

Dynamic Screening with Stochastic Evidence

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Abstract

This paper studies a dynamic screening game where a decision maker (DM) evaluates a privately informed agent, with information revealed through stochastic evidence and endogenous dropout. In equilibrium, type separation begins immediately via low-type exit and continues gradually thereafter. The DM's belief deteriorates monotonically over time even as low types continue to exit. This process continues until the DM's belief hits her indifference threshold, at which point the DM disapproves. Imposing a deadline without commitment strictly lowers the DM's payoff. We show, however, that even a simple deterministic deadline rule of the kind commonly observed in practice, committing to disapprove at a fixed date unless evidence arrives, can outperform the equilibrium when the signal arrival rate is sufficiently high.

1 Introduction

Across a wide range of economic environments, a decision maker must decide whether to approve a project or candidate whose quality is privately known, relying on evidence that arrives stochastically and at a cost to both parties. The approval of new drugs and medical devices by regulatory agencies such as the FDA or EMA is a canonical example, but the same structure arises in a wide range of institutional settings: a venture capital fund deciding whether to continue financing a startup, an employer evaluating a new hire during a probationary period, and regulatory bodies charged with certifying the safety of artificial intelligence systems or other novel technologies each face an analogous problem. In each case, the applicant or project sponsor holds a substantial informational advantage over the evaluator or reviewing authority, which must make an approval decision on the basis of limited information, much of it taking the form of costly and inherently stochastic evidence.

The approval of new drugs and medical devices provides the primary institutional motivation for the present analysis. A firm that has developed a genuinely promising

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compound has strong incentives to pursue regulatory approval, but so does a firm whose product is ineffective or unsafe, since market exclusivity generates rents regardless of underlying quality. The regulator, lacking direct access to the applicant’s private information, must rely on publicly observable evidence generated over the course of the review process.¹ This evidence is inherently stochastic: even for a high-quality product, clinical trials may fail to produce statistically significant results within a fixed review window, while a low-quality product will almost surely fail to generate favorable outcomes. The central regulatory design question is therefore how the review process should be structured to optimally exploit this asymmetric information content of stochastic evidence.

This paper develops a continuous-time model of regulatory screening in which a pharmaceutical firm submits a drug or device to a regulator, and both parties may exert costly effort during an extended review process. The firm is privately informed about its informational type: a high type has conducted rigorous development and assigns high probability to the event that the product is genuinely effective, while a low type knows the product to be ineffective. During the review period, a favorable signal, such as statistically significant trial results, arrives according to a Poisson process with strictly positive intensity if the product is truly effective, and never arrives otherwise. In the absence of a signal, the regulator updates her beliefs continuously, and the firm may choose to withdraw its application at any time.

In equilibrium, type separation occurs through two complementary mechanisms. First, a fraction of low-type applicants withdraw at the outset, representing firms that abandon a regulatory submission they privately know to be futile. Second, among continuing applicants, low types exit gradually over time, as the regulator’s approval hazard is calibrated at each instant to render the low-type firm exactly indifferent between exiting and continuing, a condition that itself follows from the regulator’s own indifference between approving and waiting. The regulator’s posterior belief nonetheless declines monotonically over time: although endogenous attrition of low types partially offsets the downward pressure from the absence of a signal, the net effect is a gradual drift downward, eventually reaching the approval indifference threshold at which point she rejects in the absence of evidence. This stands in contrast to the standard result in dynamic screening models, where low-type exit causes beliefs to rise; here, the informational content of signal absence dominates, so that attrition and belief deterioration proceed simultaneously in equilibrium.

A natural regulatory design question that follows from these equilibrium dynamics concerns the role of deadlines. Real-world regulatory institutions routinely operate under explicit time constraints. In the United States, the Prescription Drug User Fee Act (PDUFA) establishes target review dates, typically ten months for standard applications and six months for priority reviews, that the FDA is committed to meeting.² The Eu-

¹The scale of private investment underlying this informational asymmetry is substantial. DiMasi, Grabowski, and Hansen (2016) estimate the average capitalized cost of bringing a new compound to market at approximately \$2.6 billion, an expenditure that the regulator cannot directly verify.

²U.S. Food and Drug Administration 2022, PDUFA Reauthorization Performance Goals and Procedures, Fiscal Years 2023-2027.

ropean Medicines Agency similarly operates under strict procedural timelines.³ Notably, these deadline rules are deterministic in nature: the regulator commits to a fixed date by which a decision must be reached, rather than employing stochastic mechanisms. These deadlines are motivated by concerns over delayed patient access to beneficial therapies and administrative efficiency, but their informational consequences have received comparatively little formal analysis.

We show that the efficacy of such deadlines is subtle and depends critically on whether the regulator can commit to a specific approval strategy at the deadline. Within the equilibrium absent commitment, shortening the review horizon is unambiguously detrimental: a tighter deadline forecloses the later stages of the screening process during which low-type applicants would otherwise have exited, thereby reducing the informativeness of the review and the regulator’s expected payoff. This result implies that administrative pressures to accelerate review timelines may undermine the regulator’s ability to distinguish good submissions from bad ones.

However, if the regulator can credibly commit *ex ante* to a strict deadline combined with a commitment to reject at the deadline regardless of elapsed time, such a mechanism may strictly dominate the equilibrium outcome. The key condition is whether the signal arrival rate is sufficiently high relative to the high-type firm’s cost of continued participation. When signals arrive sufficiently frequently, the high-type firm remains willing to continue its effort beyond the point at which the equilibrium terminates, enabling a longer effective screening horizon of his drug. Crucially, commitment to a strict rejection deadline fully excludes low-type applicants at the outset, since no low-type firm would bear review costs in the absence of any prospect of approval. When, however, the signal arrival rate is low, the equilibrium may outperform the commitment rule: the regulator’s option to approve absent evidence, which is available in equilibrium but ruled out under commitment, can provide the additional incentive the high type needs to continue participating, sustaining experimentation that the deadline rule would otherwise cut short.

These results provide a formal foundation for evaluating FDA mechanisms such as the accelerated approval pathway, under which continued market access is conditioned on post-market confirmatory evidence, and Fast Track designation, which modifies the informational relationship between regulator and applicant. The broader applicability of this trade-off, between screening purity and the duration of information acquisition, extends naturally to the other institutional settings described above: an investor who commits to a fixed funding horizon, an employer who sets a firm probationary period, or a safety authority that imposes a hard certification deadline each faces an analogous design problem.

Our model can be viewed as a variant of the war of attrition. Representative examples in the literature include Kreps and Wilson (1982) and Ordover and Rubinstein (1986), who study attrition games with asymmetric information in which players employ mixed strategies to resolve dynamic strategic tension. A key difference from the standard war of attrition framework is that payoffs in our model are not discounted over time. Instead,

³Under the centralized procedure, standard applications are assessed within 210 active days and accelerated applications within 150 active days. See European Medicines Agency (2019).

players incur costs in order to continue. This modeling choice has two implications. First, even a firm that ultimately succeeds may incur an ex-post loss. Second, even if the DM can commit to a course of action at the beginning of the game, such commitment may be disadvantageous unless it is implemented probabilistically.

The paper also relates to the strategic experimentation literature with Poisson bandits, initiated by Keller, Rady, and Cripps (2005). Bobtcheff and Levy (2017) study signaling through investment timing; unlike their model, in which information is conveyed solely through the agent’s timing choice, our model features stochastic evidence that arrives independently of the agent’s strategy. Bonatti and Hörner (2017) and Halac and Kremer (2020) study effort incentives under Poisson learning, both featuring moral hazard as the key friction; in our model, by contrast, the central friction is adverse selection, with the agent’s type being private information. Chen, Ishida, and Suen (2020) study reputational concerns in risky experimentation, which connects to our analysis of how dropout dynamics interact with the regulator’s beliefs. Dong (2025) studies strategic experimentation with asymmetric information between two symmetric players; while sharing the Poisson signal structure, it focuses on mutual encouragement rather than the screening of agent types by a principal.

Our model is also related to the broad literature on dynamic signaling. Daley and Green (2012) analyze a dynamic lemons market in which a seller waits for exogenous news to arrive before trading; in their framework, the exit of low-quality sellers causes the decision maker’s belief to rise over time, as the surviving pool becomes progressively better. Bar-Isaac (2003), Lee and Liu (2013), and Honryo (2018) share this feature: in each of these models, the endogenous exit or mixing of low types drives beliefs upward over time. Our model generates a qualitatively different belief dynamic: because signal absence is bad news about the project’s true quality, the regulator’s belief declines even as low types continue to exit. This simultaneous occurrence of attrition and belief deterioration is a distinctive feature of our equilibrium, and reflects the dominant role of the Poisson signal technology in shaping the regulator’s posterior.

Finally, the theoretical analysis of approval processes has also been studied by Henry and Ottaviani (2019), who model the approval process as a persuasion problem in which an informer sequentially conducts research to influence an evaluator’s decision. Our paper differs in focusing on adverse selection rather than the organization of control rights.

The remainder of the paper is organized as follows. Section 2 presents the model. Section 3 characterizes the dynamic screening equilibrium and derives comparative statics. Section 4 analyzes the optimal deadline rule under commitment and compares its performance to the equilibrium. Section 5 discusses extensions and Section 6 concludes. Appendix A contains the formal definition of perfect Bayesian equilibrium and Appendix B collects all proofs.

2 Model

Time is continuous and indexed by $t \in [0, \infty] = T$. There are two players: an agent and a decision maker (DM). The agent submits a project (e.g., a newly developed drug) to

the DM, who must eventually decide whether to approve or disapprove it. The project has an underlying true quality $\omega \in \{G, B\}$, where G represents a genuinely good quality project and B a bad quality one. The prior probability that the project is of good quality is $p_0 \in (0, 1)$. If the project is approved, the agent receives payoff 1. The DM receives payoff 1 if $\omega = G$ and payoff -1 if $\omega = B$. If the project is disapproved, both players receive 0.

The agent does not directly observe the true quality ω . Instead, the agent can be one of two informational types, indexed by $j \in \{L, H\}$, which is his private information and is not observed by the DM. A type- H agent assigns probability $1 - \epsilon$ to the event that the project is of good quality, $\Pr[\omega = G|H] = 1 - \epsilon$, and probability ϵ to the event that it is bad quality, $\Pr[\omega = B|H] = \epsilon$. Thus ϵ represents the residual uncertainty of the H -type, or the difficulty in properly assessing the project's potential. For simplicity, we assume that a type- L agent knows that $\omega = B$; the type- H agent is more optimistic about the project's quality than the type- L agent. This heterogeneity captures differences in technological maturity. Consistency with the common prior then implies that an agent is H -type with probability $\frac{p_0}{1-\epsilon}$.

