# A Theory of Evidence-Based Ruling in Contract Enforcement

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**Abstract**

We propose a model to analyse how evidence-based rulings affect incentive contract formation and welfare. A contract enforcer is evidence-based if his rulings are fully backed by objective evidence and are independent of his subjective beliefs. While evidence-based rulings play a vital role in preserving contractual incentives, its implementation also leads to costlier litigation. The tradeoff between the incentives benefit and the legal costs determines which enforcement regime is optimal. We apply the theory to contrast public courts with private arbitrators, and discuss their specific roles in contract enforcement.

**Keywords**: Incentive contract enforcement, evidence-based ruling, legal costs, public courts, private arbitrators

*JEL Codes*: D82, D86, K4

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# 1 Introduction

Moral hazard problems have long been drawing the keen interest of many researchers. In the standard moral hazard framework, it is typically assumed that some measures of the agent's performance can be verified by a court. Therefore, enforceable incentive contracts can be used to induce non-verifiable effort from the agent. The presence of external enforcers is especially important if other self-enforcing mechanisms[1] are unavailable. Despite its importance in incentive provision, the enforcement regime is usually oversimplified in the contract theory literature. Perfect verification of contracted variables is usually assumed, and legal costs incurred are negligibly low. These simplifications nullify the impact of the court's behaviour on contract formation, making the legal process irrelevant to the optimal contracting problem.

In this paper, we depart from the standard setting and develop a model to discuss the relationship between enforcement regimes and optimal contracts. In particular, we are interested in the concept of *evidence-based ruling* in the context of incentive contract enforcement. Rulings are evidence-based if they are made based wholly on the objective evidence observed, and are free of the subjective beliefs of the enforcers. Its significance is clear in certain circumstances. For example, in cases where judges are biased and/or corruptible, evidence-based rulings are clearly important for preserving the fairness of their judgements. Even without personal bias and corruption, inefficiencies can still arise if judges are fully Bayesian with error minimization as their sole objective. The associated problems been discussed in the literature.[2] In particular, the provision of ex ante contractual incentives can become difficult if judges are unable to commit to evidence.[3]

Although evidence-based ruling is desirable from the incentive provision perspective, its implementation is not costless. This is especially true when the evidence generation process is explicitly considered. The objective of this paper is to provide a more balanced view of evidence-based ruling by taking the interplay between this rule and evidence generation into the analytical framework. Through the characterization of the benefits and costs associated with evidence-based ruling, our model allows us to critically examine the optimality of this

[1]See, for example, Bull (1987), Macleod and Malcomson (1989), Levin (2003) and Fuchs (2007)

[2]See, for example, Schrag and Scotchmer (1994), Daughety and Reinganum (1995), Lewis and Poitevin (1997); Sanchirico (2001), Bernhardt and Nosal (2004), and Friedman and Wickelgren (2006)

[3]See, for example, Demougin and Fluet (2006, 2008)

rule.

The backbone of our framework is a principal-agent model where a principal offers an incentive contract to an agent in order to induce non-verifiable effort from him. The quality of the output is contractible, and we assume that the contract can be enforced by a court. Unlike the standard model, we allow for the following legal imperfections. First, perfect verification of the contracted variable is not always possible. If the court fails to verify the output quality, a full trial has to be conducted for reviewing evidence before arriving at a verdict. Second, legal resolutions of contractual disputes are costly. In particular, evidence generation in the full trial leads to additional legal costs to the contracting parties. Given the legal costs concern, the contracting parties have motives to settle their disputes privately. However, the negotiation of settlement takes place in the shadow of asymmetric information because the realized output quality is privately observed by the agent.

Given the aforementioned legal imperfections, the behaviour of the court can potentially affect the optimal contract. The court is treated as a player whose objective is to maximize the accuracy of its judgement. We consider two different types of court. A court is *purely evidence-based* if it respects evidence-based ruling. In other words, its rulings are obligated to strictly follow the objective evidence obtained and thus are belief-free. On the other hand, a court is *sophisticated* if it is not subject to the restriction of evidence-based ruling. The two types of courts share the same objective and verification technology.

Legal imperfections lead to welfare costs, and the nature of the costs depends on the enforcement regime. The rulings of the sophisticated court are sensitive to its equilibrium belief. Due to the information asymmetry at the settlement stage, litigated cases are self-selected in favour of the agent. This drives the sophisticated court to form an extreme belief in equilibrium, even though the court is intrinsically unbiased. Such an extreme belief affects the court's ruling, and this can potentially jeopardize the agent's incentives to invest. This incentives problem does not exist if the court is purely evidence-based because its rulings are belief-free. However, since the accuracy of its rulings depends critically on the quality of evidence, the purely evidence-based court is more devoted to evidence generation. This eventually leads to higher legal costs incurred to the contracting parties.

The tradeoff between the incentives loss and the legal costs determines which enforcement regime is more effective in enhancing the welfare of the contracting parties. A key determinant, we argue, is the complexity of the contracted variable, which is captured by the likelihood of perfect verification of the output quality. In the benchmark case where the quality can always be perfectly verified, the first best outcome can be achieved regardless of the type of court. This conforms to our claim that the legal process is irrelevant if there are no legal imperfections. When the probability of verification failure is low, the incentives loss effect described earlier can be fully offset by adjusting the contract terms appropriately. Thus, the sophisticated court can still implement the first best outcome. The purely evidence-based court, on the other hand, cannot implement the first best outcome due to the additional legal costs incurred. As a result, the sophisticated court is the better enforcement regime. However, if the contracted variable is highly complex and perfect verification is unlikely, the incentives that can be induced by the sophisticated court are very limited. The enormous incentives cost outweighs the legal costs in this case, and the purely evidence-based court is the preferred regime from the perspective of welfare enhancement.

Given that each type of court has specific comparative advantages over the other, both regimes should co-exist in the optimal legal system so that the contracting parties can select the one that fits their needs. In Section 4, we discuss how this can be implemented in practice. Although we usually presume that contracts are enforced by public courts, many contracts are, in fact, enforced through private arbitration. We discuss the difference between these two types of contract enforcers, and argue that, in reality, arbitrators tend to behave like the sophisticated court while judges are evidence-based. Given such distinctions, we apply the proposed theory to identify their relative strengths and weaknesses, and demonstrate how they can complement each other in the optimal legal system.

## 1.1 Related literature

This paper is related to the literature of economic analysis of settlement and litigation, which began with early works by Landes (1971) and Gould (1973). A significant portion of this literature is devoted to studying the settlement bargaining problem. Settlement negotiation with asymmetric information, which is adopted in our model, was first analysed by P'ng (1983) and Bebchuk (1984). More recent research in this area focuses on the relationship between legal procedures and settlement negotiations. For instance, Reinganum and Wilde (1986) study how the allocation of legal costs affects the probability of trial. This question is further followed up by Spier (1992) and Gong and McAfee (2000). Daughety and Reinganum (1995) discuss the admissibility of settlement negotiations as evidence. While the aforementioned papers focus on settlement negotiations given the disputes, our main concerns are the optimal contracts and their welfare implications under different enforcement regimes.

The problem associated with Bayesian adjudicators has drawn the attention of many law and economics scholars. Several papers in this literature are particularly dedicated to studying the interpretation of evidence by Bayesian courts and its implications on incentives provision. Fluet (2003) argues that generally a truth telling court does not interpret evidence in a way that maximizes the incentive provision power of contracts. Demougin and Fluet (2006, 2008) further show the importance of courts' commitment to evidence in ex ante incentives provision. This incentives effect is captured in our model as well. However, we are also concerned about the legal cost implications of evidence-based ruling. The optimal enforcement regime ultimately depends on the tradeoff between these benefits and costs.[4] For simple cases where contracted variables can be easily verified, the incentives provision factor may not be sufficient to justify the legal costs incurred. It is thus suboptimal to commit to evidence-based ruling in this situation.

Another line of related research focuses on the judicial agency problems in contract enforcement. Usman (2002) analyses a judicial moral hazard problem in which the court needs to invest costly effort to verify the contracted variable. He shows that a small breach rate can be achieved even when the court's effort costs are high. Bond (2009) considers a contracting problem where the judge can be bribed by the contracting parties, and shows that high-powered contracts may be undesirable in this case. In this paper, we argue that the impact of judicial agency depends crucially on the underlying institution. Different types of welfare costs are incurred in different enforcement regimes.

In our model, the contracting parties are asymmetrically informed of the realized contracted variable. This framework is studied in the literature of contracting with subjective

[4] The tradeoff between ex ante incentives and legal costs is also analysed by Bernado et al. (2000) to discuss how a court should "weigh" the evidence offered by the plaintiff and the defendant. They argue that a stronger weight on the plaintiff's evidence encourages the plaintiff to file a costly lawsuit and reduces the ex ante shirking by the defendant, and vice versa.

evaluations [see, for example, MacLeod (2003), Levin (2003) and Fuchs (2007)]. Given that the evaluations are not verifiable, money burning is needed to make the contract self-enforcing. MacLeod (2003) exogenously assumes a money burning technology, while Levin (2003) and Fuchs (2007) endogenize money burning through termination of contracts. In this paper, the contracted variable can possibly be verified by a court although not all parties can observe its realization in the settlement stage. In this respect, this paper is closer to the recent work of Doornik (2010). She studies how costly enforcement affects the form of the optimal contract when the output is privately monitored by the principal. In her model, the output can be perfectly verified after legal costs are incurred. Therefore, unlike our model, the strategic behaviour of the court is irrelevant to her analysis.

We organize the paper as follows. Section 2 presents the model. Section 3 shows the key results and compares the effectiveness of the two types of courts in enhancing welfare. Section 4 applies the proposed theory to contrast private arbitrators with public courts as contract enforcers, and discusses the implementation of the optimal legal system. Section 5 delivers the concluding remarks. All proofs are shown in the appendix.

# 2 The Model

The basic framework of the model is a moral hazard problem with three players: a principal, an agent and a court[5]. The principal employs the agent to deliver an output. The quality of the output, denoted by $x \in \{x_l, x_h\}$ where $x_l < x_h$, is a random variable and its distribution depends on the level of non-verifiable effort invested by the agent. We assume that $x$ is the only contractible variable in the model, which can be verified by the court at a cost. Formally, the game proceeds in the following manner:

1. The principal offers a contract $(t_l, t_h)$ to the agent, where $t_i$ represents the monetary transfer from the principal to the agent if the court rules $x = x_i$.

