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Discovery, disclosure, and confidence

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ABSTRACT

With the procedural tools of discovery and disclosure available, why would a plaintiff and a defendant fail to both understand the merits of the case and settle it out of court? I analyze a model in which initially the defendant has complete information about the case whereas the plaintiff knows nothing but can learn any fraction of the information, at no cost to himself, through discovery, after which the defendant can disclose any fraction of the remaining information at a constant marginal cost. The plaintiff may underutilize discovery so as to have a chance of privately identifying the defendant's type while still outwardly maintaining his belief that the defendant may have a weak case. For a defendant with a strong case, incomplete discovery can make it excessively costly to signal his strength through a high level of disclosure and excessively risky to signal his strength through a low settlement offer. I show that, in that situation, the availability of discovery actually decreases the probability of settlement.

1. Introduction

The standard explanation for why settlement talks sometimes break down, despite the fact that both parties know that there will be additional legal fees if the case goes to court, is asymmetric information. The natural follow-up question is: "why aren't the procedures of discovery and disclosure sufficient to resolve it beforehand?" Indeed, the idea is often advanced that one of the most important purposes of discovery is to facilitate settlement (Huang, 2009). There is little cost to the party that utilizes the rules of discovery to force the other side to reveal its information, so it is not clear why a party would not discover as much as possible. But in reality, they usually do not (Brazil, 1980; Shepherd, 1999). For example, in Brazil's (1980) survey of lawyers, 155 out of 176 said that they had at least once decided not to pursue information through discovery for tactical reasons. When the 155 were asked in what fraction of cases that occurred, the mean response was 25%.

The idea that I put forward here is that the plaintiff may undertake positive but incomplete discovery to improve his chances of responding optimally to the defendant's settlement offer while still outwardly maintaining his belief that the defendant might have a weak case and thereby affect the defendant's settlement offer. It is well known, in settings in which there is either zero or complete discovery, that whichever of the two that the party responding to the settlement offer chooses, the party making the offer demands the entire expected surplus, and therefore if discovery is at all costly, it will not be utilized (Farmer and Pecorino, 2005). The main contribution of the present paper is to investigate the setting in which discovery allows for the party responding to the offer to learn any fraction of the available information and, importantly, the amount of information needed for him to (privately) assess the merit of this particular case is initially unknown by both parties. In this setting, it turns out that the responder (here, the plaintiff) can sometimes capture some of the expected surplus. For some parameterizations, he can choose the maximum level of discovery that still induces the defendant types to pool on a middling settlement offer, and if he happens to privately become informed that the defendant is a weak type, then he will be able to reject the offer and go to court. In contrast, if there were no discovery available to the plaintiff, then the defendant types would pool on a middling offer and the plaintiff would always accept.

The reason that disclosure may be underutilized is simpler – the defendant, rather than the plaintiff, decides how much to disclose, so he will internalize the positive marginal cost. In the disclosure stage, the defendant types will either pool on zero disclosure or they will separate, with the weak type providing zero disclosure and the strong type providing the least-cost separating level of dis-

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closure. Because separation in the disclosure stage would lead to separation in the settlement stage, the plaintiff can only capture some of the expected surplus if he induces pooling in the disclosure stage by keeping the least-cost separating level sufficiently high. In order to do so, he might have to undertake even less discovery than he would if there were no disclosure stage. In fact, if the cost of complete discovery is less than or equal to the total cost of going to court, then the plaintiff will be forced to undertake less discovery than he otherwise would. Under that assumption, when the availability of discovery decreases the probability of settlement, the availability of disclosure increases the probability of settlement despite the fact that it is not utilized in equilibrium.

With divisible information and the plaintiff's evaluation of the merits of the case realized privately, as the initial asymmetric information of the model disappears, a new one arises: the defendant does not know whether or not the plaintiff has become informed. To the extent he thinks the plaintiff is informed by the settlement stage, a defendant with a strong (weak) case has an incentive to capitalize on (concede to) that fact and make a low (high) offer, and by doing so may signal his type, purely through how confidently he bargains, to a completely uninformed plaintiff. This force for separation is completely distinct from the standard one that the defendant types have different outside options (i.e. expected payoffs at court). Similarly, in the disclosure stage, to the extent that a defendant with a weak case thinks the plaintiff will be informed by the start of the settlement stage, he has an incentive to concede to that fact and not pay excessive disclosure costs. Notice that, for both stages, the fact that the plaintiff has stayed uninformed is what makes him need to infer the strength of the case, and at the same time the fact that he could be informed is what makes the inference work. The final step back is to the discovery stage in which, for some parameterizations, the plaintiff will ensure that the defendant types pool in both the disclosure stage and the settlement stage, which keeps the settlement offer at a middling level.

There are a few papers with results that contrast the ones in Farmer and Pecorino (2005) that an uninformed offeror will do complete discovery if the cost is small and, more relevant to the present paper, that an uninformed responder will do zero discovery if there is any cost.[2] In Farmer and Pecorino (2013), the uninformed offeror may prefer no discovery to complete discovery even if it is costless, because the former allows him to credibly maintain the threat to spend a large amount of money to win the case in court. In Lee and Bernhardt (2016), in the extension in which successful discovery reduces court costs, an uninformed responder may prefer positive but incomplete discovery, because there is a tradeoff between improving his outside option and paying the direct cost of discovery. However, in their paper, the level of discovery is exogenous. In Farmer and Pecorino (2017a,b), an uninformed responder (for example, the defendant) may prefer costly, complete discovery to no discovery, because he may be able to achieve an expected utility greater than that from going to court even when the information asymmetry is resolved before the offer is made. The reason is that the defendant experiences a utility cost if he accepts an offer that he considers "unfair," so the lowest acceptable offer may be one that he considers "fair" and provides him with some of the expected surplus.

In Mnookin and Wilson (1998) and Lee and Bernhardt (2016), the information that is available to be discovered is divisible. In fact, in the latter one, an increase in the amount of information obtained through discovery increases the probability that the plaintiff becomes informed, which is how discovery is modeled in the present paper. Two major differences between those papers and this one, however, are that here (a) the realization of the process of discovery is private information, and (b) an uninformed responder to a take-it-or-leave-it offer endogenously undertakes positive but incomplete discovery. There are two papers with assumptions that are in line with the one in this paper that the plaintiff's evaluation of the case is his private information. Hay (1995) assumes that, apart from the evidence about the case, a party's effort to prepare their case is private and could affect the outcome at trial. He writes "The [work product] rule normally spares a party [. . .] from questions by her opponent concerning her assessment of the evidence." Chopard et al. (2010) differentiate their model of litigation with the assumption that the parties have private, unequal endowments in terms of skill or ability to predict the outcome at trial. Further, they argue that the results in Osborne (1999) "suggest that the focus be shifted to some neglected aspects of the discovery process, such as the difference in parties' skill or ability to produce pieces of information used at trial."

A more general contribution of this paper is to study the signaling games that arise in bilateral bargaining environments when, from the sender's point of view, there is a possibility that the receiver is informed. In Judd and Riordan (1994), the most relevant paper from the price-as-a-signal-of-quality literature, each consumer views the firm's price as a signal of how much he values their product but also draws on his personal experience with the product.[3] In Cotton (2009, 2016), a politician views the size of each lobbyist's bid for access as a signal of the strength of their case but also draws on the information presented to him by the lobbyist who actually wins. In Barbos (2013), an evaluator views which tier the agent applied to as a signal of the project's quality but also draws on his own evaluation. Feltovich et al. (2002) augment Spence's (1973) game by giving the receiver an exogenous additional signal.

Finally, this paper contributes to the literature on bilateral contracts with information acquisition (Sobel, 1993; Lewis and Sappington, 1993; Shavell, 1994; Cremer and Khalil, 1994; Cremer, 1995; Kessler, 1998; Nosal, 2006; Dang, 2008; Kaya, 2010; Lester et al., 2012). These papers do not address the situation where the party that makes the offer is informed and the party that responds is uninformed but can acquire private information before the contract is offered. This situation generates a different kind of information acquisition problem where the initial acquisition decision can affect the informational content of the offer.

The rest of the paper is organized as follows. In Section 2, I present the model. In Section 3, I solve for and discuss the unique (modified) undefeated perfect Bayesian equilibrium of the model. Section 4 discusses the significance of the results, and Section 5 concludes.

2. Model

The game is played between a plaintiff and a defendant in a single legal case.