Before the DM makes a decision, the players may jointly exert effort (e.g., running trials, conducting analyses, or submitting data for the agent and reviewing reports, auditing results, or maintaining oversight for the DM) to generate public evidence about the project quality. If the true quality is high ($\omega = G$), a favorable signal arrives according to a Poisson process with intensity $\lambda > 0$. If the true quality is low ($\omega = B$), no signal ever arrives. As the signal is perfectly informative, the DM learns that $\omega = G$ with certainty and immediately approves the project upon observing it.⁴ Exerting effort incurs a constant flow cost c_j for $j \in \{DM, H, L\}$. For simplicity we set the discount rate to zero. If the game ends at time τ , the total cost incurred by player is τc_j . At any moment, either player may unilaterally terminate the game, whereupon the DM immediately decides whether to approve or disapprove.

The timing of the game generates two distinct types of beliefs for the DM. First, as long as neither player stops the game, the DM updates her belief continuously based on the absence of positive signal. Let p_t denote this continuation belief that $\omega = G$ at time t ; it evolves deterministically according to the no-signal Bayes rule consistent with the agent's strategy, and it summarizes the DM's information along all histories in which the game remains active.

Second, if the agent quits at some point t , the DM forms a different belief.⁵ Let q_t denote the posterior belief that $\omega = G$ upon observing the agent's quitting at t . This belief is obtained from Bayes' rule applied to the agent's strategy. While the distinction between p_t and q_t is important, because any equilibrium has a property that $q_t = 0$ on-path, it will not feature explicitly in the exposition in the main body of the paper.

The type- H agent also updates his own belief based on the absence of a signal. Let r_t denote his posterior belief at time t that $\omega = G$, conditional on no signal arrival up to

⁴More general signal structure is discussed in Subsection 5-2.

⁵Thus, formally we allow the DM to approve the project at her discretion even after the agent quits.

t . Bayesian updating implies

$$r_t = \frac{(1 - \epsilon)e^{-\lambda t}}{\epsilon + (1 - \epsilon)e^{-\lambda t}}. \quad (1)$$

Since r_t is fully determined by time, we omit it from the state vector and use (t, p_t) as the state.

A type- j agent's mixed strategy is represented by

$$\sigma_j = (d_j, \xi_j),$$

where $d_j \in [0, 1]$ is the probability of not to enter the review process at time 0, and

$$\xi_j : T \setminus \{0\} \times [0, 1] \rightarrow [0, \infty]$$

is the quitting hazard after the review has begun. We require ξ_j to be locally integrable on any interval where $\xi_j < \infty$, and interpret $\xi_j(t, p_t) = \infty$ as the agent dropping out with probability one at (t, p_t) , i.e., an atom in the dropout distribution at (t, p_t) .⁶ If the agent chooses non-entry, the game ends immediately and both players receive payoff 0. By contrast, quitting at any $t > 0$ occurs after the review has begun; in that case, the DM observes the quitting event, forms the posterior q_t , and may still decide whether to approve or disapprove.

The DM's mixed strategy is represented by a pair

$$\sigma_{DM} = (\xi_{DM}, \Upsilon),$$

where

$$\xi_{DM} : T \setminus \{0\} \times [0, 1] \rightarrow [0, \infty]$$

is a decision hazard. The approval rule

$$\Upsilon : T \setminus \{0\} \rightarrow [0, 1]$$

specifies the probability of approval when the DM stops at a belief $p_t = 1/2$. Sequential rationality requires approval if $p_t > 1/2$ and disapproval if $p_t < 1/2$. Since sequential rationality pins down the DM's action for $p_t \neq \frac{1}{2}$, the approval rule is defined only for the tie case $p_t = 1/2$.

If the review process begins after the initial non-entry decision, the DM's belief jumps from p_0 to

$$p_0^+ = \frac{p_0(1 - d_H)}{\frac{p_0}{1 - \epsilon}(1 - d_H) + \left(1 - \frac{p_0}{1 - \epsilon}\right)(1 - d_L)}. \quad (2)$$

This is the continuation belief at the initial instant of the review process.

⁶Formally, the quitting strategy of type j can be represented as a measure on T with both absolutely continuous and atomic components, where the absolutely continuous part has a density given by $\xi_j(t, p_t)$ and the atomic part captures sure-quitting events. The formulation here, which allows $\xi_j(t, p_t) = \infty$ represent an atom, is a shorthand for this general representation.

Given the agent's quitting hazards, the continuation belief evolves according to Bayes' rule. For $t > 0$, as long as the game continues and no signal arrives,

$$\frac{dp_t}{dt} = -p_t(1 - p_t) \left(\lambda + \xi_H(t, p_t) - \frac{r_t - p_t}{r_t(1 - p_t)} \xi_L(t, p_t) \right).$$

The first term, λ , captures the bad news from the absence of a favorable signal. The quitting hazards enter because dropout changes the composition of surviving agents. In particular, H -type quitting lowers the belief, whereas L -type quitting raises it.

Given the strategy profile $(\sigma_L, \sigma_H, \sigma_{DM})$, a time $t \in [0, T]$ is said to be reachable on the equilibrium path if the game survives until t with strictly positive probability. Formally, if $d_L < 1$ and $d_H < 1$, define;

$$\mathcal{T}(\sigma_L, \sigma_H, \sigma_{DM}) := \left\{ t \in (0, T] \left| \int_0^s \sum_{j \in \{L, H, DM\}} \xi_j(u, p_u) du < \infty \text{ for all } s < t \right. \right\}.$$

If $d_H = 1$ or $d_L = 1$, set $\mathcal{T}(\sigma_L, \sigma_H, \sigma_{DM}) = \{0\}$. The terminal reachable time is;

$$\bar{t} := \sup \mathcal{T}(\sigma_L, \sigma_H, \sigma_{DM}).$$

This depends only on the players' strategies and not on realization of the agent type.

Our solution concept is that of a perfect Bayesian Nash equilibrium (PBE). This requires that in each time, the DM maximizes her expected payoff given her belief about the sender's type and the future game play including off-the-equilibrium path, and the sender maximizes his expected payoff given the DM's strategy. The continuous-time setting requires the equilibrium to specify strategies, beliefs, and continuation values both on and off the equilibrium path. In particular, these continuation values must be characterized as solutions to the associated Hamilton-Jacobi-Bellman equations to ensure dynamic consistency, making the formal definition lengthy. For clarity, we collect the complete definition in Appendix A. The wording of "equilibrium" should hereafter be understood to mean PBE.

3 Dynamic Screening Equilibrium

In this section, we characterize the equilibrium, with particular attention to the one that maximizes the DM's payoff. Although all equilibria share similar qualitative properties, the DM-optimal equilibrium serves as a natural benchmark when evaluating the performance of the optimal deadline rule. Throughout, we assume the following assumptions;

Assumption 1. $\lambda > 2c_{DM}$.

Assumption 2. $\lambda > 2(c_H - c_L)$.

Assumption 3. $\frac{\epsilon}{1-\epsilon} < \frac{c_{DM}}{\lambda}$.

Of those assumptions, Assumption 1 is essential; without it, there is no equilibrium that features dynamic screening. It enables the equilibrium construction in which, in the

absence of a signal, the DM's equilibrium belief drifts downward over time, despite the ongoing gradual screening of the L -type. Assumption 2 and 3 simplify the characterization of the DM-optimal equilibrium. Assumption 2 guarantees that the signal arrival rate is sufficiently high that the H -type is willing to sustain effort for a sufficiently long horizon. Assumption 3 rules out any equilibrium in which the L -type withdraws at time 0 and both the H -type and the DM continue with certainty until a terminal time.

We now start to characterize the properties of our dynamic equilibrium. The first property is that the H -type agent never quits on the equilibrium path, $\xi_H(t, p_t) = 0$ (Lemma 1 in the Appendix). At an intuitive level, the H -type has a stronger reason to continue, because he may benefit from the arrival of a favorable signal. One would therefore expect that, conditional on the game continuing, the H -type does not exit on the equilibrium path. This intuition, however, is not by itself sufficient, since the H -type may also face a higher flow cost than the L -type.

The formal argument goes as follows. Suppose, toward a contradiction, that the H -type quits with positive hazard on some time interval. If the L -type did not also quit on that interval, then quitting would reveal the agent to be of type H . The DM would then approve upon observing quitting, making quitting strictly profitable for the L -type as well. Hence, in any equilibrium in which the game continues over the interval, positive quitting by the H -type must be accompanied by positive quitting by the L -type.

It follows that both types' continuation values must coincide with their common exit payoff on that interval. Sustaining such coincidence requires both $p_t \geq 1/2$ and $q_t = 1/2$: at those posteriors, the DM is indifferent after observing quitting, so her mixing probability can be used to keep the two types' continuation values aligned. But if quitting makes the DM indifferent and the on-path belief satisfies $p_t \geq 1/2$, then approval is optimal for the DM after any stopping event on the interval. Waiting therefore has no value, and the DM would prefer to approve already at the beginning of the interval. This contradicts the optimality of waiting.

Since the H -type does not quit on the equilibrium path, the only source of dropout in the $\omega = B$ state is the L -type. The effective dropout hazard observed by the DM in $\omega = B$ state is therefore given by

$$\Pr[j = L | \omega = B, h_t] \xi_L(t, p_t) = \frac{1 - \frac{p_t}{r_t}}{1 - p_t} \xi_L(t, p_t),^7 \quad (3)$$

where h_t is the history where no signal has arrived up to time t and the game has continued until t . Let $\xi_B(t, p_t)$ denote this effective dropout hazard in the $\omega = B$ state. By using it, the law of motion for the DM's belief is determined as follows:

$$\frac{dp_t}{dt} = -p_t(1 - p_t)(\lambda - \xi_B(t, p_t)).^8 \quad (4)$$

The second equilibrium property is that, the posterior belief never falls below $\frac{1}{2}$ (Lemma 2 in the Appendix). If it were to fall strictly below $\frac{1}{2}$ at any point, the L -type would no

⁷As $p_t = \Pr[j = H | h_t] \times \Pr[\omega = G | h_t, j = H]$ and $\Pr[\omega = G | h_t, j = H] = r_t$, we have $\Pr[j = H | h_t] = \frac{p_t}{r_t}$. Thus $\Pr[j = L | \omega = B, h_t] = \Pr[j = L | h_t] = 1 - \frac{p_t}{r_t}$, which is used in deriving (3).