2. The agent decides whether to accept the contract. Upon acceptance, he chooses the level of effort $a \in [0, 1]$ to invest.

[5]For clarity, we use feminine, masculine and neuter pronouns to refer to the principal, the agent and the court respectively throughout this paper.

3. The quality of the output is realized and privately observed by the agent. The production technology takes the following form:

$$x = \begin{cases} x_h & \text{with probability } a \\ x_l & \text{with probability } 1-a \end{cases}.$$

4. The principal proposes a settlement transfer $s$ to the agent.

5. The agent decides whether to accept the principal's proposal. This decision is denoted by $z \in \{0, 1\}$. If the agent accepts the offer (i.e. $z = 1$), the principal transfers $s$ to the agent and the game ends. If she rejects it (i.e. $z = 0$), the dispute is brought to the court for resolution.

6. The court rules either $x = x_l$ or $x = x_h$ and enforces the contract accordingly. The legal procedure is discussed in detail in the upcoming section.

Unlike the standard moral hazard framework, we assume that the realized output is privately observed by the agent only. Such an information asymmetry gives rise to the possibility of settlement failure and contract litigation. This assumption is appropriate in many interesting cases that involve contracting with professionals and experts. Consider, for example, the situation in which a real estate developer hires a construction contractor to provide certain professional services. The developer, bound by limited expertise, may not be able to readily observe the actual quality of the services without external verification.[6] In this case, the court plays a critical role in verifying the quality and empowering the contract to induce incentives.

Based on the above model, the principal's strategy is simply $\{t_l, t_h, s(t_l, t_h)\}$, where $(t_l, t_h)$ denotes the contract offered and $s(\cdot)$ denotes the settlement proposal given the contract offered. On the other hand, the agent's strategy is defined as $\{a(t_l, t_h), z(t_l, t_h, a, x, s)\}$, where $a(\cdot)$ denotes the level of effort given the contract, and $z(\cdot)$ denotes the acceptance/rejection of

[6] One may argue that the developer can possibly compensate the contractor based on the profit derived from the final output (e.g. offering a bonus conditional on the rental value of the property), which is public information in some cases. This, however, leads to other issues. First, such a compensation scheme may not be practical if the realization of the profit takes a considerably long time and the contractor has to be compensated before this occurs. Moral hazard in teams [Holmstrom (1982)] is another potential concern if the profit only reflects the collective achievement of the entire team (which possibly includes the developer as well as other contractors) but not the contributions of individual members.


Figure 1: Contracting and settlement.

the settlement proposal, given the contract offered, the level of effort invested and the realized output quality. The court's strategy will be defined in the upcoming section where the legal procedure is formulated.

We assume that both the principal and the agent are risk neutral. The expected payoff of the principal is $E(x - T - L_P)$, where $T$ represents the monetary transfer to the agent and $L_P$ represents the legal costs she incurs. The composition of the legal costs will be discussed in depth after the legal procedure is formally described. On the other hand, the expected payoff of the agent is $E[T - c(a) - L_A]$, where $L_A$ represents the legal costs he incurs and $c(a)$ represents the cost of effort. It is assumed to take the standard form of $c(a) = \frac{K}{2}a^2$. We assume the cost parameter $K > 0$ is sufficiently large so that interior solution is guaranteed. The reservation payoff of the agent is normalized to 0.

Finally, we impose that the agent is bound by a limited liability constraint. It requires the contract proposed to satisfy $t_i \geq -M$ for all $i$, where $M > 0$ represents the agent's total wealth. This constraint eliminates the possibility for the agent to commit to contracts with unrealistic terms. We assume $M$ is sufficiently large such that the limited liability constraint does not bind in "normal" situations. However, without an evidence-based enforcement regime, we will show that "extreme" contract may arise to preserve incentives. In this case, this constraint can possibly affect contract formation.

## 2.1 Legal procedure

If the parties fail to settle, the dispute will be elevated to the court for resolution. Legal enforcement of contract is imperfect in the following sense. We assume that the court can perfectly verify the quality with probability $\delta \in [0, 1]$. If $\delta = 1$, the model is reduced to the standard framework with perfect enforcement. However, when $\delta < 1$, it is possible that the court is unable to verify the quality. In this case, a potentially costly full trial is launched in which evidence is generated and reviewed. The legal procedure is precisely outlined as follows.

1. If the dispute cannot be settled, the contract will be presented to the court for enforcement. The contract terms are public information, but the agent's effort and the settlement proposal are unknown to the court.

2. The court can perfectly verify the quality $x$ and enforce the contract accordingly with probability $\delta \in [0, 1]$.

3. If the court fails to verify $x$, a full trial will take place. The court decides how much legal effort $\kappa \in [0, \bar{\kappa}]$ to invest in the case.

4. Evidence, denoted by $e \in \{x_l, x_h\}$, is generated at the end of the trial. Given $x = x_i$, the evidence is generated according to the following technology:

$$e = \begin{cases} x_i & \text{with probability } p(\kappa) \\ x_j & \text{with probability } 1 - p(\kappa), \text{ where } j \neq i \end{cases},$$

   where $p(\cdot) \in [0.5, 1]$ is increasing and concave in $\kappa$. Assume that $p(0) = 0.5$ and $p(\bar{\kappa}) \leq 1$.

5. Upon observing the evidence, the court decides whether to rule for or against the principal. Let $X \in \{x_l, x_h\}$ denote this decision. If the court chooses $X = x_i$, it obligates the principal to transfer $t_i$ to the agent.

The court plays an active role only when perfect verification fails. Its strategy is $(\kappa(t_l, t_h), X(t_l, t_h, \kappa, e))$, where $\kappa(\cdot)$ denotes the level of legal effort to invest given the contract, and $X(\cdot)$ denotes the court's ruling given the contract, the legal effort invested and the evidence obtained. Let $\mu(t_l, t_h)$ represent the court's belief of the probability of $x = x_l$ given the contract presented. Finally, the court's objective takes the following form:

$$\max_{\kappa \in [0, \bar{\kappa}], X(\cdot) \in \{x_l, x_h\}} R \cdot Pr(X(\cdot) = x) - \phi(\kappa),$$

where $R > 0$, $\phi(0) = \phi'(0) = 0$ and $\phi'' > 0$. Assume that $\phi'(\bar{\kappa})$ is sufficiently large to guarantee interior solution.

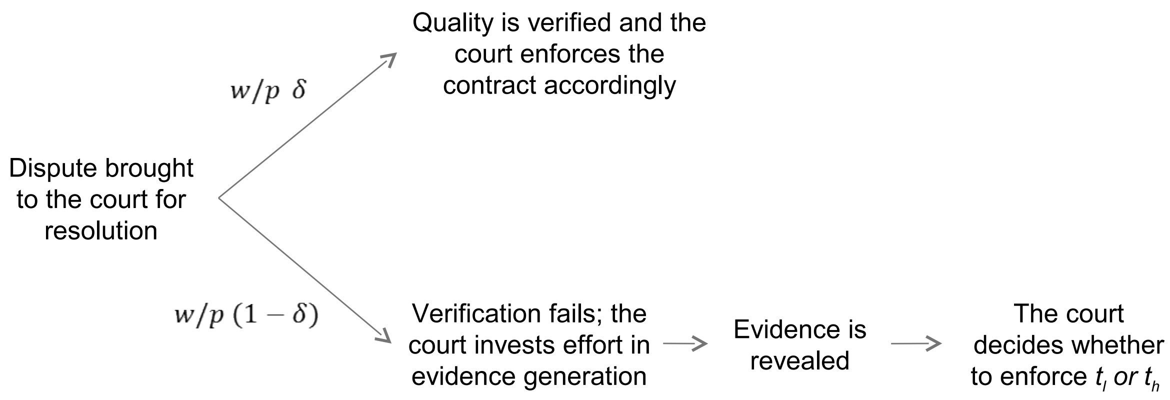


Figure 2: Legal procedure.

The enforcement model assembles some interesting features worthy of further discussion. One of the distinctive differences between our model and the standard framework is the possibility of verification failure. Such a specification allows the strategic behaviour of the court to potentially affect contract formation and welfare. Apart from modelling consideration, this setup also resembles the actual legal procedure. In particular, the initial stage of the enforcement model is analogous to the seeking of *summary judgements* in reality. In many jurisdictions, if a court finds that there are no issues of material facts requiring a full trial for resolution and that one party is clearly entitled to judgement given the undisputed facts, it can award a summary judgement in the pre-trial stage. The motivation of summary judgements is to avoid costly trials that are unnecessary. However, a summary judgement can be awarded only when simple but strong proof of the case is readily available in the pre-trial stage; otherwise a full trial will still take place and all evidence will be reviewed. This procedure is well captured by this enforcement model, with the probability parameter $\delta$ interpreted as the likelihood that a summary judgement will be awarded. This likelihood depends on the nature of the contracted variable as well as the court's expertise. We will discuss it in depth in Section 4.

The court's objective consists of two parts. The first part is its expected benefit derived from an accurate judgement. This can be motivated by considering the reputation concern of judges. In reality, given the flat monetary compensation structure of judges and the high job security they enjoy, their main motive to perform is the prospect of promotion. The chance of promotion depends critically on the reputations of the judges. If their rulings are inaccurate, they are more likely to be appealed and overturned by upper courts. This definitely harms their chances of being promoted. In order to protect their reputations, judges have incentives to minimize ruling errors.

Note that a judicial agency problem is present because it is costly to the court to generate informative evidence. A simple way to justify this setup is to consider an *inquisitorial* system where judges play an active role in evidence collection and interpretation. In this case, judges' costly effort clearly affects the accuracy of the evidence. However, we want to point out that this specification can also be rationalized in an *adversarial* system. While litigants are primarily responsible for providing supporting evidence in an adversarial system, judges are not entirely passive in the process. For instance, the U.S. federal judges are now playing a more managerial role in evidence discovery in civil cases. In particular, judges are empowered to have certain control over the amount of evidence discovery litigants can pursue.[7] In this context, we can interpret $\kappa$ as the extent of discovery judges allow. By encouraging discovery (i.e. setting a higher $\kappa$), judges can improve the informativeness of the evidence.[8] However, this can be costly to judges as more time and resources are needed for evidence processing and interpretation.[9]

*Legal costs.* Using the court to resolve contractual dispute is inevitably costly to the contracting parties. We assume that the expected legal costs incurred to the principal and the agent take the following form:

$$L_P(\kappa) \equiv \epsilon_P + (1-\delta)\gamma_P(\kappa),$$
$$L_A(\kappa) \equiv \epsilon_A + (1-\delta)\gamma_A(\kappa),$$

[7] Schrag (1999) documents that "Federal Rule of Civil Procedure 16 was amended in 1983 to permit judges to convene pretrial conferences in order to, among other things, "control and schedule discovery" and set a firm trial date. In 1993, FRCP 16 was further amended to require scheduling of discovery to be completed within 120 days of the defendant receiving the complaint. Moreover, Rules 30, 31, and 33 were amended to impose limits on the numbers of depositions and interrogatories that the litigants could take without special permission of the court."