Apart from the basic facts of the case, there is some information about the case that is initially known only by the defendant, which in its entirety is enough for him to know what he would have to pay the plaintiff if the case went to court. This dollar value is the defendant's type. If, over the course of the game, the plaintiff learns some fraction of the information, then the probability that he privately learns the defendant's type will be equal to that fraction. Later in

[2] Similarly, in contrast to the result from Sobel (1989) that an informed responder will not do complete disclosure if there is any cost, Farmer and Pecorino (2017a,b) show that an informed responder may do complete disclosure to reveal to the plaintiff that he has a negative expective value case.

[3] Judd and Riordan (1994) only characterize the equilibrium with complete separation. Moreover, their buyers do not choose their inspection intensities. Even if they did, there would not be the mechanism wherein a buyer considers how his inspection affects the seller's subsequent behavior.

this section, I discuss the choice to model the learning process as observing a private, all-or-nothing signal.

After the defendant learns his type, the plaintiff decides how much of the information to learn through discovery at no cost to himself, then the defendant decides how much of the remaining information to reveal through disclosure at a constant marginal cost. Finally, the defendant makes a settlement offer, the plaintiff accepts or rejects, and if it is rejected, then the case goes to court. Note that the results of a model identical to the one below except that the plaintiff makes the settlement offer would be completely in line with the results from Sobel (1989). That is, the defendant would do zero disclosure and the plaintiff would do complete discovery, because it is costless to him.

The precise sequence of events is as follows:

1. The defendant's type T is drawn from the distribution $P(H) = \mu = 1 - P(L)$ where $0 < H < L$ and $0 < \mu < 1$. The defendant learns the outcome of the draw, but the plaintiff does not. His type is how much he would have to pay to the plaintiff if the case went to court.
2. The plaintiff decides how much of the unit measure of information about the case to force the defendant to reveal in the discovery process. If he forces a level $d_0 \in [0, 1]$, the defendant pays a cost of cd_0, and the probability that the plaintiff knows the defendant's type increases to $x_0 = d_0$.[4] The choice of d_0 is public information, but whether or not the plaintiff has become informed is his private information. If the plaintiff is indifferent between two or more levels of discovery, he chooses the higher one.[5]
   (a) In order to determine the effect of discovery on the probability of settlement, I also briefly consider the alternative (special case) model in which discovery is not available to the plaintiff.
3. The defendant decides how much to voluntarily disclose $d_1 \in [0, 1 - x_0]$ to the plaintiff at a cost to himself of cd_1, which increases the probability that the plaintiff knows the defendant's type to $x_1 = x_0 + d_1$. Again, the choice of d_1 is public information, but whether or not the plaintiff has become informed is his private information.
4. Finally, the defendant makes the settlement offer, and the plaintiff accepts or rejects. If he accepts, then the case is settled: he receives a payoff of s and the defendant gets a payoff of $-s$. If he rejects, then the case proceeds to trial: the plaintiff receives a payoff of $T - k$ and the defendant receives a payoff of $-T - k$.

As mentioned, the learning process is modeled as the plaintiff observing a private, all-or-nothing signal about the defendant's type. That the signal is private captures the idea that, in a sufficiently complex case, one lawyer will not be able to predict how another lawyer will evaluate the merits of the case, even if he knows the information that the other lawyer has. How a lawyer evaluates a case can depend on variables other than just the facts of the case such as the lawyer's skills, past experiences, legal philosophy, and future random events. It is just as reasonable to further assume that the plaintiff will not know how much information about the case he will require to assess its merits, especially before he has begun to analyze it (i.e. to some extent, there will be a plaintiff-case specific match or random events that affect his ability to reach an accurate evaluation).[6]

This all-or-nothing signal structure is arguably the simplest with the characteristic that the accuracy of the signal starts sufficiently low and increases with the amount of information about the case the plaintiff has. Any signal structure with that characteristic should preserve the property that the defendant types will continue to pool, to some extent, if the plaintiff has sufficiently little information, and therefore he could capture some of the expected surplus by doing some discovery and basing his response to the settlement offer on the signal that he observes (or having the threat to do so). Although which signal structure is the most realistic would depend on the nature of the particular case, the all-or-nothing structure is a natural starting point.

3. Equilibrium analysis

The solution concept is perfect Bayesian equilibrium (PBE) with a modified version of the undefeated equilibrium refinement proposed by Mailath et al. (1993). Not only does the refinement pick a unique equilibrium for each parameterization, it also is based on a very intuitive idea: payoff-increasing deviations should be expected by all players and therefore they should be deviations to an alternative equilibrium. One equilibrium is "defeated" by another in the sense that there is a payoff-increasing deviation from the former to the latter. I formally introduce the refinement after characterizing all the pure strategy equilibria of the settlement stage of the game but before characterizing only the mixed-strategy equilibria that are not trivially defeated by a pure-strategy equilibrium.

The roadmap for the analysis is as follows: Denote the uninformed plaintiff's belief, just before the settlement offer is made, that the defendant is type H by μ_1. The μ_1 variable will depend on μ but also on the defendant's (public) choice in the disclosure stage. For each μ_1 and x_1, I find all the pure strategy equilibria and all the potentially relevant mixed-strategy equilibria (given the equilibrium refinement) of the settlement stage of the game and then apply the modified version of the undefeated equilibrium refinement. Then, for each x_0, I check which x_1 the defendant would choose in the disclosure stage under the same refinement. Finally, I check which x_0 the plaintiff would choose.

The focus will be on the probability of settlement and in particular whether the inclusion of discovery increases or decreases it.

3.1. Numerical example

The main result of the equilibrium analysis is that there is one case of particular interest in which the plaintiff undertakes tactically imperfect discovery, the defendant types pool on zero disclosure and a middling settlement offer, and therefore, there is

[4] The addition of a direct cost to the plaintiff to invoke discovery would detract from the role of the indirect costs (the effect on the behavior of the defendant) and would not substantially contribute to the results. Specifically, in the parameterization in which tactical underuse of discovery occurs, the addition of a constant marginal cost to invoke discovery that was less than $\mu(1-\mu)(L-H)$ would not affect the plaintiff's choice of how much discovery to invoke, and the addition of an increasing marginal cost to invoke discovery with a marginal cost that was less than $\mu(1-\mu)(L-H)$ at zero would weakly decrease his choice of how much discovery to invoke. Further, there is evidence that the main costs of discovery are borne by the responding party. In Brazil (1980), the surveyed lawyers responded that there were "substantial direct costs" in addition to "business disruption" for the responding party whereas the costs of conducting discovery did not affect their decision of whether or not to pursue some piece of information in a high percentage of cases (the median response was "a surprisingly low 20%").

[5] If the plaintiff were expecting to make the settlement offer, then he would choose the higher one. The assumption on the plaintiff's behavior when indifferent can be interpreted as there being a very small probability that the he will make the settlement offer.

[6] For one example of how future events can affect legal evaluations, in Daniel Kahneman's (2011) book "Thinking, Fast and Slow", he writes about Danziger et al.'s (2011) paper that showed that whether or not a judge had recently eaten greatly affects the probability that he will approve a parole request.

a chance that the plaintiff will realize that the defendant is a low type and obtain a higher payoff by rejecting the settlement offer and going to court. This numerical example and short discussion provides some evidence that this case is not entirely unlikely.

Consider the following example: $L = \$50,000$, $H = \$40,000$, $k = \$10,000$, $c = \$13,333$, and $\mu = 3/4$. The unique undefeated equilibrium for this is $d_0 = 1/16$ (some, but incomplete discovery), $d_1 = 0$ (no disclosure), and a settlement offer of both defendant types of $s = \$32,500$, which the plaintiff accepts unless he gets informed that the defendant is of type L.

Briefly, this is an equilibrium because the plaintiff does as much discovery as possible that is still low enough to induce pooling in the disclosure and settlement stages; the type H defendant perceives the least-cost separating level of disclosure (the cost of which is \$2500) as too expensive, given how little the plaintiff already knows, so he chooses to pool on zero disclosure; and finally, the type H defendant perceives the low settlement offer of \$30,000 as too risky (it would be accepted with probability of approximately 73%), again given how little the plaintiff knows, so he chooses to pool on a middling settlement offer.

3.2. Settlement stage

The defendant's settlement offer is a signal to the plaintiff about the defendant's type. Therefore, I go through the standard process of identifying the pure-strategy pooling and separating equilibria and then the relevant mixed-strategy equilibria of this stage of the game.

Pooling equilibria. In a pure-strategy pooling equilibrium, all players play pure strategies, and the type H and type L defendant make the same settlement offer.

