{aligned}
\frac{\partial \sigma_b(h_p)}{\partial h_p} &= \frac{1}{2}\frac{\sqrt{h_\eta}}{\sqrt{h_p}(h_\eta + h_p)^{3/2}} > 0 \\
\frac{\partial U}{\partial h_p} &= \frac{\partial U}{\partial \sigma_b}\frac{\partial \sigma_b}{\partial h_p} \\
&= [\frac{\eta^* - B}{\sigma_b^2}(B\phi(z) - \sigma_b \phi'(z)) + \phi(z)]\frac{\partial \sigma_b}{\partial h_p} \\
&= \underbrace{[\frac{\eta^* - B}{\sigma_b^2}(B\phi(z) + \sigma_b z\phi(z)) + \phi(z)]}_{>0 \text{ if } \eta^* \geq B}\underbrace{\frac{\partial \sigma_b}{\partial h_p}}_{>0}
\end{aligned}$$

evaluate the partial derivative at $\eta^* = B$ and $\eta^* = 0$ respectively:

$$\begin{aligned}
\frac{\partial U(\eta^* = B)}{\partial h_p} &= \underbrace{[\frac{\eta^* - B}{\sigma_b^2}(B\phi(z) + \sigma_b z\phi(z)) + \phi(z)]}_{>0 \text{ if } \eta^* \geq B \geq 0}\underbrace{\frac{\partial \sigma_b}{\partial h_p}}_{>0} > 0 \\
\frac{\partial U(\eta^* = 0)}{\partial h_p} &= \phi(z)\underbrace{\frac{\partial \sigma_b}{\partial h_p}}_{>0} > 0
\end{aligned}$$

The organisation benefits from a high-precision project because it can better distinguish between low-ability agents. Thus, the agent's endogenous project choice makes the principal's problem binary. By the best response correspondence, thresholds below the prior mean $\eta^* < B$ induce the least informative projects, while thresholds above the prior mean $\eta^* > B$ motivate the most informative projects. As a result, the principal faces a discrete trade-off between a low-standard regime with uninformative behaviour $\eta^* = 0$ and a high-standard regime that induces informative behaviour but might forces the threshold $\eta^* = B \quad$ (if $B > 0$) away from its screening-optimal level.

In the $B > 0$ case, we have two optimal candidates $\eta^* = 0$ or $\eta^* = B$. At the knife-edge threshold $\eta^* = B$, the agent is indifferent over all strictly positive project precisions. Under favourable tie-breaking, this allows the outcome in which the principal sets $\eta^* = B$ and the agent chooses the most informative project. And the final optimal threshold would depend on the feasible projects, which determine the extent of informative benefit.

We could formalise the existence condition for the informative equilibrium, in which the organiastion sets threshold $\eta^* = B$ and the agent selects the most informative project $h_p = \bar{h}$, by comparing the binary payoffs. Since setting $\eta^* = B$ would only be an optimal candidate for the organisation when $B \geq 0$, we assume $B \geq 0$ when in the existence discussion. We denote the organisation's payoff under the two relevant equilibrium candidates as follows:

(i) *Screening (uninformative) outcome.* When the organisation sets the tenure threshold $\eta^* = 0$, the agent strictly prefers the least informative project with precision $\underline{h} = s - x$. The principal's payoff is

$$U_p^\ell(x, s; B, h_\eta) \;=\; B\,\Phi\!\left(\frac{B}{\sigma_b(s-x)}\right) \;+\; \sigma_b(s-x)\,\phi\!\left(\frac{B}{\sigma_b(s-x)}\right).$$

(ii) *Informative (knife-edge) outcome.* When the organisation sets $\eta^* = B$, the agent is indifferent over project precision and, under favourable tie-breaking, chooses the most informative project $\bar{h} = s + x$. The principal's payoff is

$$U_p^h(x, s; B, h_\eta) \;=\; \frac{B}{2} \;+\; \sigma(s+x)\,\phi(0).$$

Let $F(x, s) \geq 0$ be the condition in which the organisation prefers the informative outcome, where $F(x, s)$ measures the utility difference between setting $\eta^* = B$ and $\eta^* = 0$ for given $B \geq 0, h_\eta$.

$$F(x, s; B, h_\eta) \;:=\; U_p^h(x, s; B, h_\eta) - U_p^\ell(x, s; B, h_\eta) = [\frac{1}{2} - \Phi(\frac{B}{\sigma_b(\underline{h})})]B + \sigma_b(\bar{h})\phi(0) - \sigma_b(\underline{h})\phi(\frac{B}{\sigma_b(\underline{h})}) \tag{1}$$

Since x measures the range of possible project precision, a larger range makes the project precision higher (lower) when the agent selects the most (least) informative project. From the partial derivatives at $\eta^* = 0$ and $\eta^* = B$, we are safe to say that $F(x, s)$ increases in x. Following the intuition that the organisation benefits from conducting the most informative projects via a better ability to avoid retaining lower-ability agents. We evaluate the extreme cases first.

In the case that the precision could be any weakly positive value, the organisation enjoys the maximum benefit of information by setting the $\eta^* = B$, whereas the ex post optimal $\eta^* = 0$ obtains the prior mean following the hiding behaviour. For any given precision of the ability distribution h_η, the inequality 2 bounds the maximum possible B that supports the informative equilibrium. The more uncertain the organisation is about the ability ex ante, the more valuable the information becomes. Hence, it is willing to raise the threshold further away from the ex post screening optimum in order to induce informative behaviour.