[8] Note that the set of evidence discovered in the pretrial phase is not always equivalent to the set that is admissible at trial. However, supporting evidence not gathered or disclosed in the pretrial phase often becomes inadmissible eventually. Thus, the extent of discovery can still directly affect the quality of admissible evidence.

[9] In addition to these direct costs, lengthy litigations may also reflect badly on judges' competence. Such reputation costs should also be included in $\phi(\cdot)$.

where the subscripts represent the cost owners. We impose that $\gamma_i(0) = 0$ and $\gamma_i' > 0$. Define $\gamma(\kappa) \equiv \gamma_P(\kappa) + \gamma_A(\kappa)$ and $\epsilon \equiv \epsilon_P + \epsilon_A$, and let $L(\kappa)$ represent the total legal costs incurred. Note that the expected legal costs are composed of two components: the fixed cost term $\epsilon$ and the variable cost term $\gamma(\kappa)$. Whenever a contractual dispute is elevated to the court, both parties have to incur certain minimal legal costs such as the cost of filing a case. We assume that these costs are relatively low. If the court can readily verify $x$ and resolve the dispute, both parties do not need to incur any further costs. This corresponds to the fact that only small legal costs are incurred if summary judgements are awarded. However, a full trial is launched, then the parties are liable to some additional legal costs $\gamma(\kappa)$, which is increasing in $\kappa$.[10] Finally, to guarantee interior solution, we impose that $L(\bar{\kappa}) < x_h - x_l$. This means that the legal costs are never large enough to fully eliminate the surplus generated by the contractual relationship.

The objective of this paper is to understand the role of evidence-based ruling in contract enforcement, which matters when perfect verification of the contracted variable fails. We will compare the effectiveness of the following two types of courts in implementing effort and enhancing welfare. A court is said to be *purely evidence-based* if it always enforces the contract according to the evidence observed, meaning that it is obligated to set $X(\cdot) = e$. On the other hand, a court is *sophisticated* if it is not obligated to follow the evidence strictly. The belief of such court can possibly influence its rulings. Apart from this difference, both types of courts share the same objective and are equipped with the same evidence generation technology. We assume that the type of the court is publicly known.

Each contract $(t_l, t_h)$ defines a proper subgame of the entire contracting game. Within a subgame, an equilibrium is formed when (i) the court's strategy $(\kappa^*(\cdot), X^*(\cdot))$ is the best response given its belief $\mu^*(\cdot)$ and the equilibrium strategies of the principal and the agent, and $\mu^*(\cdot)$ is consistently formed; (ii) the agent's strategy $(a^*(\cdot), z^*(\cdot))$ is the best response given the equilibrium strategies of the principal and the court; and (iii) the principal's settlement proposal $s^*(\cdot)$ is the best response given the equilibrium strategies of the agent and the court. The principal's ultimate goal is to select a contract that generates the highest expected

[10] Following the previous discussion, the variable $\kappa$ can be interpreted differently in inquisitorial and adversarial systems. Regardless of its interpretations, a higher $\kappa$ eventually leads to more evidence generated. This naturally results in higher legal costs incurred to the litigants.

equilibrium payoff to her.

# 3 Optimal contracts

In this section, we are going to characterize the optimal contracts under the two different enforcement regimes. We start by solving the subgame in which the principal offers a contract $(t_l, t_h)$. Adopting the standard backward induction approach, we first consider the legal enforcement stage and characterize the behaviour of the two types of courts in equilibrium. To recapitulate, the contract can be perfectly enforced only if the output quality is successfully verified. The following lemma illustrates the equilibrium behaviour of the court when perfect verification fails.

**Lemma 1.** *Consider a subgame where the principal offers a contract* $(t_l, t_h)$*. Let* $\mu \in [0, 1]$ *be the equilibrium belief of the court in this subgame. Suppose that the court fails to perfectly verify* $x$*.*

1. *If the court is purely evidence-based, it invests an effort of* $\kappa^* = \hat{\kappa} \equiv \arg\max_{\kappa \in [0,\bar{\kappa}]} R \cdot p(\kappa) - \phi(\kappa)$ *in equilibrium, which is positive and independent of* $\mu$*.*

2. *If the court is sophisticated, then there exists* $\hat{\mu} \in (0, \frac{1}{2})$ *such that the best response of the court is to:*

   (a) *invest* $\kappa^* = 0$ *and rule* $X^*(\cdot) = x_l$ *for all* $e$ *if* $\mu \geq 1 - \hat{\mu}$*;*

   (b) *invest* $\kappa^* = 0$ *and rule* $X^*(\cdot) = x_h$ *for all* $e$ *if* $\mu \leq \hat{\mu}$*;*

   (c) *invest* $\kappa^* = \hat{\kappa}$ *and rule* $X^*(\cdot) = e$ *if* $\mu \in [\hat{\mu}, 1 - \hat{\mu}]$*.*[11]

   *Furthermore,* $\hat{\mu}$ *does not depend on* $(t_l, t_h)$*.*

Lemma 1 highlights the difference in behaviour between the two types of courts. The purely evidence-based court is obligated to strictly follow the evidence when ruling. Therefore, it has greater incentives to invest effort in order to generate evidence of higher accuracy, and such incentives prevail regardless of its belief. The sophisticated court, on the other hand,

[11] Indifference arises when $\mu \in \{\hat{\mu}, 1 - \hat{\mu}\}$, but how this is resolved does not affect our analysis.

invests in evidence generation only when it has a weak belief on the output quality (i.e. $\mu \simeq \frac{1}{2}$). When its belief is extreme, it totally ignores the evidence and rules based on the belief. In this case, the sophisticated court does not invest any costly effort in evidence generation.

After characterizing the equilibrium behaviour of the two types of courts, we can take a step back to analyse the settlement stage of the game. At this stage, the principal can offer a settlement proposal to the agent. Litigation can be avoided if the offer is accepted, but the parties are not always able to arrive at a settlement due to the information asymmetry. Again, focus on the subgame defined by a contract $(t_l, t_h)$. The information asymmetry in the settlement stage gives rise to two types of agent: the type $h$ who observes output of high quality and the type $l$ who observes output of low quality. Let $\eta_i$ be the probability, perceived by the type $i$ agent, that the court rules $X = x_l$ in the equilibrium of this subgame. The agent accepts a settlement offer if it is higher than his expected gain from litigation. More precisely, the type $i$ agent accepts an offer $s$ if $s > \eta_i t_l + (1 - \eta_i)t_h - L_A$, rejects it if $s < \eta_i t_l + (1 - \eta_i)t_h - L_A$, and is indifferent when equality holds. From Lemma 1, it is easy to see that $\eta_l \geq \eta_h$, which implies that the agent is (weakly) more willing to settle when $x = x_l$. The following lemma shows how the principal responds to the agent's strategy in equilibrium. Note that this lemma holds for both types of courts.

**Lemma 2.** *Consider a subgame where a contract $(t_l, t_h)$ is proposed. Suppose that in an equilibrium of this subgame, the agent invests a positive level of effort. Then in this equilibrium, $\eta_l > \eta_h$. Also, the principal has to offer $s = \eta_l t_l + (1 - \eta_l)t_h - L_A$ in the settlement stage, which is accepted if and only if $x = x_l$.*

Lemma 2 shows that if a contract is to induce any effort from the agent, then the contractual dispute is resolved by the court only when $x = x_h$. This result is in line with the findings of Bebchuk (1984). As argued by Priest and Klein (1984), Wittman (1988) and Shavell (1996), there is a certain degree of self-selection that determines what disputes are resolved by the court. In this model, such self-selection is governed by the information asymmetry concerning the contracted variable which arises naturally in many realistic situations. The intuition of the result is as follows. In order to induce the agent to invest effort, he must expect the probability that the court chooses $X = x_h$ is higher when the actual quality is high. Therefore, a better settlement offer is needed for the type $h$ agent to accept. If the

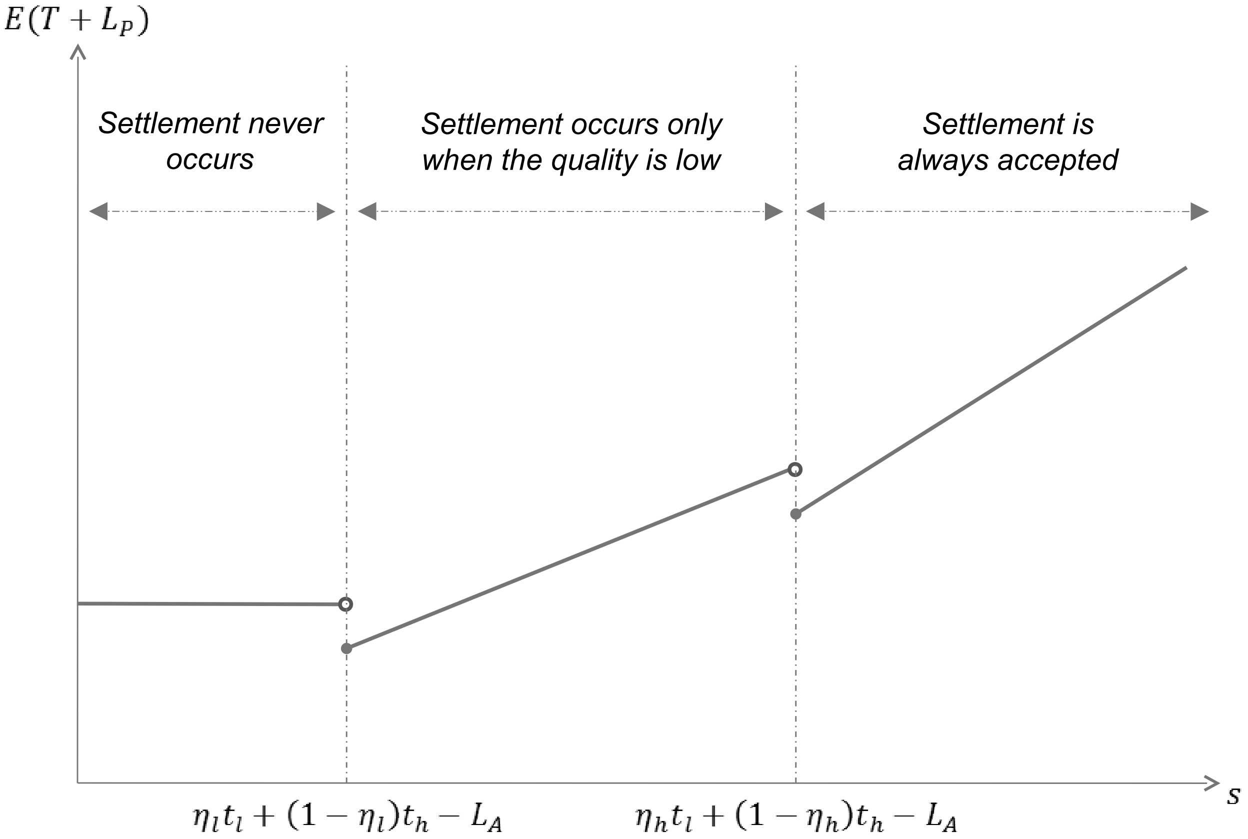


Figure 3: Equilibrium settlement proposal.