Recall that a PBE specifies beliefs that satisfy Bayes' rule on the equilibrium path, but are otherwise unrestricted, and strategies that are optimal given the beliefs. Although in principle the off-equilibrium beliefs could be complicated, any equilibrium strategies that can be supported by some beliefs can be supported by the beliefs that minimize the payoff to a deviation. More precisely, if there is a pooling equilibrium with equilibrium offer $\hat{s}$ and some beliefs of the uninformed plaintiff, then there is a pooling equilibrium with equilibrium offer $\hat{s}$ and the beliefs of the uninformed plaintiff that, if the offer is $\hat{s}$, then the probability that the defendant is a type H defendant is μ_1 and otherwise it is 0. Thus, finding the entire set of pooling equilibrium offers only requires finding the set of pooling equilibrium offers that can be supported with these beliefs.

Having specified the beliefs, what remains to be specified are the conditions under which pooling strategies are optimal given those beliefs. Of course, the strategy of the informed (uninformed) plaintiff is to accept any payoff that is greater than or equal to his payoff (expected payoff) at court and reject otherwise. For the defendant types, it cannot be optimal to pool on an offer less than $\mu_1 H + (1-\mu_1)L - k$, because the uninformed plaintiff would reject, and then the type H and type L defendant would be better off offering $H-k$ and $L-k$ respectively. Thus, the first condition is $\mu_1 H + (1-\mu_1)L - k \le \hat{s}$. The next condition derives from the fact that, if the pooling offer were too high, then the type H defendant would be better off offering $H-k$, which he knows the informed plaintiff will accept. Thus, the second condition is $x_1(H-k) + (1-x_1)(H+k) \ge \hat{s}$.

The last condition depends on whether the defendant types are pooling on an offer less than $L-k$ or equal to it, because the type L defendant faces risk of rejection by the informed plaintiff in the first case but not in the second. In the first case, if the pooling offer were too high, then the type L defendant would be better off offering $L-k$, which he knows would be accepted by both the informed and uninformed plaintiff types. In the second case, the type L defendant has no potentially profitable deviation. Thus, the third condition is that either $L-k \ge x_1(L+k) + (1-x_1)\hat{s}$ or $L-k = \hat{s}$.

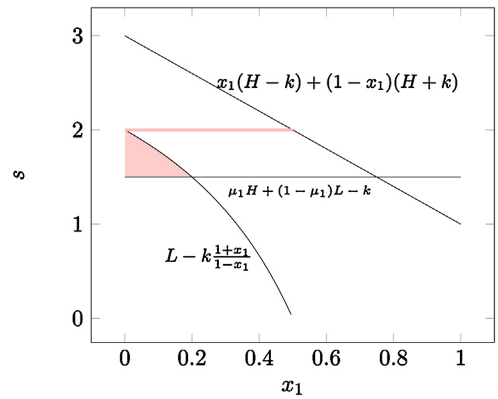

Fig. 1. The correspondence maps from the possible values of x_1 to the set of pooling equilibrium offers. Here $\mu_1 = \frac{1}{2}$, $H = 2$, $L = 3$, and $k = 1$.

Overall, the offer must be high enough that the uninformed plaintiff will accept but low enough that neither the type H nor type L defendant will prefer to deviate to the truth. Fig. 1 depicts an example of the set of pooling equilibrium offers. The following proposition summarizes.

Proposition 3.1. *In a pooling equilibrium, the type H and type L defendants offer $\hat{s}$ where (i) $\mu_1 H + (1-\mu_1)L - k \le \hat{s}$, (ii) $x_1(H-k) + (1-x_1)(H+k) \ge \hat{s}$, and (iii) either $L - k\frac{1+x_1}{1-x_1} \ge \hat{s}$ or $L-k = \hat{s}$. The informed plaintiff accepts the type H's offer and rejects the type L's unless $\hat{s} = L-k$ in which case he accepts. The uninformed plaintiff always accepts. Any pooling equilibrium offer can be supported by the uninformed plaintiff's beliefs that if the offer is $\hat{s}$, then the probability that the defendant is a type H defendant is μ_1 and otherwise equals zero.*

Separating equilibria. In a pure-strategy separating equilibrium, all players play pure strategies, and the type H and type L defendants make different settlement offers. Through reasoning almost identical to that presented above for the pooling equilibria, I reach three conditions on the set of separating equilibrium offers in which the uninformed plaintiff accepts the type H defendant's offer. They reveal that again the type H defendant's equilibrium offer must be high enough that the uninformed plaintiff will accept and still low enough that the type H defendant does not prefer to offer $H-k$. But now, in contrast to the third condition for a pooling equilibrium, it must be high enough that the type L defendant prefers to offer $L-k$ rather than mimic the type H defendant.

Fig. 2 depicts an example of the set of separating equilibrium offers. The following proposition summarizes.

Proposition 3.2. *In a separating equilibrium in which the type uninformed plaintiff accepts the type H defendant's offer, the type L defendant offers $L-k$ and type H defendant offers $\hat{s} < L-k$ where (i) $H-k \le \hat{s}$, (ii) $x_1(H-k) + (1-x_1)(H+k) \ge \hat{s}$, and (iii) $L - k\frac{1+x_1}{1-x_1} \le \hat{s}$. Both the informed and the uninformed plaintiff accept the type H's offer and the type L's offer. Any separating equilibrium can be supported by the uninformed plaintiff's beliefs that if the offer is $\hat{s}$, then the probability that the defendant is a type H defendant is 1 and otherwise is 0.*

There is also one separating equilibrium in which the uninformed plaintiff does not accept the type H defendant's offer. In that equilibrium, the type L defendant offers $L-k$, the type H defendant offers $H-k$, and $x_1(H-k) + (1-x_1)(H+k) \le L-k$. The

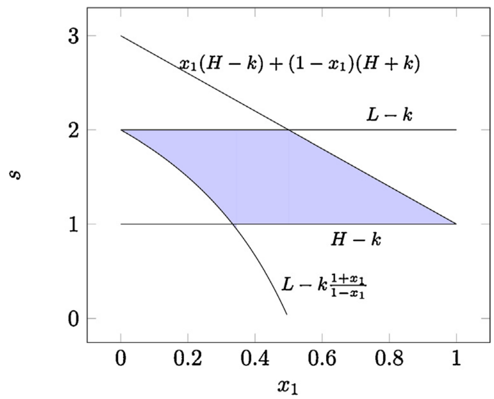

Fig. 2. The correspondence maps from the possible values of x_1 to the set of separating equilibrium offers. Here $\mu_1 = \frac{1}{2}$, $H = 2$, $L = 3$, and $k = 1$.

informed plaintiff accepts both offers, whereas the uninformed plaintiff accepts the type L's offer but rejects the type H's offer. This separating equilibrium can be supported by the uninformed plaintiff's beliefs that if the offer is $H-k$, then the probability that the defendant is a type H defendant is 1 and otherwise it is 0. However, this separating equilibrium is different from all the other separating equilibria in the sense that the uninformed plaintiff sometimes rejects, and it is similar to a set of mixed-strategy equilibria in which the type L defendant offers $L-k$, the type H defendant offers $H-k$, and the uninformed plaintiff probabilistically rejects $H-k$ to deter mimicking. For ease of exposition, outside this subsection on separating equilibria, I treat this isolated separating equilibrium as a mixed strategy equilibrium unless I am explicitly referring to the "isolated separating equilibrium."

If $(1-\mu_1)(L-H)2k > 4k^2 - \mu_1(1-\mu_1)(L-H)^2$, then there is an interval of x_1 where $x_1(H-k)+(1-x_1)(H+k)$ is less than both $\mu_1 H + (1-\mu_1)L - k$ and $L - k\frac{1+x_1}{1-x_1}$. In that interval, technically the only pure strategy equilibrium that exists is the isolated separating equilibrium in which the uninformed plaintiff rejects the type H defendant's offer. There are mixed strategy equilibria in that interval, as well as outside that interval, and mixed strategy equilibria play an important role in the overall game.

As mentioned, before proceeding to characterize the set of mixed-strategy equilibria that are not trivially defeated by a pure-strategy equilibrium, it is helpful to first introduce and formally define the modified version of the undefeated equilibrium refinement.

Equilibrium refinement. What may be the most familiar PBE refinement, the intuitive criterion, is insufficient here – it does not refine the set of equilibria with offers below $L - k\frac{1+x_1}{1-x_1}$. Fortunately, the undefeated equilibrium refinement proposed by Mailath et al. (1993) is sufficient (with a slight modification) and moreover has a very persuasive intuition. In particular, if there is at least one type that expects to increase his expected payoff by deviating, then all players in the game should expect the deviation and adjust their strategies and beliefs, possibly causing further adjustments, and if the string of adjustments ever stops, then it must be at a set of equilibrium strategies and beliefs. It is this idea – that the payoff increasing deviations should be to an alternative equilibrium, that is the crux of the equilibrium refinement and is captured by parts "i" and "ii" in the definition. The definition below has been adapted from the one in the original paper to the present setting.