⁸It is derived from Bayes' rule; $p_t + dp_t = \frac{p_t(1 - \lambda dt)}{(1 - p_t)(1 - \xi_B(p_t, t)dt) + p_t(1 - \lambda dt)}$.

longer expect approval from continuing, unless beliefs recovered above $\frac{1}{2}$ at some future time so that the DM starts approving. Since the H -type never quit, such a recovery in beliefs could only occur if the L -type quits along the way. But then the L -type would have an incentive to quit immediately rather than continuing until that belief recovery phase.

The third equilibrium property is that the DM always maintains a strictly positive hazard of approval (Lemma 3 in the Appendix). The intuition is as follows. Suppose, toward a contradiction, that there exists an equilibrium with a pure waiting interval - i.e., during this interval the L -type cannot expect approval. Then the L -type must be expecting approval at the end of the interval and thus does not quit until then once he entered this interval. However, since the DM would approve at that point anyway, waiting serves no screening purpose - the L -type is not separated out in this interval. Sequential rationality then implies that the DM should approve immediately rather than wait, contradicting the premise.

This provides a key to characterizing the belief path of the DM; the DM's indifference condition. At p_t , the DM's expected payoff from making decision promptly gives her expected payoff of $p_t \cdot 1 + (1 - p_t)(-1)$. On the other hand, waiting for a bit more and making a decision at time $t + dt$ gives her expected payoff of $-c_{DM}dt + p_t \cdot 1 + (1 - p_t)(1 - \xi_B(t, p_t)dt)(-1)$. In the equilibrium, the DM is indifferent between those options, which yields an arbitrage condition;

$$\xi_B(t, p_t) = \frac{c_{DM}}{1 - p_t}. \quad (5)$$

Combining (4) and (5) yields the differential equation for p_t in a period of no signal realization:

$$\frac{dp_t}{dt} = -p_t(1 - p_t) \left(\lambda - \frac{c_{DM}}{1 - p_t} \right). \quad (6)$$

The indifference condition for the DM further implies that the L -type agent always maintains a strictly positive hazard of quitting and is, at every moment, indifferent between quitting and continuing. This implies that the L -type must be exactly compensated for his flow cost by the prospect of immediate approval; along the equilibrium path, the DM's approval hazard is chosen so that the instantaneous benefit from possible approval just offsets the L -type's flow cost, which pins down $\xi_{DM}(t, p_t) = c_L$.

The final property of equilibrium is that at \bar{t} , the DM disapproves with certainty. If she were to approve with a strictly positive probability at \bar{t} , then from some earlier time onward both types of agents would optimally wait until that moment. This would violate the DM's indifference condition, yielding a contradiction. As $p_t \geq \frac{1}{2}$ on-equilibrium, this implies that $p_{\bar{t}} = \frac{1}{2}$. It is guaranteed that the type- H optimally continues until time \bar{t} , because under Assumption 1, his instantaneous expected gain, $p_{\bar{t}}\lambda + c_L$, exceeds the cost, c_H .

Solving the differential equation (6) using the terminal condition $p_{\bar{t}} = \frac{1}{2}$ gives a closed form of the DM's belief path;

$$p_t = \frac{\lambda - c_{DM}}{(\lambda - 2c_{DM})e^{(\lambda - c_{DM})(t - \bar{t})} + \lambda} \quad (7)$$

for $t \in (0, \bar{t})$, which is decreasing in t under Assumption 1. The belief after the initial screening p_0^+ , which is determined by (2) with $d_H = 0$, must be consistent with the initial condition of this closed form;

$$p_0^+ = \lim_{t \rightarrow 0} p_t = \frac{\lambda - c_{DM}}{(\lambda - 2c_{DM})e^{-(\lambda - c_{DM})\bar{t}} + \lambda}. \quad (8)$$

The terminal time \bar{t} cannot be chosen arbitrarily. Indeed, the equilibrium construction imposes a condition that determines the maximal feasible terminal time, which we refer to as belief consistency. This requires that the DM's belief p_t never exceeds the H -type agent's posterior belief r_t along the equilibrium path, i.e., $r_t \geq p_t$. While r_t declines over time based on exogenous factors, the evolution of p_t is endogenous, determined by the agent's equilibrium strategy. Because these two beliefs follow fundamentally different dynamics, a violation of this condition would lose its coherent Bayesian interpretation: if $r_t < p_t$, the L -type's hazard rate ξ_L would necessarily have been negative at some prior moment, which is inadmissible.

The belief-consistency condition implies that the game cannot extend beyond the time when r_t reaches $1/2$. We denote this boundary as t^* . By solving the equation for $r_{t^*} = 1/2$, we obtain:

$$t^* = \frac{1}{\lambda} \ln\left(\frac{1 - \epsilon}{\epsilon}\right),$$

which is increasing in λ and decreasing in ϵ . Intuitively, t^* decreases in λ because a higher signal arrival rate accelerates the learning process, leading the belief to hit the boundary sooner. Similarly, t^* decreases in ϵ because a higher error probability implies a starting belief that is already closer to the $1/2$ threshold, thereby shortening the duration.

One can show that the game can indeed continue until t^* , which serves as the terminal time for the DM-optimal equilibrium. Denote by $p_0^+(\bar{t})$ the post initial-screening belief consistent with terminal time \bar{t} , which is determined by (8). We particularly denote $p_0^+(t^*)$, the post initial-screening belief when \bar{t} is chosen to be t^* , by p^* . The equilibrium is characterized in the following proposition.

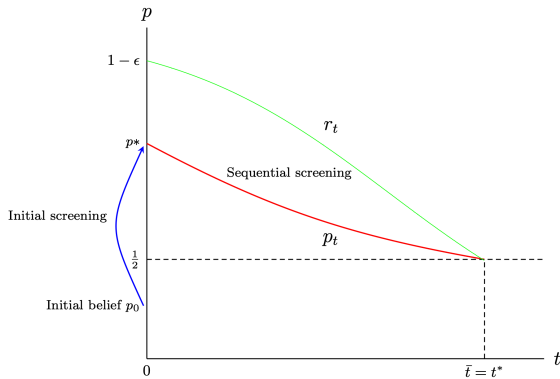


Figure 1. Optimal equilibrium

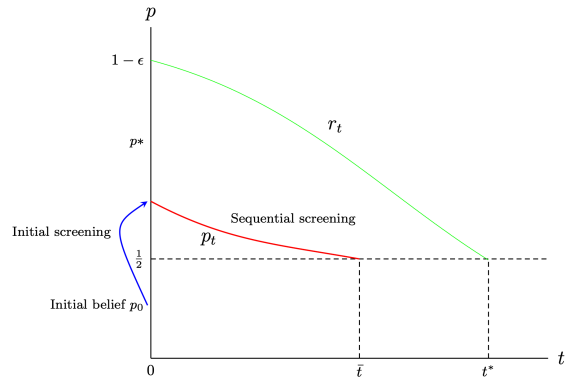


Figure 2. Suboptimal equilibrium

Proposition 1 *Suppose that Assumption 1-3 hold. Then the followings hold;*

1. *If $p_0 > p^*$, no initial screening occurs, $d_L = d_H = 0$, and the DM approves at $t = 0^+$.*

2. *If $p_0 \leq p^*$, for each $s < t^*$ there is an equilibrium such that $s = \bar{t}$ and:*

· *The H-type continues at time zero, $d_H = 0$, and the L-type quits at $t = 0$ with probability*

$$d_L = \frac{p_0^+(s) - p_0}{p_0^+(s) - p_0^+(s)p_0},$$

which implies that $p_0^+ = p_0^+(s)$.

· *For almost all $t < t^*$,*

$$\xi_{DM}(t, p_t) = c_L, \quad \xi_H(t, p_t) = 0, \quad \text{and} \quad \xi_L(t, p_t) = \left(\frac{r_t}{r_t - p_t} \right) c_{DM}.$$

· *$p_s = \frac{1}{2}$ and the DM disapproves at s ; $\Upsilon(s) = 0$.*

In the DM-optimal equilibrium, $s = t^$.*

If the initial belief exceeds p^* the DM approves at time 0 and no screening of types takes place, as in this case a dynamic screening equilibrium cannot be sustained. If the initial belief is below p^* the equilibrium features immediate screening of agent types at time zero, followed by further dynamic screening of agent types. It can be verified that Assumption 3 guarantees that the belief-consistency condition holds; $p_t < r_t$ for all $t < \bar{t}$.

Note that the optimal strategy entails immediate approval at $t = 0$ upon the agent's successful passage through the initial screening. Since the agent survives this screening with probability $\frac{p_0}{p_0^+}$, the DM's ex-ante expected payoff simplifies to $\frac{p_0}{p_0^+}(2p_0^+ - 1)$, which is increasing in p_0^+ . Therefore, in an environment where sequential screening is possible, the DM-optimal equilibrium is the one with the highest initial belief p_0^+ and thus $p_0^+ = p^*$.

Figure 1 illustrates the dynamics of the DM's belief within the DM-optimal equilibrium. The initial screening of agent types causes the DM's belief to jump upward from p_0 to p^* . Subsequently, in the absence of a signal, the belief gradually declines until it reaches $\frac{1}{2}$, the point where the beliefs of the DM and the H -type converge.

Figure 2, on the other hand, depicts the belief dynamics in a typical suboptimal equilibrium. Here, the initial screening is less pronounced, starting from a belief level below p^* . The game concludes before t^* , when the H -type's belief would have reached $\frac{1}{2}$; consequently, the extent of gradual screening remains limited.

The DM's belief is driven not by the mere arrival (or absence) of signals, but by the endogenous incentives it creates for the low type to exit and for the high type to continue. Although experimentation mechanically generates information through signal realizations, it is the endogenous adjustment of the dropout rate that calibrates the DM's incentives and sustains the indifference condition. Conditional on survival and the absence of a signal, belief declines monotonically over time until it reaches $\frac{1}{2}$. This stands in contrast to standard dynamic screening models, where the exit of low types causes the decision maker's belief to rise; here, the downward pressure from signal absence dominates the

upward pressure from attrition, so that belief deterioration and low-type exit proceed simultaneously throughout the equilibrium.