principal's offer is so high that both types of agent are willing to accept, then the agent's payoff will no longer depend on the quality and all the ex ante incentives will be destroyed. On the other hand, if the offer is too low and both types of agent reject it, the principal will incur unnecessary legal costs that can be avoided by improving the offer. Therefore, the only possible equilibrium outcome is a full separation of the two types of agent in which litigation only occurs when the quality is high. The argument is illustrated graphically in Figure 3.

An alternative way to model the settlement stage is to let the informed agent propose the settlement offer. The principal then decides whether to accept it. This framework was first studied by Reinganum and Wilde (1986). Note that in this alternative setup, the offer proposed by the informed agent can serve as a signal to the principal about the output quality. The signalling nature of the model complicates the analysis. However, it can be shown that in any pure strategy equilibrium of the signalling game, a similar separation result still prevails.[12]

[12]The argument is briefly sketched as follows. Suppose that the agent makes a settlement proposal of $s$ to the principal. In any equilibrium of the subgame, the principal must settle with the type $l$ agent. If not, the

Therefore, the key intuition of Lemma 2 is robust with respect to such modelling change.

The two lemmas characterize the equilibrium outcome given the contract offered. They help us set up the principal's optimal contracting problem. In the remainder of this section, we will characterize the optimal contracts under the two regimes and analyse their welfare implications.

## 3.1 Purely evidence-based court

We start by characterizing the agent's incentive constraint of the optimal contracting problem. The court is able to verify the output quality $x$ with probability $\delta$. If this fails, as shown in Lemma 1, the purely evidence-based court invests an effort of $\kappa^* = \hat{\kappa}$ in evidence generation, and rules based on the evidence found. Therefore, the probability that the court makes the correct judgement is $\delta' \equiv \delta + (1-\delta)p(\hat{\kappa})$. This implies $\eta_l = \delta'$ and $\eta_h = 1-\delta'$. According to Lemma 2, a settlement proposal of $s = \delta' t_l + (1-\delta')t_h - L_A(\hat{\kappa})$ is offered if a positive level of effort is to be implemented. The agent agrees to settle if and only if $x = x_l$. The expected monetary payoff of the agent is $\delta' t_h + (1-\delta')t_l - L_A(\hat{\kappa})$ if $x = x_h$, and is $\delta' t_l + (1-\delta')t_h - L_A(\hat{\kappa})$ if $x = x_l$. Therefore, the incentive constraint of the agent is:

$$a = \arg\max_{a'>0} a'[\delta' t_h + (1-\delta')t_l - L_A(\hat{\kappa})] + (1-a')[\delta' t_l + (1-\delta')t_h - L_A(\hat{\kappa})] - \frac{K}{2}a^2,$$

which can be simplified to the following first order condition:

$$Ka = (2\delta' - 1)(t_h - t_l). \tag{1}$$

We assume that the agent's reservation utility is 0. He is also subject to limited liability as discussed in the previous section. These imply the following constraints:

$$a[\delta' t_h + (1-\delta')t_l - L_A(\hat{\kappa})] + (1-a)[\delta' t_l + (1-\delta')t_h - L_A(\hat{\kappa})] \geq \frac{K}{2}a^2, \tag{2}$$

type $l$ agent can deviate to proposing $s' \in (s_l, s_l + L)$, where $s_l \equiv \eta_l t_l + (1-\eta_l)t_h - L_A$. This guarantees the principal's acceptance, and the expected transfer to the type $l$ agent is strictly higher than $s_l$. On the other hand, if $a > 0$ is implemented in an equilibrium of the subgame, then the settlement offer from the type $h$ agent must be rejected in this equilibrium. To see this, suppose that the principal accepts the settlement offers from both types of agent. To avoid deviation, their offers must be identical (i.e. a pooling equilibrium). This implies that the agent's monetary payoff is independent of the realized quality, and obviously no incentives can be induced.

$$t_l \geq -M. \tag{3}$$

Lemma 2 requires the principal to offer $s = \delta' t_l + (1-\delta')t_h - L_A(\hat{\kappa})$ in equilibrium in order to induce effort. However, this does not guarantee that such an offer minimizes the principal's expected monetary cost in the settlement stage. As illustrated in Figure 3, the principal can possibly deviate by proposing $s = \delta' t_h + (1-\delta')t_l - L_A(\hat{\kappa})$ and settling with both types of agent. The following condition needs to hold to prevent such a deviation:

$$a[\delta' t_h + (1-\delta')t_l + L_P(\hat{\kappa})] + (1-a)[\delta' t_l + (1-\delta')t_h - L_A(\hat{\kappa})] \leq \delta' t_h + (1-\delta')t_l - L_A(\hat{\kappa}).$$

Combining the above condition with (1), the following constraint is obtained:

$$L(\hat{\kappa}) \leq K(1-a). \tag{4}$$

Notice that this constraint effectively puts an upper limit on the level of effort that can be implemented. It becomes more binding when legal costs go up. Intuitively, if $a \simeq 1$, the principal is very likely to face a type $h$ agent in the settlement stage. This tempts her to propose a high settlement offer to avoid costly litigation with the type $h$ agent, but this deviation destroys the agent's ex ante incentives to invest. Therefore, such a high level of effort cannot be implemented.

With the constraints properly identified, the following proposition characterizes the optimal contract when the court is purely evidence-based.

**Proposition 1.** *Suppose the court is purely evidence-based. Then the optimal contract solves the following problem:*

$$\begin{aligned} \max_{a,t_i} \quad & a[x_h - (\delta' t_h + (1-\delta')t_l + L_P(\hat{\kappa}))] + (1-a)[x_l - (\delta' t_l + (1-\delta')t_h - L_A(\hat{\kappa}))] \\ s.t. \quad & (1), (2), (3), (4) \end{aligned}$$

*For sufficiently large $M$, the optimal contract takes the following form:*

$$t_h^* = \frac{\delta' x_h - (1-\delta')x_l}{2\delta' - 1} - \frac{\delta' L_P(\hat{\kappa}) + (1-\delta')L_A(\hat{\kappa})}{2\delta' - 1} - W_e,$$

$$t_l^* = \frac{\delta' x_l - (1-\delta')x_h}{2\delta' - 1} + \frac{\delta' L_A(\hat{\kappa}) + (1-\delta')L_P(\hat{\kappa})}{2\delta' - 1} - W_e,$$

*where*

$$W_e = \max_a a(x_h - L(\hat{\kappa})) + (1-a)x_l - \frac{K}{2}a^2.$$

*The level of effort being implemented, $a_e^*$, is:*

$$a_e^* = \arg\max_a a(x_h - L(\hat{\kappa})) + (1-a)x_l - \frac{K}{2}a^2 = \frac{x_h - x_l - L(\hat{\kappa})}{K}.$$

Risk neutrality enables us to characterize the optimal contract easily. Note that when $\delta < 1$, there is a positive probability that the purely evidence-based court needs to rule based on the imperfect evidence. Therefore, the court's ruling is not always accurate, and this weakens the incentives provided by any given contract $(t_l, t_h)$. In order to preserve the agent's incentives to invest, the principal has to commit to a larger incentive "bonus" $(t_h - t_l)$ to counter the impact of inaccurate ruling. As long as the limited liability constraint is not too binding, she can fully eliminate the impact of litigation risk on effort implementation by manipulating the bonus.

## 3.2 Sophisticated court

The optimal contracting problem in this case can be set up in a similar fashion. According to Lemma 2, if a contract $(t_l, t_h)$ is to implement a positive level of effort, then, in equilibrium, the dispute is resolved by the court only when the quality is high. Therefore, the sophisticated court has to form a consistent belief of $\mu^*(t_l, t_h) = 0$. If perfect verification fails, Lemma 1 shows that this court will simply invest $\kappa^* = 0$ and rule $X^* = x_h$ regardless of the evidence presented. This implies $\eta_l = \delta$ and $\eta_h = 0$, and the legal costs incurred are minimal (i.e. $L(\kappa^*) = \epsilon$). Applying Lemma 2 again, the principal proposes a settlement of $s = \delta t_l + (1 - \delta)t_h - \epsilon_A$ in equilibrium, which is accepted by the type $l$ agent only. The type $h$ agent, who always files a lawsuit and wins it, eventually receives a payoff of $t_h - \epsilon_A$. The agent's incentive constraint can thus be constructed as follows:

$$a = \arg\max_{a'>0} a'(t_h - \epsilon_A) + (1-a')[\delta t_l + (1-\delta)t_h - \epsilon_A] - \frac{K}{2}a^2,$$

which is equivalent to the following first order condition:

$$Ka = \delta(t_h - t_l). \tag{5}$$

The agent's individual rationality constraint in this case is:

$$a(t_h - \epsilon_A) + (1-a)[\delta t_l + (1-\delta)t_h - \epsilon_A] \geq \frac{K}{2}a^2, \tag{6}$$

and the limited liability constraint is still (3). Finally, we need to ensure that the principal's optimal offer to propose in the settlement stage is indeed $s = \delta t_l + (1-\delta)t_h - \epsilon_A$. Adopting a similar approach as shown in the previous case, the following constraint is obtained:

$$\epsilon \leq K(1-a). \tag{7}$$

The following proposition characterizes the optimal contract when the court is sophisticated.