Definition (M, O-F, & P 1993): An equilibrium E ***defeats*** another equilibrium E' when (i) there exists some E equilibrium offer s for some type(s) $\mathbb{T}$ that is not an E' equilibrium offer, (ii) at least one of the type(s) in $\mathbb{T}$ strictly prefers and all of the type(s) in $\mathbb{T}$ weakly prefer their payoffs in the E equilibrium to their payoffs in the E' equilibrium, and (iii) $\forall\, \alpha \in [0, 1]$, the uninformed plaintiff's beliefs in the E' equilibrium are inconsistent with (a) the strictly preferring type(s) in $\mathbb{T}$ offer s with the probability one, (b) the remaining type in $\mathbb{T}$, if there is one, offers s with probability α, and (c) the types not in $\mathbb{T}$ offer s with probability zero.

Definition (M, O-F, & P 1993): An equilibrium is ***undefeated*** if there is no equilibrium that defeats it.

Notice that, due to part "iii", a deviation can only be payoff increasing if the type H defendant participates (i.e. is in the set $\mathbb{T}$); otherwise deviating would only mean that the type L defendant were revealing himself.

By direct application of the definition of defeats, the set of pooling equilibria is refined to the one in which the defendants make the offer $s^*(E_P^{\mu_1}) \equiv \mu_1(H-k)+(1-\mu_1)(L-k)$, and the set of separating equilibria is refined to the one in which the type H defendant offers $s^*(E_S) \equiv \max\{L - k\frac{1+x_1}{1-x_1}, H-k\}$. However, as mentioned in Mailath et al. (1993), the refinement is not written to apply to mixed strategy equilibria, because they were not important in the games the authors had in mind. Thus, it too is insufficient;[7] Happily, the refinement can be modified in a reasonable way to apply to mixed strategy equilibria; that is, to apply when a deviation to an equilibrium does not necessarily mean a deviation to a certain offer.

Definition: The modified definition differs only in the third part of the definition of "defeats". In particular, (iii) $\forall\, \alpha \in [0, \hat{\alpha}]$ the uninformed plaintiff's beliefs that support the E' equilibrium are inconsistent with (a) the strictly preferring type(s) in $\mathbb{T}$ offer s with the probability that they do in the E equilibrium, (b) the remaining type in $\mathbb{T}$, if there is one, offers s with probability α, and (c) the types not in $\mathbb{T}$ offer s with probability zero. Here $\hat{\alpha}$ is the probability with which the remaining type offers s in the E equilibrium.

Effectively, with the modification to the third part of the definition, when the plaintiff observes an off-equilibrium settlement offer, he interprets it as a deviation to the equilibrium strategy in an alternative equilibrium (the defeating equilibrium) rather than interpreting it as a deviation to the strategy of making that particular settlement offer with probability one.

Overall, the way to understand the refinement is as follow: the type H defendant is willing to reveal his type, so he will deviate to an offer in his most preferred equilibrium (or one that is very similar), and the type L defendant and the plaintiff will expect the deviation and participate in the new equilibrium. In short, the modified version of the undefeated equilibrium refinement simply selects the type H defendant's preferred equilibrium.

Mixed strategy equilibria. In a mixed strategy equilibrium, one or more of the players plays a mixed strategy. I assume that the informed plaintiff will always accept when indifferent, which eliminates the possibility of him playing a mixed strategy, and that the uninformed plaintiff will always accept the offer $L-k$.

In Section A.1 of the appendix, Proposition 6.2, I show that no mixed strategy equilibrium in which one or more of the type H defendant's offers are greater than $s^*(E_P^{\mu_1})$ or $s^*(E_S)$ could survive the refinement, but a basic version of the explanation is the following: (1) the pooling (separating) equilibrium that survives the refinement is the one with the offer $s^*(E_P^{\mu_1})$ ($s^*(E_S)$), and in that equilibrium, the type H defendant's offer is accepted with probability one; if either exists, then the type H defendant would strictly prefer the one with the lower offer to any mixed-strategy with a higher offer, and (2) if neither exists, it is only because the type

[7] It refines the set of mixed strategy equilibria (in which the type H defendant offer(s) are either (a) less than both $s^*(E_P^{\mu_1})$ and $s^*(E_S)$, or (b) equal to $H-k$ to the subset in which the type H defendant offer(s) include $H-k$, which the uninformed plaintiff accepts with any probability less than or equal to $\hat{\lambda}(x_1) \equiv \min\{\frac{2k}{(1-x_1)(L-H+2k)}, 1\}$.

H defendant already prefers the isolated separating equilibrium to both of them.

Overall, a mixed-strategy equilibrium in which the type H defendant makes an offer greater than $s^*(E_P^{\mu_1})$ or $s^*(E_S)$ could not possibly be the type H defendant's most preferred equilibrium. See Section A.1 of the appendix, Propositions 6.3 and 6.4, for a complete characterization of the set of mixed strategy equilibria in which the type H defendant's offer(s) are either (a) less than $s^*(E_P^{\mu_1})$ and $s^*(E_S)$ but greater than $H-k$, or (b) equal to $H-k$. Briefly, assuming those restriction on the type H defendant's offers, the mixed-strategy equilibria all have the characteristic that either (a) the type L defendant only offers $L-k$ and the type H defendant only offers $H-k$, or (b) the type L defendant mixes between the offers $L-k$ and one other offer that the type H defendant also offers with a positive probability (either with probability one or with the complement of the probability with which he offers $H-k$).

With the modified definition of defeats, the remaining mixed strategy equilibria are refined to the one in which the type H defendant only offers $H-k$, which the uninformed plaintiff accepts with probability $\hat{\lambda}(x_1) \equiv \min\{\frac{2k}{(1-x_1)(L-H+2k)}, 1\}$, and the type L defendant offers $L-k$.[8] Each of the equilibria in which the uninformed plaintiff accepts $H-k$ with a probability strictly less than $\hat{\lambda}(x_1)$ is now defeated by an equilibrium in which the type H defendant offers $H-k+\epsilon$, which the uninformed plaintiff accepts with probability $\min\{\frac{2k}{(1-x_1)(L-H+2k-\epsilon)}, 1\}$ for some sufficiently small ϵ.[9] Notice that, without the modification, the uninformed plaintiff could believe that the type L defendant deviated to the offer $H-k+\epsilon$ with probability one (if he plays it at all) despite the fact that the type L defendant offers that with a very small probability in those equilibria. I use only the modified definition of "defeats" throughout the rest of the paper. See Section A.2 of the appendix for a complete analysis of the application of the refinement to the set of mixed-strategy equilibria. Intuitively, however, the best that the type H defendant can do, given that the uninformed plaintiff keeps the type L defendant indifferent between the type H defendant's offer and $L-k$, is to make as low an offer as possible to take advantage of the informed plaintiff.

Within and between group undefeated equilibria. For each pair of μ_1 and x_1, which of the within group undefeated equilibria – pooling, separating, or mixed-strategy – is the between-group undefeated equilibrium depends on which the type H defendant prefers. That is, it depends on which of the type H defendant's three possible expected costs is the lowest:

$$\mu_1(H-k)+(1-\mu_1)(L-k) \quad \text{(Pooling)}$$

$$\max\{L-k\frac{1+x_1}{1-x_1}, H-k\} \quad \text{(Separating)}$$

$$\max\{\gamma(x_1)(H-k)+(1-\gamma(x_1))(H+k), H-k\} \quad \text{(Mixed)}$$

where $\gamma(x_1)=x_1+(1-x_1)\hat{\lambda}(x_1)$; alternatively, the entire expression labeled "Mixed" can be written $\max\{x_1(H-k)+(1-x_1)(H+k)-\frac{4k^2}{L-H+2k}, H-k\}$. It turns out that the type H defendant's cost in the mixed-strategy equilibrium is always less than or equal to his cost in the separating equilibrium (when they are equal, the two equilibria are completely identical), so only the pooling equilibrium and the mixed-strategy equilibrium remain relevant. Of course, the pooling equilibrium does not exist for some pairs of μ_1 and x_1, but his cost in the mixed-strategy equilibrium is always lower for those values anyway.

[8] For ease of exposition, the equilibrium of this form in which $\hat{\lambda}(x_1)=1$ are still referred to as "mixed-strategy equilibria."

[9] As Proposition 6.5 and its proof make clear, if the minimum is equal to 1, then the defeating equilibrium is a pure-strategy equilibrium.