It follows that the effective hazard rate in the bad state, $\xi_B(t, p_t)$, is decreasing over time. As the deadline approaches, the belief p_t drifts further toward the bad state; consequently, a lower effective hazard is sufficient to satisfy the DM's indifference condition. In contrast, the low type's dropout hazard, $\xi_L(t, p_t)$, follows different dynamics. Specifically, as the terminal time approaches and $r_t - p_t$ approaches 0, this rate diverges to infinity. This implies that low types exhaust their willingness to experiment and quits before the deadline is actually reached.

The equilibrium characterization provides a useful foundation for understanding how parameters shape the DM's payoff. In particular, the cost of delay and the informativeness of experimentation jointly determine the speed and intensity of separation and, ultimately, the DM's expected payoff. We now present the following comparative statics results.

Corollary 1 *Suppose that Assumption 1-3 hold and $p_0 \leq p^*$. The DM's expected payoff is;*

$$V_{DM} = p_0 \frac{(\lambda - 2c_{DM})}{\lambda - c_{DM}} \left(1 - \left(\frac{\epsilon}{1 - \epsilon} \right)^{\frac{\lambda - c_{DM}}{\lambda}} \right),$$

which is increasing in λ , decreasing in c_{DM} and ϵ , and invariant in c_H and c_L .

The type H agent's payoff is

$$(1 - \epsilon) \left(1 - \frac{c_H}{\lambda + c_L} \right) \left(1 - e^{-\frac{(\lambda + c_L)}{\lambda} \ln\left(\frac{1 - \epsilon}{\epsilon}\right)} \right) + \epsilon \left(1 - \frac{c_H}{c_L} \right) \left(1 - e^{-\frac{c_L}{\lambda} \ln\left(\frac{1 - \epsilon}{\epsilon}\right)} \right),$$

which is increasing in c_L and λ , and decreasing in c_H and ϵ . The type L agent's payoff is 0.

While most comparative statics results describe how parameter changes affect players' payoffs in intuitive ways, a notable finding is that the type- H agents' payoff is increasing in the type- L agent's effort cost c_L . This result arises because the DM's approval hazard is increasing in c_L , as implied by the equilibrium indifference condition. This feature of the equilibrium, whereby the presence of c_L helps sustain the H -type's incentive to continue, turns out to be an advantage that the equilibrium holds over the optimal deadline rule that we discuss in the next section.

Note that the expected payoffs above are calculated from an ex-ante point of view. Ex post, even a firm that ultimately succeeds, or the DM who eventually learns with certainty that the project is viable and grants approval, may incur a loss if this occurs only at a late stage.

Proposition 1 demonstrates that for every $\tau < t^*$, there is a dynamic screening equilibrium with $\bar{t} = \tau$. This carries a significant implication for regulatory authorities: imposing a deadline without committing to a specific approval strategy may be counterproductive. Indeed, setting a deadline $\hat{t} < t^*$ exogenously precludes any equilibria where $\bar{t} > \hat{t}$, thereby constraining the efficiency of the screening process and ultimately diminishing the decision-maker's payoff.

Corollary 2 *The DM's expected payoff is lower in the finite-horizon model when the time horizon is shorter than t^* .*

Finally, we briefly discuss what the DM-optimal equilibrium would look like without Assumptions 2 and 3. Even when these assumptions are violated, an equilibrium of the same form as that characterized in Proposition 1 may still exist. In such cases, however, the DM-optimal equilibrium cannot persist until t^* . If Assumption 2 is violated, the maximum duration an equilibrium can reach is the time t satisfying $r_t\lambda + c_L = c_H$; the DM-optimal equilibrium then requires the initial screening to set the path of p_t to hit $1/2$ at this t . Similarly, if Assumption 3 is violated, the initial screening sets the path of p_t such that $p_t < r_t$ is guaranteed for all $t < \bar{t}$. In both cases, the degree of initial screening is reduced, and the terminal time is shorter than t , which consequently decreases the DM's equilibrium payoff.

4 Optimal Deadline with Commitment

The analysis in the previous section shows that shortening the time horizon within the dynamic screening equilibrium does not improve the DM's payoff. This suggests that simply imposing an earlier stopping time is not effective as a policy intervention. To derive policy implications, this section therefore considers a setting in which the DM can commit ex ante to a strict deadline together with a commitment not to approve without signal arrival, and evaluates whether such commitment improves her payoff relative to the dynamic screening equilibrium. Our focus on deterministic rules is motivated by their practical dominance in regulatory and organizational screening. Unlike stochastic mechanisms, deterministic deadlines offer superior verifiability and transparency, which are essential for preventing ex-post manipulation.

As will become clear, when the DM's effort cost is higher than that of the H -type, such a commitment improves the DM's payoff. This case is plausible in environments where the DM internalizes large social costs of delay or bears substantial evaluation, legal, or political costs. For instance, in urgent medical review, safety certification of high-risk technologies, or other settings in which delayed approval imposes large external costs, the DM's cost of waiting may exceed the applicant's cost of continuing the review process.

The more delicate case is therefore the opposite one, in which the applicant's continuation cost exceeds the DM's. This case reflects the usual asymmetry between production and evaluation. The agent's effort cost reflects a concentrated sacrifice of specialized labor and cognitive resources required to generate a breakthrough. In contrast, the decision-maker's cost mainly consists of relatively passive auditing and reviewing, as well as ordinary administrative delay costs, rather than active experimentation. The analysis below focuses on this latter case.

Committing to a deadline automatically excludes the low-type agent, so the exclusion constraint does not need to be imposed explicitly. Given this, the DM's optimization problem considers only the H -type agent's participation constraint. Thus the optimal

deadline rule for the DM solves the following maximization problem;

$$\begin{aligned} & \max_{\tau} (1 - \epsilon) \left\{ \int_0^{\tau} \lambda e^{-\lambda t} (1 - c_{DM} \cdot t) dt - e^{-\lambda \tau} \tau c_{DM} \right\} - \epsilon \cdot \tau \cdot c_{DM}, \\ & s.t \ \tau \leq \arg \max_s (1 - \epsilon) \left\{ \int_0^s \lambda e^{-\lambda t} (1 - c_H \cdot t) dt - e^{-\lambda s} s c_H \right\} - \epsilon \cdot s \cdot c_H. \end{aligned}$$

In this formulation, the maximand takes the form of optimal stopping problem for the DM. Conditional on the event that the agent is type H , with probability $(1 - \epsilon)$ the project is type G and it may generate a positive signal in due course, while with probability ϵ it is type B and then they end up paying effort cost, $\tau \cdot c_{DM}$. The constraint is the type- H 's participation constraint, which guarantees that the H -type continues until τ .⁹

The assumption $c_{DM} < c_H$ ensures that in the optimal, the- H type agent's participation constraint is binding. Thus optimal deadline τ_D is given by:

$$\tau_D = \begin{cases} \frac{1}{\lambda} \ln \left(\frac{(1-\epsilon)(\lambda - c_H)}{\epsilon c_H} \right) & \text{if } \lambda > \frac{c_H}{1-\epsilon}, \\ 0 & \text{if } \lambda < \frac{c_H}{1-\epsilon}. \end{cases}$$

Importantly, although the DM commits to disapprove at τ_D , this action is sequentially rational for her when $\lambda > 2c_H$. This is because in this case $\tau_D > t^*$ holds and the DM's belief has fallen below $1/2$ at τ_D .

Note that fixing c_H , τ_D and λ have non-monotonic relationship, typically manifesting as an inverted U-shaped profile. At lower values of λ , an increase in the arrival rate drives τ_D upward as the improved information flow justifies a more extended threshold. However, as λ continues to increase beyond a critical point, the opportunity cost of delay begins to dominate, ultimately incentivizing a reduction in τ_D .

The comparative performance of the optimal deadline rule relative to the DM-optimal equilibrium hinges on whether the agent is willing to continue until t^* . If $\tau_D \geq t^*$, the rule necessarily outperforms the equilibrium. Under these conditions, the DM can replicate her equilibrium behavior; continuing until t^* and then rejecting, while benefiting from the commitment's ability to exclude the L -type entirely. This (sub-optimal) deadline rule thus outperforms the equilibrium. Consequently, the optimal deadline rule fails to surpass the equilibrium only when the agent's endogenous stopping time is short ($\tau_D < t^*$). Denote by V_D the DM's payoff in the optimal deadline rule, which is compared to V_{DM} .

The following proposition is concerned with the relative performance of optimal deadline relative to the equilibrium, within a range in which Assumption 1-3 are satisfied; thus $2c_H > \frac{c_H}{1-\epsilon}$.

Proposition 2 *Fix c_H . Then the following hold;*

- 1: $c_{DM} \geq c_H$, then $V_D > V_{DM}$.
- 2: Suppose that $c_{DM} < c_L$. Then:

⁹The stopping problem is time-consistent for both parties: given the Markovian belief trajectory, neither the DM nor the agent has an incentive to deviate from the stopping rule determined ex ante, since the deterioration of beliefs in the absence of news is fully anticipated at the time of commitment.

- (a) if $\lambda > 2c_H$, then $V_D > V_{DM}$.
- (b) if $\lambda < \frac{c_H}{1-\epsilon}$, then $V_{DM} > V_D$.
- (c) if $\lambda \in (c_H, 2c_H)$, then there exists $\bar{\epsilon} > 0$ such that for all $\epsilon < \min\{\bar{\epsilon}, 1 - \frac{c_H}{\lambda}\}$, $V_D > V_{DM}$.

The first case covers environments in which the DM's cost of waiting is at least as large as the H -type's cost of continuing. Under the deadline rule, conditional on the agent being type H , the DM and the H -type face the same benefit from signal arrival. When $c_{DM} \geq c_H$, the H -type's participation constraint is therefore weaker than the DM's own willingness to wait. The DM can then choose a deadline long enough to ensure $\tau_D > t^*$. Crucially, this implies that the agent remains willing to continue even after the posterior belief of $\omega = G$ falls below $\frac{1}{2}$, the threshold beyond which the equilibrium becomes unsustainable without commitment. The optimal commitment thus strictly outperforms the DM-optimal equilibrium.