**Proposition 2.** *Suppose the court is sophisticated. Then the optimal contract solves the following problem:*

$$\begin{aligned} \max\nolimits_{a,t_i} \quad & a[x_h - (t_h + \epsilon_P)] + (1-a)[x_l - (\delta t_l + (1-\delta)t_h - \epsilon_A)] \\ s.t. \quad & (3), (5), (6), (7) \end{aligned}$$

*The optimal contract depends on the probability parameter $\delta$. In particular, for sufficiently large $M$, there exists $\tilde{\delta} \in (0,1)$ such that:*

1. *If $\delta \geq \tilde{\delta}$, the optimal contract is:*

$$\begin{aligned} t_h^* &= x_h - \epsilon_P - W_s, \\ t_l^* &= \frac{1}{\delta}[x_l - (1-\delta)(x_h - \epsilon)] + \epsilon_A - W_s, \end{aligned}$$

*where*

$$W_s = \max_{a>0} a(x_h - \epsilon) + (1-a)x_l - \frac{K}{2}a^2.$$

*The level of effort being implemented, $a_s^*$, is at the first best level:*

$$a_s^* = a_{fb} \equiv \arg\max_a a(x_h - \epsilon) + (1-a)x_l - \frac{K}{2}a^2 = \frac{x_h - x_l - \epsilon}{K}.$$

2. *If $0 < \delta < \tilde{\delta}$, the optimal contract is:*

$$\begin{aligned} t_h^* &= \frac{K a_s^*}{\delta} - M, \\ t_l^* &= -M, \end{aligned}$$

*where $a_s^*$ is determined by the following equation:*

$$-M - \epsilon_A + K a_s^* (\frac{1}{\delta} - 1) + \frac{K}{2} a_s^{*2} = 0.$$

*Furthermore, $a_s^*$ is continuously increasing in $\delta$ and it satisfies $\lim_{\delta \to \tilde{\delta}} a_s^* = a_{fb}$ and $\lim_{\delta \to 0} a_s^* = 0$.*

3. *If $\delta = 0$, it is impossible to induce any effort from the agent through contracting. Thus, $a_s^* = 0$.*

## 3.3 Comparisons

With the optimal contracts characterized, we can compare the effectiveness of the two enforcement regimes in enhancing welfare. In the benchmark case where the output quality can always be perfectly verified (i.e. $\delta = 1$), the strategic behaviour of the court is irrelevant to the contracting problem. Therefore, the same optimal contract is offered by the principal under the two different regimes, and the first best level of effort is implemented.[13] Once we depart from this case and allow for legal imperfections (i.e. $\delta < 1$), the court's behaviour can affect the optimal contract. Interestingly, the impact depends crucially on the types of courts faced by the contracting parties. The following proposition compares the level of effort implemented under the two different regimes.

[13] Strictly speaking, it is not exactly the first best scenario because some minimal legal costs are still incurred in equilibrium. However, as shown in Lemma 2, these costs cannot be avoided if the contract is to provide any incentives. Therefore, this case already demonstrates the best possible outcome.

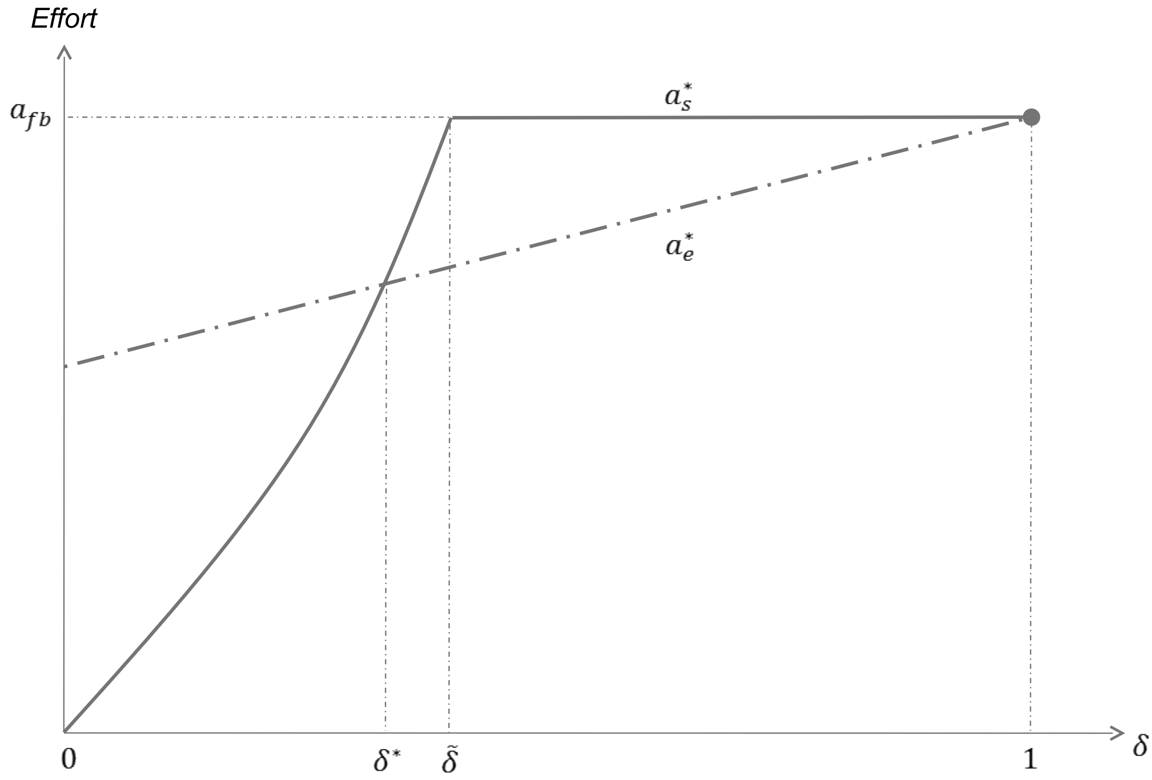


Figure 4: Effort implementation under the two regimes.

**Proposition 3.** *There exists $\delta^* \in (0, \tilde{\delta})$ such that $a_e^* > a_s^*$ when $\delta < \delta^*$, and $a_e^* \leq a_s^*$ when $\delta \geq \delta^*$.*

The levels of effort implemented under the two enforcement regimes are illustrated graphically in Figure 4. If the court is purely evidence-based, the principal is able to fully preserve the contractual incentives by manipulating the contract terms appropriately. However, the equilibrium level of effort $a_e^*$ still decreases when the degree of imperfections increases (i.e. when $\delta$ falls). This is due to the change of legal costs. A purely evidence-based court is more devoted to evidence generation, leading to higher expected legal costs which are incurred only when the output quality is high. This reduces the marginal benefit of the agent's effort and downwards distorts $a_e^*$. When the degree of imperfections increases, the expected legal costs go up (due to the increase in the probability of full trial) and the optimal level of effort the principal desires to implement decreases. Nevertheless, given that legal costs are not large enough to fully eliminate the surplus (i.e. $L(\kappa) < x_h - x_l$), a positive level of effort is still always implemented under the purely evidence-based court.

The legal costs concern discussed above does not exist if the court is sophisticated. Supported by the extreme equilibrium belief, the sophisticated court rules without investing heavily in evidence generation. As a result, the legal costs incurred by the parties are minimal regardless of $\delta$. On the flip side, legal imperfections can possibly limit the incentives provided by contracts in this case. Note that the sophisticated court can always make the right judgement on the equilibrium path. Off the equilibrium path (i.e. when $x = x_l$), however, the court rules correctly only when the quality can be perfectly verified. Therefore, the incentive provision power of contracts depends critically on the likelihood of perfect verification. If the probability of perfect verification is high, the first best outcome described in the benchmark case can still be achieved by adjusting $t_l$, and thus $a_s^* > a_e^*$. However, the agent's limited liability constraint eventually binds for sufficiently low $\delta$, and the first best outcome can no longer be achieved by any feasible contract. The level of effort implemented falls rapidly as $\delta$ decreases, and, eventually, $a_s^* < a_e^*$. In the extreme case in which perfect verification is never possible (i.e. $\delta = 0$), the sophisticated court always rules $X = x_h$ on and off the equilibrium path. As a result, no effort from the agent can possibly be induced by contracting.

Based on the above results, we can compare the two enforcement regimes in terms of welfare enhancement. In this paper, we focus on the welfare of the contracting parties. The payoff of the court is not included in the welfare analysis. To justify this exclusion, note that the court's objective is largely driven by its reputation concern. The way that the reputation is converted into actual benefits (e.g. increase in promotion chances) is specific to the legal regime in place. In this sense, the payoffs of the two types of courts are not directly comparable. From the practical point of view, this interpretation of welfare also allows us to analyse how contracting parties choose their contract enforcer. This issue will be further discussed in Section 4.

Note that the agent always receives his reservation utility in equilibrium, and the principal captures the full surplus generated from the contracting relationship. Therefore, it suffices to focus on the principal's equilibrium payoffs achieved under different regimes. This is formally characterized in the following proposition.

**Proposition 4.** *Let $U_e^*$ and $U_s^*$ be the principal's equilibrium payoffs when the court is purely* *evidence-based and sophisticated respectively. For sufficiently large $M$, there exists $\delta^{**} \in (0, \delta^*)$ such that $U_e^* > U_s^*$ when $\delta < \delta^{**}$, and $U_e^*(\delta) \leq U_s^*(\delta)$ when $\delta \geq \delta^{**}$.*

Proposition 4 shows that the purely evidence-based court is the optimal enforcement regime when $\delta$ is low, and vice versa. The result is graphically illustrated in Figure 5, and the logic behind is similar to that of Proposition 3. The probability of perfect verification is one of the key factors determining the optimality of evidence-based ruling. From the theoretical perspective, this probability measures how far our model deviates from the standard framework in which perfect verification is assumed. We show that evidence-based ruling is welfare enhancing if and only if the deviation is sufficiently large (i.e. $\delta << 1$); otherwise the incentives benefits are not sufficient to justify the increase in legal costs. Practically, the parameter $\delta$ captures certain important aspects of the contracting environment such as the complexity of the contracted variable and the expertise of the court. Our model predicts that an evidence-based court is preferred if the contracted variables are complex and difficult to be verified. On the other hand, if the contracts are relatively standard, and the adjudicators possess the relevant experience and expertise in dealing with similar cases, then evidence-based ruling may not be desirable due to the extra legal costs incurred. In the upcoming section, we will further discuss its implications on enforcement regime selection in reality.