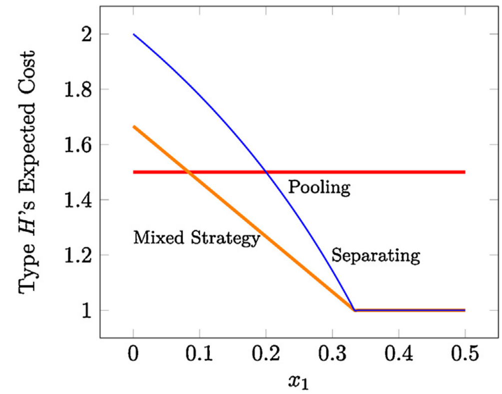

Fig. 3. The type H defendant's expected cost with the parameters $\mu_1=\frac{1}{2}$, $H=2$, $L=3$, and $k=1$.

There is a threshold value of the probability that the plaintiff is informed, $\hat{x}_1(\mu_1)$, below which the between-group undefeated equilibrium of the settlement stage of the game is the within-group undefeated pooling equilibrium and above which it is the within-group undefeated mixed strategy equilibrium. As x_1 increases, the overall probability with which the plaintiff accepts the offer $H-k$ increases, because (a) the probability that the plaintiff is informed has increased, which matters because the informed plaintiff accepts $H-k$ whereas the uninformed mixes and (b) even the probability that the uninformed plaintiff will accept $H-k$ increases because, he only rejects probabilistically to deter the type L defendant from mimicking, and a higher x_1 means that the type L defendant has less incentive to mimic. Below $\hat{x}_1(\mu_1)$, the type H defendant perceives making the offer $H-k$ as being too risky and prefers the safer option of offering $s^*(E_P^{\mu_1})$, but as x_1 increases and with it the probability that the offer $H-k$ will be accepted, eventually he gets a higher expected payoff by offering $H-k$. The following proposition summarizes (Fig. 3).

Proposition 3.3. *The unique undefeated equilibrium of the settlement stage of the game is as follows: (1) For* $x_1 \le \hat{x}_1(\mu_1) = \frac{L-H}{L-H+2k}[\mu_1-(1-\mu_1)\frac{L-H}{2k}]$, *the type H and type L defendant offer* $s^*(E_P^{\mu_1})$, *which the informed plaintiff accepts if and only if the defendant is a type H and the uninformed plaintiff accepts. (2) For* $x_1 > \hat{x}_1(\mu_1)$, *the type H and type L defendants offer* $H-k$ *and* $L-k$ *respectively. The informed plaintiff accepts, whereas the uninformed plaintiff accepts* $H-k$ *with probability* $\hat{\lambda}(x_1)=\min\{\frac{2k}{(1-x_1)(L-H+2k)}, 1\}$ *and accepts* $L-k$.

Notice that $0<\hat{x}_1(\mu)$ if and only if $\frac{L-H}{L-H+2k}<\mu$. The switch from μ_1 to μ in the previous sentence is in expectation of the result from the analysis of the disclosure stage that the defendant types will either play a pure-strategy pooling equilibrium with zero disclosure or a pure-strategy separating equilibrium, and therefore the results from the analysis of the settlement stage will only be relevant if $\mu_1=\mu$.

I refer to $\frac{L-H}{L-H+2k}<\mu$ as Condition 1 for the rest of the paper.

When Condition 1 does not hold, the type H defendant's incentive to make the risky low offer $H-k$ rather than the safe middling $s^*(E_P^{\mu})$ is so strong that he would do so even if he were sure that the plaintiff had not changed his belief since the beginning of the game. In that case, the plaintiff will not be able to employ a strategy of imperfect discovery to induce pooling in the settlement stage and capture an expected surplus.

Alternatively, when Condition 1 holds, there are positive values of x_1 that still induce the defendant types to pool on the middling offer when they have already played a pure-strategy pooling equilibrium in the disclosure stage (i.e. $\mu_1=\mu$). Therefore, the plaintiff can expect to capture some of the surplus from settling if he invokes a positive amount of discovery that is still less than or equal to $\hat{x}_1(\mu)$ and, at the same time, induces pooling (on zero disclosure) in the disclosure stage. In effect, he will be getting a good deal on the type H defendant but, by rejecting the type L defendant when he happens to become informed, only sometimes getting an offsetting bad deal on the type L defendant.

At this point, we know how the settlement stage of the game would play out for each possible pair of μ_1 (i.e. the uninformed plaintiff's belief, just before the settlement offer is made, that the defendant is type H) and x_1 (i.e. the probability, from the defendant's perspective, that the plaintiff has become informed). Those variables will depend on the players' behaviors at the earlier stages of the game.

3.3. Disclosure stage

The defendant's level of disclosure is another signal to the plaintiff about the defendant's type.

Rather than solve for the entire set of PBE, I only search for the undefeated pooling equilibrium and the undefeated separating equilibrium of the disclosure stage. By direct application of the definition of defeats, the undefeated pooling equilibrium is the one in which both defendant types choose $d_1 = 0$, and the undefeated separating equilibrium is the least-cost separating equilibrium: the type L defendant chooses $d_1 = 0$, and the type H defendant chooses the minimum d_1 such that the type L does not strictly prefer to mimic.

In Section A.3, Proposition 6.7, of the appendix, I show that each mixed strategy equilibrium is defeated by a pooling equilibrium or a separating equilibrium, except in a knife-edge case in which all players are indifferent between the undefeated pooling equilibrium and the undefeated separating equilibrium. Therefore, I focus only on those two equilibria as possible outcomes of the disclosure stage. There are only three possible values of μ_1: $\mu_1 = \mu$ if the defendant types pool in the disclosure stage, and $\mu_1 = 1$ or $\mu = 0$ if they separate.

To settle which of those two within-group undefeated equilibria is the between-group undefeated equilibrium only requires finding which one the type H prefers. His expected cost in the undefeated pooling equilibrium of the disclosure stage equals $s^*(E_P^{\mu})$ under Condition 1 and equals $\gamma(x_0)(H-k) + (1-\gamma(x_0))(H+k)$ otherwise where $\gamma(x_0) = x_0 + (1-x_0)\hat{\lambda}(x_0)$. His expected cost in the undefeated separating equilibrium of the disclosure stage is $H - k + c\hat{d}_1$ where $\hat{d}_1$ is the least-cost separating level of disclosure. It is determined by the level of d_1 such that the type L defendant is indifferent between mimicking the type H defendant in both the disclosure and the settlement stage (thereby incurring a disclosure cost of cd_1 and then obtaining an expected cost in the settlement stage of $(x_0+d_1)(L+k) + (1-x_0-d_1)(H-k)$) and not mimicking (thereby incurring a disclosure cost of zero but revealing his type and obtaining an expected cost in the settlement stage of $L-k$):

$$\hat{d}_1 = \frac{(1-x_0)(L-H) - 2kx_0}{L-H+2k+c} \tag{1}$$

Notice that the RHS is strictly decreasing in x_0 and is positive for all $x_0 < \frac{L-H}{L-H+2k}$ and negative if the inequality is reversed. In the latter case, the type H defendant would prefer to pool in the disclosure stage and separate in the settlement stage, because his settlement offer of $H-k$ would be accepted with probability one anyway (i.e. for all x_0 greater than or equal to $\frac{L-H}{L-H+2k}$, it is the case that $\hat{\lambda}(x_0) = 1$).

Proceeding in the case in which there is a positive solution for $\hat{d}_1$, whether the type H defendant prefers pooling or separating in the disclosure stage depends on whether, if there were pooling in the disclosure stage, there would be pooling or separating in the settlement stage. If pooling in the disclosure stage leads to pooling in the settlement stage (i.e. if $x_0 \le \hat{x}_1(\mu)$), he prefers the undefeated pooling equilibrium of the disclosure stage if and only if $s^*(E_P^{\mu})$ is less than $H - k + c\hat{d}_1$, which simplifies to the following condition:

$$(1-\mu)(L-H) \le c\hat{d}_1 \tag{2}$$

If pooling in the disclosure stage leads to separating in the settlement stage (i.e. if $x_0 > \hat{x}_1(\mu)$), he prefers the undefeated pooling equilibrium of the disclosure stage if and only if $\gamma(x_0)(H-k) + (1-\gamma(x_0))(H+k)$ is less than $H - k + c\hat{d}_1$, which simplifies to the following condition:

$$(1-x_0)2k - \frac{4k^2}{L-H+2k} \le c\hat{d}_1 \tag{3}$$

Intuitively, the type H defendant prefers the undefeated pooling equilibrium of the disclosure stage if and only if the cost of separating is sufficiently high.