We next turn to the more delicate case in which the H -type's cost of continuing is strictly larger than the DM's cost of waiting. In subcase 2(a), the signal arrival rate λ is sufficiently large; $\lambda > 2c_H$. Consequently, the type- H agent's incentive to continue is strong enough to ensure $\tau_D > t^*$. Therefore, as in the first case, the optimal commitment strictly outperforms the DM-optimal equilibrium.

In subcase 2(b), the cost of participating in the deadline rule is prohibitive for the type- H agent, leading the type- H agent to opt out; $\tau_D = 0$. Consequently, the DM must disapprove the project at $t = 0$. In this case, the DM-optimal equilibrium is superior, as the DM's flexibility to approve the project with a certain hazard, $\xi_{DM}(t, p_t) = c_L$, provides the necessary incentive to sustain the type- H agent's involvement.

Subcase 2(c) corresponds to a situation in which the benefit of completely excluding the L -type must be weighed against the loss arising from the premature termination of the experiment. By continuity from the previous result, holding $\epsilon > 0$ fixed, the equilibrium is superior when λ is sufficiently close to $2c_H$. It is, however, demonstrated that for any $\lambda \in (c_H, 2c_H)$ the optimal deadline rule is superior for sufficiently small ϵ . The advantage of the equilibrium, a longer experimentation horizon, is tied to the presence of a screening problem within the high type. When ϵ is positive, a high type may draw the bad state and therefore fail to generate a signal, which creates an informational overlap with the L -type. The equilibrium mechanism accommodates this problem by allowing experimentation to continue for a sufficiently long time.

When ϵ is small, however, the H -type is willing to continue for a sufficiently long time, mitigating the main advantage of the equilibrium. At the same time, the probability that a high type draws the bad state becomes negligible; the screening problem within the high type effectively disappears. As a result, the benefit of maintaining a longer experimentation horizon in the equilibrium becomes less important. The deadline rule, which simply waits for a signal and approves if it arrives, then yields a higher payoff for the DM. We note, however, that characterizing the precise boundary between the regions in which the equilibrium and the deadline rule dominate is analytically intractable in general, as the payoffs under the two schemes are highly nonlinear functions of the underlying parameters.

Crucially, the optimal deadline rule is robust to the collapse of a dynamic screening equilibrium. While the absence of commitment leads to a total failure of experimentation when $t^* = 0$, the DM can restore productive screening through ex-ante commitment. As long as the expected information value $\lambda(1 - \epsilon)$ exceeds the marginal costs for both players, the commitment rule remains a viable and superior alternative to immediate approval or rejection.

Remark 1 *Suppose that Assumption 1 is violated and thus $t^* = 0$ in equilibrium. If $p_0 < \frac{1}{2}$ and $\lambda(1 - \epsilon) > \max\{c_{DM}, c_H\}$, then $V_A > V_{DM}$.*

5 Discussion

5.1 Uncertainty-Free Limit

We may consider the uncertainty-free limit, where ϵ is set to zero. In this idealized case, the type- H agent is perfectly informed of the fact that $\omega = G$, and thus $r_t = 1$ for all t and thus the risk of false positives for the principal is reduced. With informational inaccuracy removed, the focus of the model shifts entirely to the screening process of agent types.

In this frictionless benchmark, belief consistency is never an issue, since r_t always exceeds p_t , regardless of how long the signal remains absent. Consequently, an equilibrium construction that persists indefinitely is feasible.

Proposition 3 *Consider the uncertainty-free limit case; $\epsilon = 0$. Let*

$$\bar{p} = \frac{\lambda - c_{DM}}{\lambda}.$$

The DM-optimal equilibrium is characterized as follows;

1. *If $p_0 \geq \bar{p}$, the DM quits and approves at $t = 0$ with probability 1.*
2. *If $p_0 < \bar{p}$, the following holds:*
 - *The DM and the high type continues at time zero, $d_{DM} = d_H = 0$ and the low type quits at $t = 0$ with probability*

$$d_L = \frac{\bar{p} - p_0}{\bar{p} - \bar{p}p_0},$$

which implies that $p_{0+} = \bar{p}$.

- *For almost all t ,*

$$\xi_{DM}(t, p_t) = c_L, \quad \xi_H(t, p_t) = 0, \quad \text{and} \quad \xi_L(t, p_t) = \frac{c_{DM}}{1 - \bar{p}}.$$

- *For all t , $p_t = \bar{p}$, and $\bar{t} = \infty$.*

Thus in the uncertainty-free limit case, the equilibrium's horizon becomes infinite, but the same mechanism disciplines beliefs and aligns approval decisions with the true underlying quality. What changes across environments is only the way in which this

mechanism is expressed: through a belief path that declines toward $\frac{1}{2}$ in finite time or through an immediate transition to the stationary cutoff in the infinite case. The payoff structures characterized here correspond precisely to the limit of the equilibrium obtained in the case with positive noise ($\epsilon > 0$); the DM's payoff is now $p_0 \frac{(\lambda - 2c_{DM})}{\lambda - c_{DM}}$.

The presence of a finite terminal time effectively rules out the stationary equilibrium construction described above and forces the belief path to drift down to the DM's indifference threshold before the terminal time. This allows us to strengthen the statement of Corollary 2: in the uncertainty-free limit, the DM's expected payoff is strictly lower in the finite-horizon model than in the infinite-horizon counterpart.

Corollary 3 *In the uncertainty limit case, the DM's expected payoff is strictly lower in the finite-horizon model than in the infinite-horizon model.*

5.2 Terminal Recognition

One might theoretically conceive of a regime that can be termed Terminal Recognition, where the principal grants approval at the deadline regardless of signal arrival. The absence of Terminal Recognition in real-world institutions can be attributed to the formidable barrier of accountability. The necessity of accountability effectively renders the scheme untenable in formal institutions; a presumptive approval based on silence fails the basic test of procedural verifiability. More importantly, the introduction of Terminal Recognition undermines the very incentive structure the screening process aims to maintain. If the H -types, who likely face a higher opportunity cost of time, know they will be approved regardless of their performance, the disciplinary value of the deadline is eliminated. Consequently, instead of acting as a salvage mechanism, terminal recognition would merely nullify the signaling value of the waiting period. Therefore, we maintain that the deadline rule, despite its inherent omission costs, remains the only robust benchmark for institutional analysis.

Theoretically, in our framework, the terminal time of terminal recognition must be set so that the exclusion constraint for the L -type agent is satisfied, which requires that his expected payoff from participation remains non-positive. Obviously, as long as this exclusion is secured, the sooner the deadline, the better for the DM; thus it must set the terminal time $\tau_D = \frac{1}{c_L}$ so that $t \cdot c_L$ equals 1. This, however, may cause the H -type to quit earlier. Especially, when c_L is sufficiently lower than c_H the terminal time τ_D extends and the H -type may not be willing to continue until the terminal time. This undermines the effectiveness of this scheme. In fact, in many regulatory and screening environments, higher-quality projects tend to face higher marginal costs of continued evaluation and the lower-quality projects may be able to prolong the review process through minimal or procedural compliance, which may give an alternative explanation for the lack of terminal recognition in the real-world.

If such an impractical commitment were indeed feasible, the DM could achieve significantly better outcomes by committing to a stochastic approval strategy, even if no signal arrives. Specifically, optimal commitment entails a constant approval hazard rate c_L and a deadline T defined by $r_T = \min\{c_{DM}/\lambda, (c_H - c_L)/\lambda\}$. This deadline marks the point

where either the DM or the H -type's participation constraint binds (this T will be later than t^* under Assumption 1-3). Such a strategy invariably yields a higher payoff than the equilibrium.

5.3 Imperfect Signals

Finally, we briefly explore a setting where signals are imperfect; specifically, we consider the environment in which the L -type, whose project is type B for certain, may also produce a signal with a positive arrival rate. In such a framework, the emergence of a signal no longer serves as definitive proof of quality, but merely shifts the principal's posterior belief upward. We focus on parameter constellations that ensure the existence of a dynamic screening equilibrium.

In this generalized setting, in the absence of a signal, beliefs evolve according to:

$$\frac{dp_t}{dt} = -p_t(1-p_t)(\lambda_H - \lambda_L - \xi_B(t, p_t)).$$

This formulation reveals that the arrival rate λ in our baseline model is effectively replaced by the differential arrival rate between the two agent types. Moreover, the DM's posterior belief after receiving the signal is not necessarily 1, and therefore the DM does not necessarily make an immediate decision. Meanwhile, the DM's indifference condition remains unchanged, given by $\xi_B(t, p_t) = \frac{c_{DM}}{1-p_t}$. Following the same analytical procedure as in the previous section, it can be shown that the principal's equilibrium payoff is:

$$p_0 \frac{(\lambda_H - \lambda_L - 2c_{DM})}{\lambda_H - \lambda_L - c_{DM}} \left(1 - \left(\frac{\epsilon}{1-\epsilon} \right)^{\frac{\lambda_H - \lambda_L - c_{DM}}{\lambda_H - \lambda_L}} \right)$$

This yields the intuitive result that the principal's welfare is strictly increasing in the degree of signal reliability, as characterized by the spread; $\lambda_H - \lambda_L$. As $\lambda_H - \lambda_L$ approaches $2c_{DM}$, the value of information vanishes relative to the DM's cost, leading to a breakdown of the screening mechanism altogether.

Although characterizing the DM's payoff in the DM-optimal equilibrium in this general setting does not entail additional analytical challenges, extending the analysis to optimal deadlines with commitment would require substantially more work. In particular, the DM could condition approval on the accumulation of multiple signals, or let the approval threshold vary with time.

6 Conclusion

This paper studies a dynamic screening environment in which information is revealed through stochastic evidence and endogenous dropout. The belief dynamics of this environment are qualitatively distinct from those in standard dynamic screening models: low-type exit and belief deterioration occur simultaneously in equilibrium, driven by the dominant informational content of signal absence under the Poisson technology. This

feature gives rise to a trade-off between screening purity and the duration of information acquisition, with implications for the design of evaluation deadlines.