# 4 Discussion: Public Courts versus Private Arbitrators

In the previous sections, we develop a model to analyse the welfare implications of evidence-based ruling. Making allowances for legal imperfections, we show that the contracting parties incur different kinds of costs under different enforcement regimes. The tradeoff between these costs determines the optimal regime. In the model, the enforcement regime in place is exogenously assigned to the contracting parties. If they are able to choose and commit to a particular regime through contracting, the welfare maximizing regime should naturally emerge as their choice.

We term the contract enforcer "court" throughout the paper. In practice, however, not all contracts are enforced by public courts. Instead, it is quite common for parties to resolve their contractual disputes through private arbitration. In order to enforce a contract through

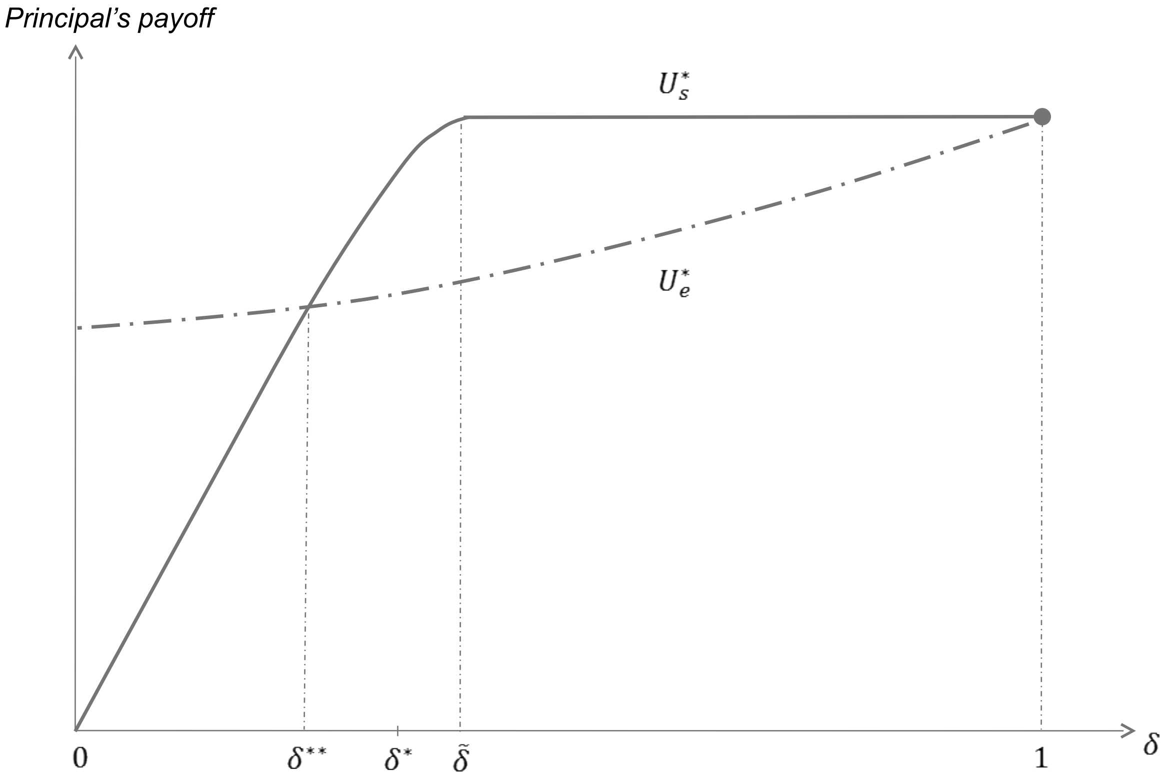


Figure 5: Optimal enforcement regime.

private arbitration, the contracting parties need to include an arbitration clause in their contract. This mandates the parties to resolve their future disputes, if any, through private arbitration rather than litigation. Such a clause is usually well respected by the courts.[14] Therefore, private arbitration is a feasible alternative that the contracting parties can choose to enforce their contracts.

In this section, we are going to contrast these two enforcement regimes. We argue that public courts respect evidence-based ruling but private arbitrators tend to be sophisticated. In fact, such a difference is acknowledged in the literature of arbitration and litigation. It is often assumed that arbitrators can infer information from disputants' strategies and incorporate this in their decision making,[15] while public courts are usually considered to be evidence-based.[16] In reality, public courts and private arbitrators do differ widely in their objectives

[14]In the U.S., for example, the Federal Arbitration Act (F.A.A.) provides for the judicial facilitation of private dispute resolution through arbitration. Once the contracting parties agree to arbitrate, the court enforces the arbitration clause accordingly, and requires the parties to resolve any future disputes through arbitration in lieu of going to the court.

[15]See, for example, Gibbons (1988), Samuelson (1991), and Olszewski (2011).

[16]See, for example, Bebchuk (1984), Schweizer (1989), Daughety and Reinganum (2000a, 2000b), Baye et

as well as the constraints they are subject to.

☐ *Restrictions on rulings.* Public courts are usually bound by rules of evidence and procedure. These restrictions prevent them from basing their rulings on their subjective beliefs. For example, courts are required to focus only on admissible evidence. Once a piece of evidence is ruled inadmissible, jurors and judges are not allowed to form inferences based on it. In particular, the fact that settlement fails, which drives the sophisticated court to form an extreme equilibrium belief in the model, is inadmissible as evidence in the U.S. Federal Courts.[17] In the common law system, judges are further restricted by the precedents set by other judges in previous cases. With the aforementioned restrictions, rulings by public courts need to be well justified by objective facts and evidence. Private arbitrators, on the other hand, enjoy a much higher degree of freedom in making decisions.[18] Compared with public courts, arbitrators' judgements are more likely to be influenced by their personal beliefs.

☐ *Enforcers' incentives and monitoring.* Reputation-driven judges are concerned their verdicts are overturned by upper appellate courts. As Posner (1998) points out, a primary function of the appellate courts is to guarantee the proper interpretation of law by lower courts. Therefore, while accurate judgements are less likely to be challenged, judges still need to ensure that all important rules and procedures are closely followed in order to avoid being reversed. Private arbitrators also have reputation incentives, but the monitoring scheme they are subject to is different. Arbitration awards are usually final and irrevocable except under exceptional circumstances.[19] From this perspective, the risk of being reversed is not a key concern of arbitrators. Indeed, given that private arbitrators serving a particular industry are usually practitioners in that industry, they are more concerned about their reputations within their profession. This gives them stronger incentives to strive for accuracy in order to

al. (2005), and Friedman and Wittman (2007).

[17]See Federal Rules of Evidence 408 in Graham (1992).

[18]For example, Mentschikoff (1961) reports that most arbitrators felt "they were free to ignore these rules [of substantive law] whenever they thought that more just decisions would be reached by doing so." A more recent discussion of labour arbitration by Murray et al. (1996) also arrives at similar conclusions. Even judges are aware of arbitrators' tendency and willingness to ignore legal rules, as reported by Guzman (2000) (see Wilko v. Swan, 346 U.S. 427 (1953); Barrentine v. Arkansas-Best Freight Sys., Inc., 450 U.S. 728, 744 (1981); Alexander v. Gardner-Denver Co., 415 U.S. 36, 56 (1974)).

[19]In the U.S., for example, the F.A.A. states that an arbitral ruling can only be overturned if obvious arbitrator misconduct such as corruption or fraud has occurred (Chapter 1 Section 10). Courts cannot modify or correct an arbitral award unless (1). there is an evident material mistake or miscalculation; (2). the matter is not submitted to the arbitrator who awards; or (3). the award is imperfect in matter of form not affecting the merits of the controversy (Chapter 1 Section 11).

signal their expertise and professional knowledge in their specialized fields. The pursuance of judgement accuracy makes private arbitrators behave like a sophisticated court.

Based on the above argument, we see that public courts and private arbitrators are analogous to the purely evidence-based court and the sophisticated court respectively. Our proposed theory can be applied to discuss how an enforcement regime is selected in practice.

1. Private arbitration as an alternative enforcement regime.

This is the central issue of this section. Our model suggests that if the arbitrator possesses the expertise to verify the variable easily, private arbitration is the better enforcement regime due to the legal cost advantage. In practice, the legal cost consideration is indeed one of the main motivations for private arbitration. Of course, the success of arbitration relies heavily on the arbitrators' speciality and experience in verifying the contracted variables. This explains the prevalence of private arbitration in enforcing industry-specific contracts, thanks to the availability of qualified arbitrators from the profession. On the flip side, a common critique against private arbitration is that arbitrators are likely to be biased, even though most arbitration associations put a strong emphasis on their neutrality. We show that the sophisticated arbitrators tend to rule without support from objective evidence. In complicated situations where the contracted variables are not readily verifiable by third parties, their inability to interpret evidence properly severely limits the contractual incentives. This problem can be alleviated by evidence-based ruling, and thus public courts are preferred despite the high legal costs.[20]

The relationship between legal costs and regime selection is worthy of further discussion. It is commonly believed that rising legal costs should increase the appeal of arbitration. While the legal cost advantage is a major motivation for private arbitration, whether higher legal costs necessarily justify private arbitration is doubtful. Note that a rise in the expected legal costs can be caused by costlier evidence generation (i.e. $\gamma(\cdot)$ increases), or by increasing difficulty in verification (i.e. $\delta$ decreases). In the former case, the welfare achieved under the evidence-based regime falls, and thus private arbitration becomes relatively more attractive. In the latter case, however, the change in fact favours evidence-based ruling. Therefore, the

[20] Observing their shortcomings in dealing with complex cases, some arbitration associations may even encourage their members to resolve their disputes legally if needed. See Bernstein (1992) for an example in the diamond industry.

reasons leading to the rise in legal costs need to be correctly identified in order to determine its impact on the enforcement regime selection.

2. The optimal legal enforcement system.

Given that the two regimes have their specific strengths and weaknesses, a well-designed system should allow both of them to coexist so that the contracting parties are free to select the one that suits them better. For private arbitration to be effective, public courts must properly enforce arbitration clauses, and obligate the parties to resolve their disputes accordingly. To see why this is important, recall that the sophisticated arbitrator tends to form a belief against the principal and rule based on this belief. Therefore, even though the principal may prefer private arbitration when the contract is being drafted, she is tempted to deviate later, and bring the dispute to public court for resolution. A binding arbitration clause is necessary to prevent the ex post opportunistic behaviour of the contracting parties from voiding the private arbitration regime.