I pause here to consider the alternative model in which there is no discovery available to the plaintiff, so the first action of the game is the defendant choosing how much to disclose (i.e. $x_0 = 0$). The results summarized in the proposition below are also presented in the "Without Discovery" column in Table 1. Further, several shorthands are first used in the proposition and later used in Table 1: (a) $(1-\mu)(L-H+2k) < \mu c$ is henceforth referred to as K1, (b) $2k(L-H+2k) \le c(L-H)$ is henceforth referred to as K2, and (c) $\mu\hat{\lambda}(0) + (1-\mu)$ is henceforth referred to as A2.

Table 1
As described in the body of the paper, K1 represents $(1-\mu)(L-H+2k) < \mu c$, A1 represents $\mu + (1-\mu)(1-\min\{\hat{x}_0, \hat{x}_1(\mu)\})$, K2 represents $2k(L-H+2k) \le c(L-H)$, and A2 represents $\mu\hat{\lambda}(0) + (1-\mu)$. The explanations for the conditions and probabilities in the "Without Discovery" and the "With Discovery" columns are in Propositions 3.4 and 3.5, respectively.

Probability of settlement		
	Without discovery	With discovery
Condition 1	1	A1 if K1, 1 otherwise
¬Condition 1	A2 if K2, 1 otherwise	1

Proposition 3.4. *In the alternative model in which there is no discovery, there are four possible outcomes: Assume Condition 1 holds. If K1, then the defendant types pool in both the disclosure and settlement stage. If not K1, they separate in the disclosure stage and the settlement stage. In either case, the probability of settlement equals one. Now assume instead that Condition 1 does not hold. If K2, then they pool in the disclosure stage but separate in the settlement stage: the probability of settlement equals A2, because the uninformed plaintiff rejects probabilistically to deter mimicking. If not K2, they separate in the disclosure stage and the probability of settlement equals one.*

The proposition follows directly from the results derived earlier in this subsection. Specifically, condition K1 is obtained by combining Eq. (1), with x_0 set to zero, and Eq. (2). Whereas condition K2 is obtained by combining Eq. (1), with x_0 set to zero, and Eq. (3).

3.4. Discovery stage

The only way that the plaintiff can capture an expected payoff that exceeds that from always going to court is to undertake a positive amount of discovery $d_0 > 0$ and, at the same time, induce pooling in both the disclosure and the settlement stages of the game. That will only be possible if there exists an $x_0 > 0$ such that (a) $x_0 \le \hat{x}_1(\mu) \equiv \frac{L-H}{L-H+2k}[\mu - (1-\mu)\frac{L-H}{2k}]$, so that if the defendant types pool in disclosure stage, then they will pool in the settlement stage, and also (b) $x_0 \leq \hat{x}_0 \equiv \frac{\mu(L-H)}{L-H+2k} - \frac{(1-\mu)(L-H)}{c}$, which is the lower bound on x_0 that emerges by combining Eqs. (1) and (2), so that if the defendant types expect to pool in the settlement stage, then they will pool in the disclosure stage. Such an x_0 exists if and only if both $\frac{L-H}{L-H+2k} < \mu$ (i.e. Condition 1 holds) and $(1-\mu)(L-H+2k) < \mu c$ (i.e. K1 holds).

Of course, if it is not the case that both $\hat{x}_0$ and $\hat{x}_1(\mu)$ are greater than zero, then no matter what level of discovery the plaintiff chooses, there will be separation in at least one of the subsequent stages, and he will not be able to capture any of the expected surplus from settlement. In that case, by the assumption that, when indifferent between two or more levels of discovery, the plaintiff will choose the highest one, he will choose to do complete discovery. Recall that the assumption is meant to capture the idea that there is some perceived risk about who makes the settlement offer because, if the plaintiff were the one who makes the offer, then he would prefer complete discovery.

That completes the process of finding the equilibrium outcome. The results summarized in the proposition below are also presented in the "With Discovery" column in Table 1. Further, one shorthand is first used in the proposition and later used in Table 1: $\mu + (1-\mu)(1-\min\{\hat{x}_0, \hat{x}_1(\mu)\})$ is henceformth referred to as A1.

Proposition 3.5. *In the full model in which there is discovery, there are four possible outcomes: Assume Condition 1 holds. If K1, then the defendant types pool in both the disclosure and settlement stage, and the probability of settlement is A1, because the plaintiff always accepts unless he has become informed and the defendant is a low type. If not K1, the plaintiff would foresee that any positive amount of discovery would lead to separation in the disclosure stage, and therefore choose* $d_0 = 1$ *by the assumption that when indifferent he does what would be optimal if he were the one who makes the settlement offer. In that case, the probability of settlement equals one. Now assume instead that Condition 1 does not hold. Again, the plaintiff would foresee that any positive amount of discovery would lead to separation in the settlement stage, choose* $d_0 = 1$ *and the probability of settlement would equal one.*

4. Discussion

With both discovery and disclosure available, the parties can only fail to settle when the plaintiff purposely under-utilizes discovery to induce pooling in both the disclosure and the settlement stages of the game. It is well known that the initially uninformed responder of a take-it-or-leave-it offer may be indifferent between zero and complete discovery if it is costless to him. The important difference in the present paper is that he may strictly prefer positive but incomplete discovery. Further, that the plaintiff under-utilizes discovery only when the defendant makes the settlement offer (the plaintiff would do complete discovery if he were the one making the offer) and even then only for some parameterizations is in line with the survey result presented in the first paragraph of this paper: 155 out of 176 lawyers surveyed said that they had at least once decided not to pursue information through discovery for tactical reasons, and when the 155 were asked in what fraction of cases that occurred, the mean response was 25%.

I briefly return to the numerical example provided in Section 3.1. It turns out that the assuming that the cost to the defendant of complete discovery or complete disclosure is less than or equal to the total cost of going to court (i.e. $2k \leq c$) implies that $\hat{x}_0 < \hat{x}_1(\mu)$. Proceeding under that assumption, underdiscovery will occur if and only if K1 holds, which implies that $0 < \hat{x}_0$ and that the extent of discovery would be equal to $\hat{x}_0 = (L-H)\frac{\mu}{L-H+2k} - \frac{1-\mu}{c}$. With the normalization $L - H = \$10,000$, the values of $\mu = 3/4$, $k = \$10,000$, and $c = \$13,333$, condition K1 is satisfied. Then the plaintiff would choose a level of discovery equal to $1/16$. He would reject the offer of \$32,500 with probability $1/16 \times 1/4$, and when he rejects, he receives a payoff of \$40,000 instead. Although the plaintiff would choose $\hat{x}_1(\mu) > 2/10$ if disclosure were not available to the defendant, the fact that it is forces him to choose the lower $\hat{x}_0 = 1/16$, even though it will not be utilized in equilibrium. As mentioned above, the feature of this numerical example that disclosure helps to mitigate the negative impact of tactical underdiscovery on the probability of settlement flows solely from the assumption that $c \leq 2k$.

Moving now to the question of whether or not discovery increases or decreases the probability of settlement, again assuming $c \leq 2k$ greatly simplifies matters and is assumed for the rest of this paragraph. Without discovery, the probability of settlement equals one, because the condition represented as K2 never holds. Intuitively, $c \leq 2k$ guarantees that it is cheaper for the type H defendant to pay disclosure costs to reveal himself in the disclosure stage than to probalistically pay court costs to reveal himself in the settlement stage. With discovery available to the plaintiff and $c \leq 2k$, the probability of settlement equals one unless K1 holds. Overall, the availability of discovery weakly decreases the probability of settlement.

5. Conclusion

This paper studies a model in which initially the defendant has private information about the strength of his case, the plaintiff chooses any amount of discovery at no cost to himself, the defendant chooses any amount of disclosure, and finally the defendant makes a settlement offer. The result is an endogenous signaling game that derives from the fact that a defendant with a strong case can disclose and bargain more confidently. In the unique modified undefeated equilibrium, the plaintiff may undertake imperfect discovery to maintain the weak type defendant's incentive to mimic in both the disclosure and settlement stages, which increases the strong type's settlement offer. Relative to the related theoretical literature, the present paper captures that an uninformed responder to a take-it-or-leave-it offer may undertake positive but incomplete discovery, even when he can choose any amount of discovery at no cost to himself. The main assumptions that drive that result are that information is divisible and that the evaluation that the plaintiff reaches about the merits of the case is private.

The model presented in this paper is very similar to one in which a seller of a good, service, or asset knows its quality, the buyer does a public inspection and reaches a private evaluation, and the seller has the option to reveal information about the quality at a cost. The amount of information revealed and the price the seller sets are signals of quality, and the buyer may do an imperfect inspection to keep the price low.