These results have concrete policy implications for regulatory design. In pharmaceutical approval, our analysis suggests that administrative pressure to shorten review timelines, as embodied in PDUFA target dates, may be counterproductive when it operates without accompanying commitment on the approval strategy. A regulator who shortens the review horizon without committing to a strict rejection rule at the deadline truncates the very process through which low-quality applications are endogenously weeded out, reducing the informativeness of the review and the regulator’s expected payoff. By contrast, a credible commitment to reject absent evidence, analogous to the FDA’s accelerated approval pathway conditioning continued market access on post-market confirmatory trials, can restore and even improve upon the screening outcome, provided that signals arrive sufficiently fast relative to participation costs. The same logic extends beyond pharmaceutical regulation: safety certification of artificial intelligence systems, venture capital staging, and probationary employment evaluation all involve analogous trade-offs between the length of the evaluation horizon and the purity of the resulting screening.

A natural limitation of the present analysis is that the decision maker is modeled as a payoff-maximizing entity unconstrained by internal organizational pressures. An important empirical regularity documented by Carpenter, Zucker, and Avorn (2008) and Carpenter, Chattopadhyay, Moffitt, and Nall (2012) point to a distinct mechanism: PDUFA deadlines induce a piling of drug approvals just before the deadline, and these approvals are associated with significantly higher rates of post-market safety problems. While our model explains how deadlines can undermine screening quality through the truncation of endogenous low-type exit, it does not account for this piling phenomenon, which suggests an additional channel whereby deadline pressure distorts decision-making on the regulator’s side. Incorporating such agency frictions, whereby the regulator’s own incentives lead to premature approval rather than optimal stopping under deadline pressure, into a dynamic screening framework represents a natural and empirically motivated direction for future research.

7 Appendix A: Perfect Bayesian Equilibrium

Given the DM’s tie-breaking rule $\Upsilon(t)$ at $p_t = \frac{1}{2}$, let $U_{DM}(p)$, $U_A(p)$, and $U_A(q)$ denote the DM’s and the Agent’s expected payoffs, respectively, evaluated at the moment the DM takes an action, net of each player’s sunk costs;¹⁰

$$\begin{aligned}
 U_{DM}(p_t) &= \begin{cases} 2p_t - 1 & \text{if } p_t \geq \frac{1}{2}, \\ 0 & \text{if } p_t < \frac{1}{2} \end{cases}, \quad U_{DM}(q_t) = \begin{cases} 2q_t - 1 & \text{if } q_t > \frac{1}{2}, \\ 0 & \text{if } q_t < \frac{1}{2} \end{cases}, \\
 U_A(p_t) &= \begin{cases} 1 & \text{if } p_t > \frac{1}{2}, \\ \Upsilon(t) & \text{if } p_t = \frac{1}{2}, \\ 0 & \text{if } p_t < \frac{1}{2} \end{cases}, \quad \text{and } U_A(q_t) = \begin{cases} 1 & \text{if } q_t > \frac{1}{2}, \\ 0 & \text{if } q_t < \frac{1}{2}, \end{cases}.
 \end{aligned}$$

¹⁰In this formulation, we drop explicitly considering the tie-breaking rule for $q_t = 1/2$, as this case never arises on the equilibrium path.

These payoff functions are defined for continuation beliefs p_t with $t > 0$ and for quitting posteriors q_t with $t > 0$.

Let T_s denote the stopping time at which a signal arrives, with the convention that $T_s = \infty$ if no signal arrives. Similarly, let T_j and T_{DM} denote the stopping times at which the type- j agent exits and the DM stops, respectively. We denote by τ the overall stopping time of the game;

$$\tau = \min\{T_s, T_L, T_H, T_{DM}\},$$

which is a random variable.

Finally, let $V_{DM} : T \setminus \{0\} \times [0, 1] \rightarrow [0, 1]$, $V_H : T \setminus \{0\} \times [0, 1] \rightarrow [0, 1]$, and $V_L : T \setminus \{0\} \times [0, 1] \rightarrow [0, 1]$, which maps from the time and the DM's belief to values in $[0, 1]$, value functions of the players.¹¹

Let $\mu = (\{p_t\}_{t \in T}, \{q_t\}_{t \in T})$. A tuple $(\sigma_L, \sigma_H, \sigma_{DM}, \mu, V_H, V_L, V_{DM})$ is a Perfect Bayesian Equilibrium iff the following two conditions, dynamic optimality and Bayes consistency are satisfied.

1. Dynamic optimality:

Given $(\sigma_L, \sigma_H, \sigma_{DM}, \mu)$, the continuation values of players are continuous on $[0, \bar{t}]$, where \bar{t} is as defined in the main text, and satisfy the following conditions:

For almost all $t \leq (0, \bar{t}]$, the following value-consistency conditions hold for each player;¹²

$$\begin{aligned} V_{DM}(t, p_t) &= \mathbb{E}_\tau [G_{DM}(\tau) - (\tau - t) c_{DM} | (t, p_t)], \\ V_H(t, p_t) &= \mathbb{E}_\tau [G_H(\tau) - (\tau - t) c_H | (t, p_t)], \\ \text{and } V_L(t, p_t) &= \mathbb{E}_\tau [G_L(\tau) - (\tau - t) c_L | (t, p_t)], \end{aligned}$$

where

$$G_{DM}(\tau) = \begin{cases} U_{DM}(1) & \text{if } \tau = T_s, \\ U_{DM}(q_\tau) & \text{if } \tau = T_L \text{ or } \tau = T_H, \\ U_{DM}(p_\tau) & \text{if } \tau = T_{DM}, \end{cases}$$

and similarly for $G_H(\tau)$ and $G_L(\tau)$, which are players' terminal payoffs at stopping time τ , as determined by the event that ends the game and the corresponding terminal belief.

For almost all $t \in (0, \bar{t})$, the players' continuation values satisfy Hamilton-Jacobi-Bellman equation (HJB)¹³;

¹¹For the agent types, continuation values depend on the DM's strategy rather than directly on p_t . Since the DM's strategy depends on the state (t, p_t) , however, the agents' value functions can also be written as functions of (t, p_t) .

¹²Thus, in this formulation, past effort costs are sunk.

¹³These are derived from the recursive forms:

$$\begin{aligned} V_{DM}(t, p_t) &= -c_{DM}dt + \lambda p_t dt + \{p_t \xi_H(p_t, t) + (1 - p_t) \xi_B(p_t, t)\} U_{DM}(q_t) dt \\ &\quad + [1 - p_t \{\lambda + \xi_H(p_t, t)\}] dt - (1 - p_t) \xi_B(p_t, t) dt V_{DM}(t + dt, p_{t+dt}), \\ V_H(t, r_t) &= -c_H dt + \lambda r_t dt + \xi_{DM}(p_t, t) U_A(p_t) dt + (1 - \lambda r_t dt - \xi_{DM}(p_t, t) dt) V_H(t + dt, r_{t+dt}), \end{aligned}$$

$$\begin{aligned} & \frac{dV_{DM}(t, p_t)}{dt} \\ = & c_{DM} - p_t \lambda (1 - V_{DM}(t, p_t)) + [p_t \xi_H(t, p_t) + (1 - p_t) \xi_B(t, p_t)] (V_{DM}(t, p_t) - U_{DM}(q_t)), \end{aligned} \quad (9)$$

$$\frac{dV_H(t, p_t)}{dt} = c_H - \lambda r_t (1 - V_H(t, p_t)) + \xi_{DM}(t, p_t) [V_H(t, p_t) - U_A(p_t)], \quad (10)$$

$$\frac{dV_L(t, p_t)}{dt} = c_L + \xi_{DM}(t, p_t) (V_L(t, p_t) - U_A(p_t)) \text{ and } V_L(t, p_t) \geq U_A(q_t). \quad (11)$$

For almost all $t < \bar{t}$, the following value-matching conditions hold for each player;

$$\begin{aligned} V_{DM}(t, 1) &= V_H(t, 1) = V_L(t, 1) = 1, \\ V_{DM}(t, p_t) &\geq U_{DM}(p_t) \text{ with equality if } \xi_{DM}(t, p_t) > 0, \\ V_H(t, p_t) &\geq U_A(q_t) \text{ with equality if } \xi_H(t, p_t) > 0, \\ \text{and } V_L(t, p_t) &\geq U_A(q_t) \text{ with equality if } \xi_L(t, p_t) > 0. \end{aligned}$$

Similarly;

$$d_L > 0 \text{ only if } \lim_{t \downarrow 0} V_L(t) = 0, \text{ and } d_H > 0 \text{ only if } \lim_{t \downarrow 0} V_H(t, r_t) = 0.$$

2. Bayes consistency:

$$\lim_{t \rightarrow 0} p_t = \frac{p_0(1 - d_H)}{\frac{p_0}{(1-\epsilon)}(1 - d_H) + (1 - \frac{p_0}{(1-\epsilon)})(1 - d_L)}$$

and for all $t \in (0, \bar{t})$,

$$\begin{aligned} \frac{dp_t}{dt} &= -p_t(1 - p_t) \left(\lambda + \xi_H(t, p_t) - \frac{r_t - p_t}{r_t(1 - p_t)} \xi_L(t, p_t) \right) \\ \text{and } q_t &= \frac{p_t \xi_H(t, p_t)}{p_t \xi_H(t, p_t) + (1 - p_t) \xi_B(t, p_t)}. \end{aligned}$$

Beliefs and strategies off the equilibrium path are arbitrary as long as they do not affect on-path optimality.

and

$$V_L(t) = -c_L dt + \xi_{DM}(p_t, t) U_A(p_t) dt + (1 - \xi_{DM}(p_t, t) dt) V_L(t + dt).$$

8 Appendix B: Proofs

The following Lemmas 1-4 establish properties of equilibria in which both the H -type and the L -type remain active until \bar{t} . In the following proofs, statements like "on (t_1, t_2) " are to be read in the almost-everywhere sense.

Lemma 1 *In an equilibrium, $\xi_H(t, p_t) = 0$ for almost all $t \leq \bar{t}$.*

Proof. Suppose, to the contrary, that the claim fails. Then there exists an open interval $(t_1, t_2) \subset (0, \bar{t})$ such that $\xi_H(t, p_t) > 0$ on $t \in (t_1, t_2)$. From value matching, $V_H(t, p_t) = U_A(q_t)$ on (t_1, t_2) . If $V_L(t, p_t) > U_A(q_t)$ on some subinterval $S \subset (t_1, t_2)$, then $\xi_L(t, p_t) = 0$ and thus $U_A(q_t) = U_A(1) = 1$ on S , contradicting $V_L(t, p_t) > U_A(q_t)$ on S . Therefore, $V_L(t, p_t) = U_A(q_t) = V_H(t, p_t)$ on (t_1, t_2) .