3. Core qualities of a good judge/arbitrator.

Public courts and private arbitrators contribute differently in the optimal system. The commitment to evidence allows public courts to preserve contractual incentives even when the contracted variables are hard to verify. Private arbitrators, on the other hand, count on their ability to promptly verify the contracted variables, thus providing a cheaper enforcement alternative. Given such difference, judges and arbitrators require different core qualities to succeed. Disputes resolved by public courts tend to be more complicated, and perfect verifications are usually not possible. Consequently, judges need to interpret the law and evidence properly to ensure that their judgements are well justified. It is also important for them to optimize the evidence presentation and review process, and be ready to make the best decision with imperfect information. Private arbitrators, however, do not have to be proficient general fact-finders like judges. Instead, competent arbitrators need to be very experienced in their specialized fields so that they can arrive at the correct verdicts readily. This explains why arbitrators are typically seasoned practitioners or industry experts.

# 5 Conclusion

In this paper, we develop a theoretical model to analyse the value of evidence-based ruling and the cost of its implementation in the context of incentive contract enforcement. Evidence-based ruling is defined as the exclusive use of objective evidence in ruling. In order to improve the accuracy of its judgement, the purely evidence-based court always invests costly effort and time to generate informative evidence, resulting in higher legal costs incurred by the contracting parties. On the other hand, the ruling of the sophisticated court, which is not restricted to be evidence-based, can be heavily influenced by its equilibrium belief. Given the information asymmetry in the settlement stage, the litigated dispute is self-selected in favour of the informed party. The sophisticated court takes this self-selection into consideration, and delivers judgement without reviewing objective evidence. This simplifies the trial and lowers the legal costs, but the contractual incentives can be compromised. Whichever regime is preferable depends on the tradeoff between the legal costs and the incentives loss. If the contracted variable can be easily verified, the incentives loss is limited and thus the sophisticated court is more effective in enhancing welfare. However, in complex situations where such a verification is difficult, the loss in incentives can be so large that no effort from the agent can be induced. The purely evidence-based court is preferred in this case for its ability to preserve the agent's incentives to invest.

Finally, we apply the proposed theory to discuss how the enforcement regime is selected in reality. In some circumstances, contracting parties are able to elect to arbitrate their contractual disputes instead of going to court. Due to the differences in their objectives and constraints, we argue that public courts and private arbitrators have the tendency to be purely evidence-based and sophisticated respectively. Given such distinction, our model suggests that the two regimes have their specific advantages and shortcomings. They complement each other in the optimal legal enforcement system, and their co-existence allows the contracting parties to select the regime that suits them better.

# A Appendix

*Proof of Lemma 1.*

1. Note that the purely evidence-based court always sets $X(\cdot) = e$. This implies $Pr(X(\cdot) = x) = p(\kappa)$. Therefore, the court's optimization problem is simplified to:

$$\max_{\kappa \in [0,\bar{\kappa}]} R \cdot p(\kappa) - \phi(\kappa),$$

which is solved by setting $\kappa^* = \hat{\kappa}$. It is positive given the assumptions on $p(\kappa)$ and $\phi(\kappa)$, and is independent of the belief $\mu$.

2. Consider the case in which a positive $\kappa$ is invested in equilibrium. In this case, the sophisticated court must strictly follow the evidence and rule $X(\cdot) = e$. To see this, suppose to the contrary that the best response of the court is to invest $\kappa > 0$ and rule $X(\cdot) = x_i$ when $e = x_j$ for some $i \neq j$. If so, the court must also rule $X(\cdot) = x_i$ when $e = x_i$. Now consider the alternative strategy in which the court invests $\kappa = 0$ and sets $X(\cdot) = x_i$ for all $e$. Deviating to this alternative lowers the effort cost of the court without affecting the accuracy of its judgement. This is a profitable deviation and thus the initial solution cannot be optimal. Note that if the sophisticated court rules $X(\cdot) = e$, it will optimally set $\kappa = \hat{\kappa}$ as argued in case (1). The court's payoff in this case is $R \cdot p(\hat{\kappa}) - \phi(\hat{\kappa})$.

Consider the case in which the sophisticated court invests $\kappa = 0$. In this case, the optimal response of the court is to rule $X(\cdot) = x_l$ for all $e$ if $\mu \geq \frac{1}{2}$, and to rule $X(\cdot) = x_h$ for all $e$ if $\mu \leq \frac{1}{2}$. This gives a payoff of $R \cdot \max\{\mu, 1 - \mu\}$.

Define $\hat{\mu} \equiv 1 - p(\hat{\kappa}) + \frac{\phi(\hat{\kappa})}{R}$. Clearly, $\hat{\mu}$ is independent of the contract $(t_l, t_h)$. Notice that $\frac{1}{2}R < R \cdot p(\hat{\kappa}) - \phi(\hat{\kappa}) < R$. This implies $\hat{\mu} \in (0, \frac{1}{2})$. Also,

$$R \cdot p(\hat{\kappa}) - \phi(\hat{\kappa}) \geq \max\{\mu, 1 - \mu\}R,$$

if $\mu \in [\hat{\mu}, 1 - \hat{\mu}]$, and

$$R \cdot p(\hat{\kappa}) - \phi(\hat{\kappa}) \leq \max\{\mu, 1 - \mu\}R,$$

if $\mu \leq \hat{\mu}$ or $\mu \geq 1 - \hat{\mu}$. Therefore, the claim is proved. □

*Proof of Lemma 2.*

Consider the subgame where the principal offers $(t_l, t_h)$. By Lemma 1, it is trivial that $\eta_l \geq \eta_h$. We now show that $\eta_l > \eta_h$ must hold in equilibrium if $a > 0$ is implemented in this subgame. Suppose to the contrary that $\eta_l = \eta_h \equiv \eta$. If so, both types of agent accept the settlement $s$ if $s > \eta t_l + (1-\eta)t_h - L_A$, and reject it if $s < \eta t_l + (1-\eta)t_h - L_A$. In order to avoid incurring legal costs, the principal offers $s = \eta t_l + (1-\eta)t_h - L_A$ in equilibrium to settle with both types of agent. The monetary transfer to the agent is then independent of the realized quality, and therefore $a > 0$ cannot be implemented.

Suppose that an effort of $a > 0$ is implemented in this subgame. Let $u(s)$ be the principal's expected monetary transfer (including the transfer to the agent and the legal costs) in the settlement stage. Define $s_i \equiv \eta_i t_l + (1-\eta_i)t_h - L_A$. Note that $\eta_l > \eta_h$ implies $s_l < s_h$. Given the settlement offer $s$, the type $i$ agent accepts it if $s > s_i$, reject it if $s < s_i$, and is indifferent if $s = s_i$. This implies:

$$u(s) = \begin{cases} s & \text{if } s > s_h, \\ a(s_h + L) + (1-a)s & \text{if } s \in (s_l, s_h), \\ a(s_h + L) + (1-a)(s_l + L) & \text{if } s < s_l, \end{cases}$$

and $u(s_l)$ and $u(s_h)$ depend on how the agent resolves indifference.

The principal chooses $s$ to minimize $u(s)$ in equilibrium. Note that if $a > 0$, $\inf_{s > s_h} u(s) = s_h$ and $\inf_{s \in (s_l, s_h)} u(s) = a(s_h + L) + (1-a)s_l \leq a(s_h + L) + (1-a)(s_l + L)$. Therefore, in equilibrium where $u(s)$ is minimized, the principal either proposes $s = s_h$ which is always accepted, or proposes $s = s_l$ which is accepted only when $x = x_l$. In the first case, the agent's monetary payoff is independent of the realized quality, and therefore $a > 0$ cannot be implemented. As a result, the second case is the only possible equilibrium outcome if $a > 0$ is implemented. □

*Proof of Proposition 1.*

It is straightforward to formulate the principal's optimal contracting problem given the constraints identified in Section 3. Now ignore the constraints (3) and (4), and consider the relaxed contracting problem. In order to fully align the agent's incentives with the principal's objective, the optimal contract has to satisfy:

$$Ka_e^* = (2\delta' - 1)(t_h^* - t_l^*),$$

where

$$a_e^* = \arg\max_a a(x_h - L(\hat{\kappa})) + (1-a)x_l - \frac{K}{2}a^2 = \frac{x_h - x_l - L(\hat{\kappa})}{K}.$$

This, together with (2), implies:

$$t_h^* = \frac{\delta' x_h - (1-\delta')x_l}{2\delta' - 1} - \frac{\delta' L_P(\hat{\kappa}) + (1-\delta')L_A(\hat{\kappa})}{2\delta' - 1} - W_e,$$

$$t_l^* = \frac{\delta' x_l - (1-\delta')x_h}{2\delta' - 1} + \frac{\delta' L_A(\hat{\kappa}) + (1-\delta')L_P(\hat{\kappa})}{2\delta' - 1} - W_e,$$

where

$$W_e = \max_a a(x_h - L(\hat{\kappa})) + (1-a)x_l - \frac{K}{2}a^2.$$

Observe that $K(1 - a_e^*) = K - x_h + L(\hat{\kappa}) + x_l > L(\hat{\kappa})$, implying that (4) is not binding. Also, notice that $\delta' \geq p(\hat{\kappa}) > \frac{1}{2}$. Hence, $t_l^*$ is bounded away from negative infinity, and (3) does not bind for large $M$. Therefore, the optimal contract of the relaxed problem also solves the original problem. □

*Proof of Proposition 2.*

Similar to Proposition 1, the formulation of the principal's optimization problem simply follows after all the constraints are identified. Again ignore the constraints (3) and (7), and consider the relaxed contracting problem. The optimal contract can be characterized using a similar approach:

$$t_h^* = x_h - \epsilon_P - W_s,$$

$$t_l^* = \frac{1}{\delta}[x_l - (1-\delta)(x_h - \epsilon)] + \epsilon_A - W_s,$$

where

$$W_s = \max_{a>0} a(x_h - \epsilon) + (1-a)x_l - \frac{K}{2}a^2 = \frac{(x_h - x_l - \epsilon)^2}{2K} + x_l. \tag{A.1}$$

The level of effort being implemented is determined by:

$$a_{fb} = \arg\max_a a(x_h - \epsilon) + (1-a)x_l - \frac{K}{2}a^2 = \frac{x_h - x_l - \epsilon}{K}.$$

Observe that $K(1-a_{fb}) = K - x_h + \epsilon + x_l > \epsilon$. Therefore, (7) is satisfied if $a \le a_{fb}$. Note that $t_l^*$ is increasing in $\delta$ and $\lim_{\delta\to 0} t_l^* = -\infty$. Define $\tilde{\delta}$ by the following equation:

$$\frac{1}{\tilde{\delta}}[x_l - (1-\tilde{\delta})(x_h - \epsilon)] + \epsilon_A - W_s = -M. \tag{A.2}$$

Note that $\tilde{\delta} \in (0,1)$ for sufficiently large $M$. Consider the following three cases:

*Case 1:* $\delta \ge \tilde{\delta}$. In this case, (3) does not bind. Also, (7) is also satisfied at $a_s^* = a_{fb}$. Therefore, the optimal contract of the relaxed problem also solves the original problem.