Recall $\underline{h} = s - x,\ \bar{h} = s + x$. Then for fixed $B > 0, h_\eta$,

$$\begin{aligned}
\lim_{s\to\infty}\ \lim_{x\to s^-} F\Big(x, s; B, h_\eta\Big) &\geq 0 \\
\lim_{\bar{h}\to\infty} U_p^h(\bar{h}) - \lim_{\underline{h}\to 0} U_p^l(\underline{h}) &\geq 0 \\
\frac{1}{2}B + \frac{\phi(0)}{\sqrt{h_\eta}} - B &\geq 0 \\
B &\leq \frac{2}{\sqrt{h_\eta}}\phi(0)
\end{aligned}$$

$$\lim_{s\to\infty}\ \lim_{x\to s^-} F\Big(x, s; B, h_\eta\Big) \geq 0 \implies B \leq \frac{2}{\sqrt{h_\eta}}\phi(0). \tag{2}$$

In the other extreme case, where the set of project precision is a finite singleton $h_p \in s$, i.e. $\bar{h} = \underline{h} = s$, the organisation obtains nothing extra by setting the tenure threshold as $\eta^* = B$, because there is no room for agents to send more precise information. We could obtain the following.

$$F(B; x = 0, s, h_\eta) = 0 \quad \text{if } B = 0, \qquad F(B; x = 0, s, h_\eta) < 0 \quad \text{if } B > 0,$$

The case $B = 0$ is immediate. For $B > 0$, the expression for $F(B; 0, s)$ can be decomposed into strictly negative two terms, given $B > 0$, $\sigma_b(s) > 0$ and the properties of normal distribution. So that setting $\eta^* = B$ yields no additional payoff relative to a lower threshold. Intuitively, when agents cannot vary project precision, the organisation faces a pure screening problem, and raising the threshold only reduces the probability of retention without improving informational content.

Proposition 3.2 (Existence of an Informative Equilibrium). *Let $h_\eta > 0$ and*

$$B \in \left[0,\ \frac{2}{\sqrt{h_\eta}}\,\phi(0)\right).$$

Suppose the agent chooses project precision from

$$h_p \in \{\, s - x,\ s + x \,\}, \qquad s > 0,\ x \in [0, s).$$

There exists an informative equilibrium in which the organisation sets the tenure threshold $\eta^* = B$ and the agent selects the most informative project if and only if the dispersion x is sufficiently large.

Sketched proof. Recall

$$F(x, s; B, h_\eta) = U_p^h(x, s; B, h_\eta) - U_p^\ell(x, s; B, h_\eta),$$

with

$$U_p^\ell(x, s; B, h_\eta) = B\,\Phi\!\left(\frac{B}{\sigma_b(\underline{h})}\right) + \sigma_b(\underline{h})\,\phi\!\left(\frac{B}{\sigma_b(\underline{h})}\right), \qquad U_p^h(x, s; B, h_\eta) = \frac{B}{2} + \sigma_b(\bar{h})\,\phi(0),$$

where $\sigma_b(h)$ is the posterior standard deviation and $\underline{h} = s - x,\ \bar{h} = s + x$.

The proof proceeds in three short steps.

(i) Continuity and monotonicity. $F(x, s; B, h_\eta)$ is continuous on $x \in [0, s)$ since it is composed of continuous functions of $\underline{h}, \bar{h}$. We have shown that, with $B \geq 0$, the organisation's utility is strictly increasing in h_p at $\eta^* = B$ and $\eta^* = 0$, that is U_p^h increases in x, and U_p^l decreases in x; thus, $F(x, s; B, h_\eta) = U_p^h - U_p^l$ increases in x.

(ii) Endpoint signs. We have also shown that at $x = 0$, $\underline{h} = \bar{h} = s$, and for any $B > 0$, $F(0, s) < 0$ because $\Phi(\frac{B}{\sigma_b(\underline{h})}) > 1/2$ and $\phi(\frac{B}{\sigma_b(\underline{jh})}) < \phi(0)$ for $t > 0$. As $x \to s^-$ we have $\underline{h} \to 0^+$, hence $\sigma_b(\underline{h}) \to 0^+$ and

$$\lim_{x \to s^-} F(x, s) = -\frac{B}{2} + \sigma_b(2s)\phi(0).$$

Consequently, if s is large enough that $\sigma_b(2s) > \frac{B}{2\phi(0)}$ then $\lim_{x \to s^-} F(x, s) > 0$, the two end points are in different signs. If we take the limit of s to infinity, we obtain the upper bound B that the informative equilibrium exists.

(iii) Intermediate Value Theorem. Since F is continuous and strictly increasing in x, and $F(0, s; B, h_\eta) < 0$ while $\lim_{x \to s^-} F(x, s; B, h_\eta) > 0$ under the stated bound on B and a large enough s, the intermediate value theorem yields a unique $x^* \in (0, s)$ with $F(x^*, s; B, h_\eta) = 0$. For all $s > x > x^*$ we have $F(x, s; B, h_\eta) > 0$, which is the claimed existence of an informative equilibrium for sufficiently large dispersion. The equilibrium is knife-edge and requires favourable tie-breaking when the agent is indifferent. □

4 Prospective plan

We will try to endogenise efforts and allow higher-dimensional contracts. Then, to enlarge the scope of the insights, we will adopt tools from Bayesian Persuasion literature.

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Appendix A: Technical lemmas and full proof