From equations (10) and (11),

$$\frac{d}{dt}(V_H(t, p_t) - V_L(t, p_t)) = c_H - c_L - \lambda r_t(1 - V_H(t, p_t)),$$

on (t_1, t_2) . Since $\frac{dV_H(t, p_t)}{dt} - \frac{dV_L(t, p_t)}{dt} = 0$ in (t_1, t_2) ,

$$V_H(t, p_t) = U_A(q_t) = 1 - \frac{c_H - c_L}{\lambda r_t}. \quad (12)$$

As $V_H(t, p_t) = U_A(q_t)$ and $U_A(q_t)$ can take values other than 0 and 1 only at $q_t = \frac{1}{2}$, it follows that $q_t = \frac{1}{2}$.

We next show that $p_t \geq \frac{1}{2}$ on (t_1, t_2) . Suppose, to the contrary, that $p_t < 1/2$ on some subinterval $(s_1, s_2) \subset (t_1, t_2)$. Then $U_A(p_t) = 0$ on this subinterval. As r_t strictly decreases, (12) implies that $U_A(q_t)$ also strictly decreases on (s_1, s_2) .

However, the HJB equation for the L -type gives, on (s_1, s_2) ,

$$\frac{dV_L(t, p_t)}{dt} = c_L + \xi_{DM}(t, p_t)(V_L(t, p_t) - U_A(p_t)) = c_L + \xi_{DM}(t, p_t)V_L(t, p_t) > 0.$$

Thus $V_L(t, p_t)$ must be strictly increasing on (s_1, s_2) , contradicting the fact that $V_L(t, p_t) = U_A(q_t)$ is strictly decreasing there. Hence $p_t \geq 1/2$ on (t_1, t_2) .

We thus have $p_t \geq \frac{1}{2}$ and $q_t = \frac{1}{2}$ on (t_1, t_2) , which implies that approval must be optimal for any contingency event on (t_1, t_2) . Therefore, $U_{DM}(p_t) = V_{DM}(t, p_t) = 2p_t - 1$ and $U_{DM}(q_t) = V_{DM}(t, q_t) = 2q_t - 1$ on (t_1, t_2) .

From the HJB for type- L , $\xi_{DM}(t, p_t)$ cannot be 0 and thus $\xi_{DM}(t, p_t) > 0$ must hold in this interval and thus $V_{DM}(t, p_t) = U_{DM}(p_t) = 2p_t - 1$ on (t_1, t_2) . This yields for any

$t_3 \in (t_1, t_2)$;

$$\begin{aligned}
V_{DM}(t_1, p_{t_1}) &= \mathbb{E}_\tau [G_{DM}(\tau) - (\tau - t_1)c_{DM} \mid \tau \geq t_1] \\
&= \Pr [\tau \in [t_1, t_3] \mid \tau > t_1] (2 \Pr [\omega = G \mid \tau \in [t_1, t_3]] - 1) \\
&\quad + \Pr [\tau \notin [t_1, t_3] \mid \tau > t_1] \mathbb{E}_\tau [G_{DM}(\tau) - (\tau - t_1)c_{DM} \mid \tau \notin [t_1, t_3]] \\
&\quad - \mathbb{E}_\tau [(\tau - t_1)c_{DM} \mid \tau \geq t_1] \\
&< \Pr [\tau \in [t_1, t_3] \mid \tau > t_1] (2 \Pr [\omega = G \mid \tau \in [t_1, t_3]] - 1) \\
&\quad + \Pr [\tau \notin [t_1, t_3] \mid \tau > t_1] \mathbb{E}_\tau [G_{DM}(\tau) - (\tau - t_3)c_{DM} \mid \tau \notin [t_1, t_3]] \\
&= \Pr [\tau \in [t_1, t_3] \mid \tau > t_1] (2 \Pr [\omega = G \mid \tau \in [t_1, t_3]] - 1) \\
&\quad + \Pr [\tau \notin [t_1, t_3] \mid \tau > t_1] V_{DM}(t_3, p_{t_3}) \\
&= \Pr [\tau \in [t_1, t_3] \mid \tau > t_1] (2 \Pr [\omega = G \mid \tau \in [t_1, t_3]] - 1) \\
&\quad + \Pr [\tau \notin [t_1, t_3] \mid \tau > t_1] (2p_{t_3} - 1) = 2p_{t_1} - 1 = U_{DM}(p_{t_1}),
\end{aligned}$$

where the second to last equality follows from the martingale property of Bayesian belief updates. This, however, contradicts $V_{DM}(t_1, p_{t_1}) \geq U_{DM}(p_{t_1})$. We therefore conclude that $\xi_H(t, p_t) = 0$ on $(0, \bar{t})$. ■

Lemma 2 *In an equilibrium, $p_t \geq \frac{1}{2}$ on $(0, \bar{t})$.*

Proof. Suppose, toward a contradiction, that there exists some $t' < \bar{t}$ such that $p_{t'} < \frac{1}{2}$.

We first show that there must exist some $s > t'$ such that $p_s = \frac{1}{2}$. If this were not the case, then $p_t < \frac{1}{2}$ for all $t \geq t'$. In this case, $U_A(p_t) = 0$ for all $t \geq t'$, and the continuation value of the L -type agent at time t' is given by the expected payoff from waiting until the stopping time τ ,

$$V_L(t', p_{t'}) = \mathbb{E}_\tau [U_A(p_\tau) - (\tau - t')c_L \mid \tau \geq t'] = -\mathbb{E}_\tau [(\tau - t')c_L \mid \tau \geq t'] < 0.$$

This contradicts the value matching condition $V_L(t', p_{t'}) \geq U_A(p_{t'})$. Hence, there must exist some $s > t'$ such that $p_s = \frac{1}{2}$. Without loss of generality, let s be the smallest such value; thus $p_t < \frac{1}{2}$ and $U_A(p_t) = 0$ for all $t \in [t', s)$.

Since p_t is continuous, there exists an interval $[t_1, t_2]$ contained in $(t', s]$ with $t_1 < t_2$ such that $\frac{dp_t}{dt} > 0$ for all $t \in [t_1, t_2]$. This implies that $\xi_L(t, p_t) > 0$ for all $t \in [t_1, t_2]$. By the previous lemma, we then have $U_A(q_t) = 0$ on (t_1, t_2) . Moreover, since $\xi_L(t, p_t) > 0$, the continuation value satisfies $V_L(t, p_t) = U_A(q_t) = 0$ on $[t_1, t_2]$.

From (11) and $U_A(p_t) = 0$, it follows that $\frac{dV_L(t, p_t)}{dt} = c_L > 0$ in $t \in [t_1, t_2]$. This contradicts $V_L(t, p_t) = 0$ for all $t \in [t_1, t_2]$. We therefore conclude that $p_t \geq \frac{1}{2}$ on $(0, \bar{t})$. ■

Lemma 3 *In an equilibrium, $\xi_{DM}(t, p_t) = c_L$ and $\xi_B(t, p_t) = \frac{c_{DM}}{1-p_t}$ for almost all $t \in (0, \bar{t})$.*

Proof. We first show that $\xi_{DM}(t, p_t) > 0$ for almost all t . Suppose, toward a contradiction, that there exists an open interval $(t_1, t_2) \subset (0, \bar{t})$ such that $\xi_{DM}(t, p_t) = 0$ on (t_1, t_2) .

By Lemma 1, if $\xi_L(s, p_s) > 0$ for some $s \in (t_1, t_2)$, then $q_s = 0$ and hence $V_L(s, p_s) = U_A(q_s) = 0$. On the other hand, from the HJB for the L -type agent, we have $\frac{dV_L(t, p_t)}{dt} = c_L > 0$ for all $t \in (t_1, t_2)$. It then follows that, for any $t \in (t_1, t_2)$,

$$V_L(t, p_t) = c_L(t - t_1) + V_L(t_1, p_{t_1}) > V_L(t_1, p_{t_1}) \geq 0,$$

which contradicts $V_L(s, p_s) = 0$. Therefore, $\xi_L(t, p_t) = 0$ on (t_1, t_2) .

Next, let $t_3 = \inf\{\int_{t_1}^t \xi_{DM}(t, p_t) dt > 0\} \geq t_2$. From above argument, $\xi_L(t, p_t) = 0$ on (t_1, t_3) . Because $\xi_j(t, p_t) = 0$ on (t_1, t_3) for $j \in \{DM, H, L\}$, in (t_1, t_3) the game stops only when the signal arrives. Then from same algebraic argument as in Lemma 1, we obtain $V_{DM}(t_1, p_{t_1}) < U_{DM}(p_{t_1})$, which is a contradiction. Therefore we may conclude that $\xi_{DM}(t, p_t) > 0$ on $(0, \bar{t})$. This further implies value matching for the DM, so that $V_{DM}(t, p_t) = 2p_t - 1$ on $(0, \bar{t})$. Substituting this expression into the HJB equation for the DM (9) yields $\xi_B(t, p_t) = \frac{c_{DM}}{1-p_t}$ on $(0, \bar{t})$.

By a symmetric argument, $\xi_B(t, p_t) > 0$ for almost all t implies $\xi_{DM}(t, p_t) = c_L$ on $(0, \bar{t})$. ■

From Lemma 3, $\xi_{DM}(t, p_t) = c_L$. Therefore, for any $t < \bar{t}$, the H -type's continuation value is

$$V_H(t, p_t) = r_t \left\{ \int_t^{\bar{t}} (\lambda + c_L) e^{-(\lambda+c_L)(s-t)} (1 - c_H(s-t)) ds + e^{-(\lambda+c_L)(\bar{t}-t)} (1 - c_H(\bar{t}-t)) \right\} \\ + (1 - r_t) \left\{ \int_t^{\bar{t}} c_L e^{-c_L(s-t)} (1 - c_H(s-t)) ds + e^{-c_L(\bar{t}-t)} (1 - c_H(\bar{t}-t)) \right\}.$$

Under Assumption 2 and the terminal time used in the constructed equilibrium, this value is strictly positive at the initial date. Thus

$$\lim_{t \downarrow 0} V_H(t, p_t) > 0.$$

Hence the H -type strictly prefers to enter the continuation game, and $d_H = 0$.