*Case 2:* $0 < \delta < \tilde{\delta}$. In this case, (3) binds and $t_l^* = -M$. The incentive constraint becomes $Ka = \delta(t_h + M)$, which can be rewritten as $t_h = \frac{Ka}{\delta} - M$. Substituting it into objective function and (6), the contracting problem becomes:

$$\begin{aligned} \max_a \quad & a(x_h - \epsilon) + (1-a)x_l - \frac{K}{2}a^2 - [-M - \epsilon_A + Ka(\frac{1}{\delta} - 1) + \frac{K}{2}a^2] \\ s.t. \quad & -M - \epsilon_A + Ka(\frac{1}{\delta} - 1) + \frac{K}{2}a^2 \ge 0, \\ & \text{and (7).} \end{aligned} \tag{A.3}$$

Ignore (7) and consider the relaxed problem. Observe that the objective function is concave in $a$, and (A.3) effectively exerts a lower bound on $a$. Without (A.3), the unconstrained problem is solved by setting $a = \max\{\frac{x_h - x_l - \epsilon}{2K} - \frac{1-\delta}{2\delta}, 0\}$. In this case, the agent's expected payoff becomes $-M - \epsilon_A + \max\{K(\frac{x_h - x_l - \epsilon}{2K} - \frac{1-\delta}{2\delta})(\frac{1-\delta}{\delta}) + \frac{K}{2}(\frac{x_h - x_l - \epsilon}{2K} - \frac{1-\delta}{2\delta})^2, 0\}$. Notice that

$$\max_\delta K(\frac{x_h - x_l - \epsilon}{2K} - \frac{1-\delta}{2\delta})(\frac{1-\delta}{\delta}) + \frac{K}{2}(\frac{x_h - x_l - \epsilon}{2K} - \frac{1-\delta}{2\delta})^2 = \frac{(x_h - x_l - \epsilon)^2}{6K}. \tag{A.4}$$

On the other hand, (A.1) and (A.2) imply that:

$$-M - \epsilon_A = \frac{1}{\tilde{\delta}}[x_l - (1-\tilde{\delta})(x_h - \epsilon)] - W_s < -\frac{(x_h - x_l - \epsilon)^2}{2K}. \tag{A.5}$$

From (A.4) and (A.5), we see that the agent's expected payoff is negative at the unconstrained solution. Therefore, (A.3) is binding in the original problem, and the optimal effort level implemented $a_s^*$ is simply the positive root that solves $-M - \epsilon_A + Ka(\frac{1}{\delta} - 1) + \frac{K}{2}a^2 = 0$. Observe that $a_s^*$ is increasing in $\delta$. It converges to $a_{fb}$ when $\delta \to \tilde{\delta}$, and converges to 0 when $\delta \to 0$. Finally, note that $a_s^* < a_{fb}$ in this case. Therefore, (7) does not bind and can be ignored without loss.

*Case 3:* $\delta = 0$. In this case, the sophisticated court always enforces $t_h$ and thus $\eta_l = \eta_h = 1$. As argued in the proof of Lemma 2, any positive level of effort cannot be implemented and $a_s^* = 0$. □

*Proof of Proposition 3.*

Recall from Proposition 1 that $a_e^* = \frac{x_h - x_l - L(\hat{\kappa})}{K}$, and it is linearly increasing in $\delta$. Also by Proposition 2, $a_s^*$ is continuously increasing in $\delta$ for $\delta \in [0, \tilde{\delta}]$, and stays flat at $a_s^* = a_{fb}$ for $\delta \geq \tilde{\delta}$.

When $\delta = 1$, $a_e^* = a_s^* = a_{fb}$ and the first best level of effort can be implemented by both types of court. When $\delta \in [\tilde{\delta}, 1)$, $L(\hat{\kappa}) > \epsilon$ and therefore $a_e^* < a_{fb} = a_s^*$. On the other hand, when $\delta = 0$, the sophisticated court cannot implement any positive level of effort. Given that $L(\cdot) < x_h - x_l$, $a_e^* > a_s^* = 0$ in this case. This, together with the continuity of $a_e^*$ and $a_s^*$ in $\delta$, implies that there exist some $\delta^* \in (0, \tilde{\delta})$ such that $a_e^* = a_s^*$. To complete the proof, we need to show that $a_e^* > a_s^*$ when $\delta < \delta^*$ and $a_e^* < a_s^*$ when $\delta \in (\delta^*, \tilde{\delta})$.

Pick any $\delta^* \in (0, \tilde{\delta})$ at which $a_e^* = a_s^*$, and denote $a^*$ as the effort level being implemented at this point. Recall from Proposition 2 that for $\delta \in (0, \tilde{\delta})$, $a_s^*$ has to satisfy:

$$-M - \epsilon_A + Ka_s^*(\frac{1}{\delta} - 1) + \frac{K}{2}a_s^{*2} = 0,$$

$$\Rightarrow \frac{a_s^*}{\delta} = \frac{M + \epsilon_A + Ka_s^* - \frac{K}{2}a_s^{*2}}{K}. \tag{A.6}$$

Note that RHS of (A.6) is increasing in $a_s^*$, which is increasing in $\delta$. Therefore, $\frac{a_s^*}{\delta}$ has to be increasing in $\delta$. This implies $a_s^* < a^* \frac{\delta}{\delta^*}$ for any $\delta < \delta^*$, and $a_s^* > a^* \frac{\delta}{\delta^*}$ for any $\delta \in (\delta^*, \tilde{\delta})$. On the other hand, recall from Proposition 1 that:

$$a_e^* = \frac{x_h - x_l - L(\hat{\kappa})}{K} = \frac{x_h - x_l - \epsilon - (1 - \delta)\gamma(\hat{\kappa})}{K},$$

$$\Rightarrow \frac{a_e^*}{\delta} = \frac{x_h - x_l - \epsilon - \gamma(\hat{\kappa})}{\delta K} + \frac{\gamma(\hat{\kappa})}{K}. \tag{A.7}$$

Again observe that RHS of (A.7) is decreasing in $\delta$. Therefore, $\frac{a_e^*}{\delta}$ is decreasing in $\delta$. This implies $a_e^* > a^* \frac{\delta}{\delta^*}$ for any $\delta < \delta^*$, and $a_e^* < a^* \frac{\delta}{\delta^*}$ for any $\delta \in (\delta^*, \tilde{\delta})$. Hence, the proof is completed. □

*Proof of Proposition 4.*

We will prove the claim in a few steps. First, consider the benchmark case where $\delta = 1$. In this case, both types of courts implement the first best level of effort $a_{fb}$ with minimum legal costs incurred. Therefore, $U_e^* = U_s^*$.

When $\delta \in [\delta^*, 1)$, Proposition 3 shows that $a_e^* \leq a_s^* \leq a_{fb}$. The legal costs incurred are strictly lower if the court is sophisticated. Therefore, $U_e^* < U_s^*$ in this case. On the other hand, when $\delta = 0$, the sophisticated court cannot implement any positive level of effort and thus $U_s^* = x_l$. However, the purely evidence-based court can still implement $a_e^* > 0$ in this case. This implies $U_e^* > U_s^*$ when $\delta = 0$.

Next, we will show that for sufficiently large $M$, there exists $\delta^{**} \in (0, \delta^*)$ such that $U_e^* \leq U_s^*$ if and only if $\delta \geq \delta^{**}$. Notice that $U_e^*$ and $U_s^*$ are continuous and differentiable in $\delta$ when $\delta \in (0, \delta^*)$. Given that $U_e^* > U_s^*$ when $\delta = 0$ and $U_e^* < U_s^*$ when $\delta = \delta^*$, it is sufficient to show that $\frac{dU_e^*}{d\delta} - \frac{dU_s^*}{d\delta} < 0$ for $\delta \in (0, \delta^*)$. Note that $a_s^* < a_e^*$ for $\delta \in (0, \delta^*)$. By Envelope theorem, $\frac{dU_e^*}{d\delta} = a_e^* \gamma(\hat{\kappa})$. Also, recall from the proof of Proposition 3 that $\frac{d}{d\delta}\frac{a_s^*}{\delta} > 0$ for $\delta \in (0, \delta^*)$. This implies $\frac{da_s^*}{d\delta} > \frac{a_s^*}{\delta} > \frac{M+\epsilon_A}{K}$, where the last inequality comes from (A.6). Therefore,

$$\begin{aligned}
\frac{dU_s^*}{d\delta} &= \frac{da_s^*}{d\delta}(x_h - x_l - \epsilon - K a_s^*), \\
&> \frac{M + \epsilon_A}{K}(x_h - x_l - \epsilon - K a_s^*), \\
&= (M + \epsilon_A)(a_{fb} - a_s^*), \\
&> (M + \epsilon_A)(a_{fb} - a_e^*).
\end{aligned}$$

As a result:

$$\begin{aligned}
\frac{dU_e^*}{d\delta} - \frac{dU_s^*}{d\delta} &< a_e^* \gamma(\hat{\kappa}) - (M + \epsilon_A)(a_{fb} - a_e^*), \\
&= (M + \epsilon_A + \gamma(\hat{\kappa}))(a_e^* - \frac{M + \epsilon_A}{M + \epsilon_A + \gamma(\hat{\kappa})} a_{fb}).
\end{aligned}$$

Observe that $a_e^*$ is strictly below $a_{fb}$ for $\delta \in (0, \delta^*)$, and it is independent of $M$. Therefore, $a_e^* < \frac{M+\epsilon}{M+\epsilon+\gamma(\hat{\kappa})} a_{fb}$ for sufficiently large $M$, which implies $\frac{dU_e^*}{d\delta} - \frac{dU_s^*}{d\delta} < 0$. $\square$

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