Appendix A

A.1 Mixed strategy equilibria in the settlement stage

Proposition 6.1. *For any* $x_1 \in [0, 1)$*, there can be at most one settlement offer that the type H and the type L defendant both play with a positive probability.*

Proof. The approach will be to show that, if the type H defendant is indifferent between two offers, then the type L defendant strictly prefers the higher one.

As a shorthand, the arbitrary value of $x_1 \in [0, 1)$ will be denoted simply by x for the rest of the proof.

Suppose the type H defendant is indifferent between two offers $s_1 < s_2 \leq L - k$.

Let α_k be the probability with which the uninformed plaintiff accepts the offer s_k, $k = 1, 2$.

The type H defendant's indifference means that his expected cost from offering s_1 is equal to his expected cost from offering s_2:

$$(x + (1-x)\alpha_1)s_1 + (1-x)(1-\alpha_1)(H+k) = (x + (1-x)\alpha_2)s_2 + (1-x)(1-\alpha_2)(H+k) \tag{4}$$

$$\alpha_2 s_2 - \alpha_1 s_1 = (\alpha_2 - \alpha_1)(H+k) - \frac{x}{1-x}(s_2 - s_1) \tag{5}$$

$$(x + (1-x)(1-\alpha_1))(L+k) + (1-x)\alpha_1 s_1 \leq (x + (1-x)(1-\alpha_2))(L+k) + (1-x)\alpha_2 s_2 \tag{6}$$

$$(\alpha_2 - \alpha_1)(L+k) \leq \alpha_2 s_2 - \alpha_1 s_1 \tag{7}$$

$$(\alpha_2 - \alpha_1)(L-H) + \frac{x}{1-x}(s_2 - s_1) \leq 0 \tag{8}$$

$$(x + (1-x)(1-\alpha_1))(L+k) + (1-x)\alpha_1 s_1 \leq L - k = x(L-k) + (1-x)\alpha_2(L-k) \tag{9}$$

$$(1-\alpha_1)(L+k) + \frac{x}{1-x}2k \leq \alpha_2 s_2 - \alpha_1 s_1 \tag{10}$$

$$(1-\alpha_1)(L-H) + \frac{x}{1-x}(s_2 - s_1 + 2k) \leq 0 \tag{11}$$

Notation: In a mixed strategy equilibrium of the settlement stage of the game, denote the probability with which the type K defendant offers s by $q_K(s)$, $K = H, L$.

Proposition 6.2. *Consider a mixed-strategy equilibrium in which there exists a $\tilde{s}$ such that $q_H(\tilde{s}) > 0$ and $\tilde{s} \geq z_1 \equiv min\{s^*(E_P^{\mu_1}), s^*(E_S)\}$. If the inequality is strict, then the mixed-strategy equilibrium is defeated by a pure-strategy equilibrium. If the inequality holds with equality, then the mixed-strategy equilibrium does not defeat the undefeated pure-strategy equilibrium with the offer z_1 (if it exists); if it does not exists, the mixed-strategy equilibrium is defeated by the isolated separating equilibrium.*

Proof. Recall that the type H defendant's offer in the undefeated pooling equilibrium, $s^*(E_P^{\mu_1})$, is accepted with probability one; his offer in the undefeated separating equilibrium, $s^*(E_S)$, is also accepted with probability one; and his offer in the isolated separating equilibrium is $H - k$, which is accepted with probability x_1, and therefore his expected cost in the isolated separating equilibrium is $x_1(H-k) + (1-x_1)(H+k) \equiv c(E_{IS})$. Recall also that the undefeated pooling equilibrium does not exist if and only if $c(E_{IS}) < s^*(E_P^{\mu_1})$; the undefeated separating equilibrium does not exist if and only if $c(E_{IS}) < s^*(E_S)$; and the isolated separating equilibrium does not exist if and only if $L - k < c(E_{IS})$. Therefore, at least one of the three always exists.

Suppose first that the inequality in the proposition is strict. The type H defendant's expected cost in the mixed-strategy equilibrium is at least $\tilde{s}$, and it is exactly $\tilde{s}$ if the probability with which that offer is accepted equals one.

If either the undefeated pooling equilibrium or the undefeated separating equilibrium exists, then the type H defendant could profitably deviate to a pure-strategy equilibrium with the offer z_1 if it is not already an equilibrium offer in the mixed-strategy equilibrium, or deviate to a pure-strategy equilibrium with the offer $z_1 + \epsilon$ for some very small ϵ otherwise. The existence of some offer $z_1 + \epsilon$ that is not an equilibrium offer in the mixed-strategy equilibrium is guaranteed by the facts that (a) there can be at most one offer $s > H - k$ such that $q_H(s) > 0$ and $q_L(s) = 0$, because if there were two, both would be accepted with probability one and the type H defendant could not be indifferent between them, and (b) there can be at most one offer $s > H - k$ such that $q_H(s) > 0$ and $q_L(s) > 0$, because of Proposition 6.1.

If instead neither the undefeated pooling equilibrium nor the undefeated separating equilibrium exists, then the type H defendant could profitably deviate to the isolated separating equilibrium with the offer $H - k$. That it is not already an equilibrium offer in the mixed-strategy equilibrium is guaranteed by the facts that (a) $c(E_{IS}) < z_1 < \tilde{s}$, and (b) $c(E_{IS})$ is the greatest expected cost for the type H defendant that is possible if he makes the offer $H - k$, because it is the expected cost if the uninformed plaintiff rejects his offer with probability one.

Suppose now that the inequality in the proposition holds with equality. If either the undefeated pooling equilibrium or the undefeated separating equilibrium exists, then the mixed-strategy equilibrium does not defeat the one with equilibrium offer z_1, because z_1 is an equilibrium offer in the mixed-strategy equilibrium. If neither exists, then the mixed-strategy equilibrium does not defeat, and in fact is defeated by, the isolated separating equilibrium, because $c(E_{IS}) < z_1 = \tilde{s}$. □

Proposition 6.3. *Assume that, in a mixed strategy equilibrium of the settlement stage of the game, there does not exist a $\tilde{s}$ such that both $q_H(\tilde{s}) > 0$ and $q_L(\tilde{s}) > 0$. Assume also that, for all offers s such that $q_H(s) > 0$, it is the case that either (a) $s < min\,\{s^*(E_P^{\mu_1}), s^*(E_S)\}$, or (b) $s = H - k$. Let $\tilde{\lambda}$ be the probability with which the uninformed plaintiff accepts $H - k$.*

Then, in such a mixed-strategy equilibrium, the type H defendant offers $H - k$ the type L defendant offers $L - k$, and the following conditions hold: (i) $(x_1 + (1-x_1)\tilde{\lambda})(H-k) + (1-x_1)(1-\tilde{\lambda})(H+k) \leq L - k$ (i.e. the type H defendant prefers to make the offer $H - k$ rather than $L - k$), and (ii) $(1-x_1)\tilde{\lambda}(H-k) + (x_1 + (1-x_1)(1-\tilde{\lambda}))(L+k) \geq L - k$ (i.e. the type L defendant prefers to make the offer $L - k$ rather than $H - k$).

Proof. Because the defendant types do not pool, the plaintiff will know the defendant's type from his offer. Therefore, the type L defendant will offer $L - k$.

If the type H defendant were to make an offer greater than $H - k$, it would be accepted with probability one. By the assumption that for any such offer $s < s^*(E_S)$, the type L defendant would mimic that offer if it were accepted with probability one. Therefore, the type H defendant must only offer $H - k$.

This type of equilibrium can be supported by the beliefs of the uninformed plaintiff that, if the offer is $H - k$, then the defendant is a type H, and the defendant is type L otherwise. □

Proposition 6.4. *Assume that, in a mixed strategy equilibrium of the settlement stage of the game, there exists a $\tilde{s}$ such that both $q_H(\tilde{s}) > 0$ and $q_L(\tilde{s}) > 0$. Assume also that, for all offers s such that $q_H(s) > 0$, it is the case that either (a) $s < min\,\{s^*(E_P^{\mu_1}), s^*(E_S)\}$, or (b) $s = H - k$. Let $\tilde{\lambda}$ be the probability with which the uninformed plaintiff accepts $H - k$. Let $\tilde{\alpha}$ be the probability with which the uninformed plaintiff accepts the (unique) pooling offer $\tilde{s}$.*

Then, in such a mixed-strategy equilibrium, the following conditions hold: (i) $\tilde{s} = \frac{\mu_1 q_H(\tilde{s})(H-k) + (1-\mu_1) q_L(\tilde{s})(L-k)}{\mu_1 q_H(\tilde{s}) + (1-\mu_1) q_L(\tilde{s})}$ (i.e. the uninformed plaintiff is indifferent between accepting and rejecting $\tilde{s}$), (ii) $(1-x_1)\tilde{\alpha}\tilde{s} + (x_1 + (1-x_1)(1-\tilde{\alpha}))(L+k) = L - k$ (i.e. the type L defendant is indifferent between the offers $\tilde{s}$ and $L - k$), and (iii) $(x_1 + (1-x_1)\tilde{\alpha})\tilde{s} + (1-x_1)(1-\tilde{\alpha})(H+k) \leq (x_1 + (1-x_1)\tilde{\lambda})(H-k) + (1-x_1)(1-\tilde{\lambda})(H+k)$ (i.e. the type H defendant weakly prefers to make the offer $\tilde{s}$ rather than $H - k$).