Lemma 4 *In an equilibrium, $p_{\bar{t}} = \frac{1}{2}$ and p_t is decreasing on $(0, \bar{t}]$.*

Proof. Suppose, toward a contradiction, that $p_{\bar{t}} > \frac{1}{2}$. Then $\lim_{t \rightarrow \bar{t}} V_L(t) = 1$. This implies that $\xi_L(t, p_t) = 0$ on $(\bar{t} - \Delta, \bar{t}]$ for sufficiently small $\Delta > 0$. Consequently, the belief p_t must be strictly decreasing on $(\bar{t} - \Delta, \bar{t}]$.

Consider HJB for the DM, (9). On $(\bar{t} - \Delta, \bar{t}]$, it is

$$\frac{dV_{DM}(t, p_t)}{dt} = c_{DM} - p_t \lambda + p_t \lambda V_{DM}(t, p_t)$$

for all $t \in (\bar{t} - \Delta, \bar{t}]$. From Lemma 3, we have $\xi_{DM}(t, p_t) > 0$ for almost all $t \in (\bar{t} - \Delta, \bar{t}]$, which implies value matching $V_{DM}(t, p_t) = U_{DM}(p_t)$, on this interval. Substituting $V_{DM}(t, p_t) = 2p_t - 1$ into the HJB equation yields $2 \frac{dp_t}{dt} = c_{DM} - p_t \lambda + p_t \lambda (2p_t - 1)$ for all $t \in (\bar{t} - \Delta, \bar{t}]$. This equation implies that p_t is constant in $(\bar{t} - \Delta, \bar{t}]$, which is a contradiction. Thus $p_{\bar{t}} = \frac{1}{2}$.

From Lemma 3, p_t evolves according to the autonomous ordinary differential equation (6). The right-hand-side is continuous, hence it admits a unique solution for any initial condition.

Suppose, by contradiction, that p_t is not decreasing. Then the set $T_+ = \{t : \frac{dp_t}{dt} > 0\}$ is non-empty. Take $t_0 \in T_+$. By the law of motion (6), $\frac{dp_t}{dt} > 0$ at t_0 implies that $p_{t_0} \geq p^* = 1 - \frac{c_{DM}}{\lambda} > \frac{1}{2}$. Since the belief converges to $1/2$, it must at some time cross the level p^* from above. Let $t_1 > t_0$ denote the first such crossing time, so that $p_{t_1} = p^*$. However, by (6), $\frac{dp_t}{dt} = 0$ at $p_t = p_{t_1}$ and thus the trajectory cannot reach $\frac{1}{2}$. Therefore, p_t decreases over time. ■

Proof of Proposition 1. To prove that the prescribed strategies are supported as an equilibrium, suppose that Assumption 1-3 hold and $p_0 \leq p^*$. Let;

$$V_L(t, p_t) = 0, \quad V_{DM}(t, p_t) = 2p_t - 1,$$

$$\text{and } V_H(t, p_t) = r_t \left(1 - \frac{c_H}{\lambda + c_L}\right) (1 - e^{-(\lambda + c_L)(\bar{t} - t)}) + (1 - r_t) \left(1 - \frac{c_H}{c_L}\right) (1 - e^{-c_L(\bar{t} - t)}),$$

for $t \in (0, \bar{t})$, where p_t and r_t follow (1) and (7), respectively. Then, it can be verified that the value-matching conditions, $V_{DM}(t, p_t) = U_{DM}(p_t)$, $V_L(t, p_t) = U_A(q_t)$, and $V_H(t, p_t) > U_A(q_t)$, are satisfied.

To show that belief consistency condition is satisfied for all those equilibrium candidates, it is sufficient to show it for the one in which $\bar{t} = t^*$, as it has the highest p_t for all $t \in [0, t^*)$. To see that $r_t > p_t$ for all $t \in [0, t^*)$, let

$$\Phi(t) = \frac{1}{r_t} - \frac{1}{p_t} = \frac{\epsilon + (1 - \epsilon)e^{-\lambda t}}{(1 - \epsilon)e^{-\lambda t}} - \frac{(\lambda - 2c_{DM}) \left(\frac{\epsilon}{1 - \epsilon}\right)^{\frac{\lambda - c_{DM}}{\lambda}} e^{(\lambda - c_{DM})t} + \lambda}{\lambda - c_{DM}};$$

then it is sufficient to show that $\Phi(t) < 0$ for all $t \in [0, t^*)$. From Assumption 3, we have;

$$\begin{aligned} \Phi(0) &= \frac{1}{1 - \epsilon} - \frac{(\lambda - 2c_{DM}) \left(\frac{\epsilon}{1 - \epsilon}\right)^{\frac{\lambda - c_{DM}}{\lambda}} + \lambda}{\lambda - c_{DM}} \\ &< \frac{1}{1 - \epsilon} - \frac{\lambda}{\lambda - c_{DM}} = \frac{\lambda\epsilon - c_{DM}}{(1 - \epsilon)(\lambda - c_{DM})} < 0. \end{aligned}$$

If $\Phi'(\hat{t}) = 0$ for some \hat{t} , then it holds that;

$$\frac{\lambda\epsilon}{1 - \epsilon} e^{\lambda\hat{t}} = (\lambda - 2c_{DM}) \left(\frac{\epsilon}{1 - \epsilon}\right)^{\frac{\lambda - c_{DM}}{\lambda}} e^{(\lambda - c_{DM})\hat{t}}.$$

Substituting this into $\Phi''(\hat{t})$ gives;

$$\begin{aligned} \Phi''(t') &= \frac{\lambda^2\epsilon}{1 - \epsilon} e^{\lambda t'} - (\lambda - 2c_{DM})(\lambda - c_{DM}) \left(\frac{\epsilon}{1 - \epsilon}\right)^{\frac{\lambda - c_{DM}}{\lambda}} e^{(\lambda - c_{DM})t'} \\ &= c_{DM}(\lambda - 2c_{DM}) \left(\frac{\epsilon}{1 - \epsilon}\right)^{\frac{\lambda - c_{DM}}{\lambda}} e^{(\lambda - c_{DM})t'} > 0. \end{aligned}$$

Therefore, $\Phi(t)$ has only local minimum and thus $\Phi(t) = 0$ holds for at most one time. From our choice of t^* , $\Phi(t^*) = 0$ and $\Phi(t) < 0$ for all $t \in (0, t^*)$. Thus belief consistency condition is satisfied and the strategies are supported as an equilibrium.

To see that $s = t^*$ in the DM-optimal equilibrium, observe that the DM's payoff in an equilibrium is $\frac{p_0}{p_0^+(s)}(2p_0^+(s) - 1)$, as it is optimal for her to immediately approve after the initial screening, which occurs with probability $\frac{p_0}{p_0^+(s)}$. As this is increasing in $p_0^+(s)$, which is also increasing in s , in the DM-optimal equilibrium it holds that $s = t^*$.

Finally, we rule out the equilibrium in which the L-type withdraws at time 0, while both the H-type and the DM continue with certainty until a terminal time \bar{t} . For the DM to find it optimal to continue at each time t , it must be that:

$$\begin{aligned} 2r_t - 1 &\leq r_t \left\{ \int_0^\Delta \lambda e^{-\lambda s} (1 - c_{DM} \cdot s) ds - e^{-\lambda \Delta} \Delta c_{DM} \right\} - (1 - r_t) \Delta c_{DM} \\ &= r_t \left(1 - \frac{c_{DM}}{\lambda}\right) (1 - e^{-\lambda \Delta}) - (1 - r_t) c_{DM} \Delta, \end{aligned}$$

where $\Delta = \bar{t} - t$.

In particular, at $t = 0$, this condition becomes

$$1 - 2\epsilon \leq (1 - \epsilon) \left(1 - \frac{c_{DM}}{\lambda}\right) (1 - e^{-\lambda \Delta}) - (1 - r_t) c_{DM} \Delta.$$

The right-hand side is strictly smaller than $(1 - \epsilon) \left(1 - \frac{c_{DM}}{\lambda}\right)$. Under Assumption 3, however,

$$1 - 2\epsilon \leq (1 - \epsilon) \left(1 - \frac{c_{DM}}{\lambda}\right).$$

It follows that the above inequality cannot hold at $t = 0$. Therefore, such an equilibrium cannot be supported. ■

Proof of Proposition 2. 1. Suppose that $\lambda > 2c_H$. Let

$$g(s) = \frac{p_0}{1 - \epsilon} \left[(1 - \epsilon) \left\{ \int_0^s \lambda e^{-\lambda t} (1 - c_{DM} \cdot t) dt - e^{-\lambda s} s c_{DM} \right\} - \epsilon \cdot s \cdot c_{DM} \right],$$

which is the DM's expected payoff if she continues until t^* and then disapprove, holding the agent's strategy fixed, conditional on the event that the agent is type H . Note that sequential rationality implies that it is indeed optimal for the DM to do so. Thus her equilibrium payoff is written as follows:

$$g(t^*) - (1 - p_0) c_{DM} \left\{ \int_0^{t^*} \xi_B(t, p_t) e^{-\int_0^t \xi_B(s, p_s) ds} dt + e^{-\int_0^{t^*} \xi_B(s, p_s) ds} \right\},$$

which can be verified to be identical to the expression in Corollary 1. From $c_{DM} < c_H$, $\frac{dg(t)}{dt} > 0$ for all $t < \tau_D$ and from $\lambda > 2c_H$, we have $t^* < \tau_D$. Thus $V_D = g(\tau_D) > g(t^*) > V_{DM}$.

2. It is straightforward, as $V_A = 0$.

3. Using $\tau_D = \frac{1}{\lambda} \ln \left(\frac{(1-\epsilon)(\lambda-c_H)}{c_H} \right)$, it is computed that;

$$V_D = g(\tau_D) = \frac{p_0}{(1-\epsilon)\lambda} \left[\frac{(\lambda - c_{DM}) \{ \lambda(1-\epsilon) - c_H \}}{\lambda - c_H} - \epsilon c_{DM} \log \frac{(1-\epsilon)(\lambda - c_H)}{c_H} \right].$$

Thus if $\epsilon = 0$, $V_D - V_{DM} = \frac{c_{DM}^2}{\lambda(\lambda - c_{DM})} > 0$. Because both V_D and V_{DM} are continuous with respect to ϵ , the result follows. ■

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9 Declaration of generative AI and AI-assisted technologies

Statement: During the preparation of this work the authors used ChatGPT and Claude in order to improve the readability and language of the manuscript. After using this ChatGPT and Claude the author reviewed and edited the content as needed and take full responsibility for the content of the published article.