Proof. It must be that $\tilde{\alpha} > 0$, otherwise, it could not be the case that $q_L(\tilde{s}) > 0$, because the type L defendant would strictly prefer to offer $L - k$.

The result that $q_L(\tilde{s}) > 0$ together with the assumption that $\tilde{s} < s^*(E_P^{\mu_1})$ imply that $q_L(\tilde{s}) < q_H(\tilde{s})$. Otherwise the uninformed plaintiff would not accept $\tilde{s}$ with positive probability. Next, the result that $q_L(\tilde{s}) < 1$ together with the assumption that $\tilde{s} < s^*(E_S)$ imply that $\tilde{\alpha} < 1$. Otherwise, the type L defendant would offer $\tilde{s}$ with probability one. Therefore, the uninformed plaintiff must be indifferent between accepting and rejecting.

By Proposition 6.1, the defendant types do not pool on more than one offer, so it must be that $q_L(\tilde{s}) + q_L(L-k) = 1$. That is, the type L defendant must be indifferent between those two offers.

Next, I have that $q_H(s) = 0$ for all s not equal to $\tilde{s}$ or $H-k$. If there were another offer that the type H defendant made with a positive probability, then the uninformed plaintiff would accept it with probability one. But then the type L defendant would prefer that offer to the offer of $L-k$. Finally, the type H defendant must weakly prefer to offer $\tilde{s}$ to $H-k$; though, in equilibrium, he may also offer $H-k$.

This type of equilibrium can be supported by the beliefs of the uninformed plaintiff that, if the offer is $H-k$ ($L-k$) the defendant is a type H (type L). If the offer is $\tilde{s}$ then the probability that the defendant is a type H is $\frac{\mu_1 q_H(\tilde{S})}{\mu_1 q_H(\tilde{S}) + (1-\mu_1) q_L(\tilde{S})}$. □

A.2 Within-group undefeated equilibria of the settlement stage

Proposition 6.5. *Consider the set of mixed-strategy equilibria with the characteristic that, for all offers s such that $q_H(s) > 0$, it is the case that either (a) $s < \min\{s^*(E_P^{\mu_1}), s^*(E_S)\}$, or (b) $s = H-k$. Consider also the separating equilibria in which the type H defendant's offer is strictly greater than $s^*(E_S)$. Of the equilibria in the union of those two sets, the equilibrium that survives the modified version of the undefeated equilibrium refinement is the one in which the type H defendant offers $H-K$, the type L defendant offers $L-k$, and the uninformed plaintiff accepts $H-k$ with the maximum probability such that the type L defendant does not strictly prefer to mimic: $\hat{\lambda} \equiv \min\{\frac{2k}{(1-x_1)(L-H+2k)}, 1\}$.*

Proof. The set of mixed-strategy equilibria can be split into the following sets: (a) those in which the type L defendant is indifferent between the offer $L-k$ and one of the type H defendant's offers, and (b) the remaining mixed-strategy equilibria.

Consider first the mixed-strategy equilibrium in group (a).

Denote by α the probability with which the uninformed plaintiff accepts the offer s.

The type H defendant's expected cost can be written $(x_1 + (1-x_1)\alpha(s))s + (1-x_1)(1-\alpha(s))(H+k)$ where α is a function of the offer s, because the type L defendant must be indifferent between s and $L-k$.

Specifically, $(1-x_1)\alpha s + (x_1 + (1-x_1)(1-\alpha))(L+k) = L-k$, which can be written as the following:

$$\alpha(s) = \frac{2k}{(1-x_1)(L+k-s)} \tag{12}$$

$$\alpha\prime(s) = \frac{2k}{(1-x_1)(L+k-s)^2} \tag{13}$$

$$\begin{aligned} &x_1 + (1-x_1)\alpha(s) - (1-x_1)\alpha\prime(s)(H+k-s) \\ &= x_1 + \frac{2k(L-H)}{(L+k-s)^2} > 0 \end{aligned} \tag{14}$$

Notice that, if the minimum in the previous paragraph equals one, then the defeating equilibrium is a separating equilibrium of the form described in the proposition. These separating equilibria are also defeated by E^*, because the type H defendant's expected cost in E^* is always less than or equal to $s^*(E_S)$, and none of these separating equilibria have an equilibrium offer of $H-k$.

A.3 Mixed strategy equilibria in the disclosure stage

Proposition 6.6. *In a mixed-strategy equilibrium of the disclosure stage of the game, there can be at most one equilibrium disclosure level that induces the pooling equilibrium in the settlement stage.*

Proof. Suppose, to reach a contradiction, that there are two disclosure levels, $d_1^* > d_1^{**}$, that induce the pooling equilibrium in the settlement stage.

After d_1^* (d_1^{**}) is played in the disclosure stage, denote the uninformed plaintiff's belief that the defendant is type H by μ_1^* (μ_1^{**}).

The fact that the type H defendant is indifferent between d_1^* and d_1^{**} yields the following:

$$\mu^* H + (1-\mu^*)L - k + cd_1^* = \mu_1^{**} H + (1-\mu^{**})L - k + cd_1^{**} \tag{15}$$

$$\begin{aligned} &x_1^*(L+k) + (1-x_1^*)(\mu_1^* H + (1-\mu_1^*)L - k) + cd_1^* \\ &= x_1^{**}(L+k) + (1-x_1^{**})(\mu_1^{**} H + (1-\mu_1^{**})L - k) + cd_1^{**} \end{aligned} \tag{16}$$

$$x_1^*(\mu_1^*(L-H) + 2k) = x_1^{**}(\mu_1^{**}(L-H) + 2k) \tag{17}$$

which contradicts that both $d_1^* > d_1^{**}$ and $\mu_1^* > \mu_1^{**}$. □

Because the type L defendant would not pay a positive disclosure fee in the disclosure stage only to then separate in the settlement stage, a corollary of proposition 6.6 is that there can be at most one positive disclosure level that the type L defendant plays with a positive probability.

Proposition 6.7. *Each mixed strategy equilibrium of the disclosure stage is defeated by a pooling equilibrium or a separating equilibrium, except in a knife-edge case in which all players are exactly indifferent between the undefeated pooling equilibrium and the undefeated separating equilibrium.*

Proof. Suppose that there is a mixed strategy equilibrium (denote it by E_0) that is not defeated by a pooling equilibrium or a separating equilibrium.

Denote the equilibrium probability with which the type K defendant chooses the disclosure level d by $p_K(d)$, $K = H, L$.

Because of the corollary to Proposition 6.6, the type L defendant can have at most two equilibrium disclosure levels: (1) zero disclosure, and (2) a positive disclosure level d that induces pooling in the settlement stage.

There can be at most one disclosure level $\tilde{d}$ such that $p_H(\tilde{d}) > 0$ and $p_L(\tilde{d}) = 0$, because if there were two or more, then the type H defendant would strictly prefer the lowest one. Therefore, the type H defendant can have at most three equilibrium disclosure levels: (1) zero disclosure, (2) a positive disclosure level d that induces pooling in the settlement stage, and (3) a separating disclosure level.

At this point, I have that if the type H defendant prefers the undefeated pooling equilibrium to E_0, then there exists a pooling equilibrium that defeats E_0. If zero disclosure is not an equilibrium disclosure level in E_0, then the undefeated pooling equilibrium itself would defeat E_0. Otherwise, the type H defendant can deviate to a pure-strategy pooling equilibrium in which the defendant types pool on some very small disclosure level ϵ, which is not an equilibrium disclosure levels in E_0. The existence of some ϵ is guaranteed by the fact that there are at most two equilibrium positive levels of disclosure.

I also have that if the type H defendant prefers the undefeated separating equilibrium to E_0, then there exists a separating equilibrium that defeats E_0. If the least-cost separating disclosure level is not an equilibrium disclosure level in E_0, then the undefeated separating equilibrium itself would defeat E_0. Otherwise, the type H defendant would simply choose the least-cost separating disclosure level with probability one (i.e. the undefeated separating equilibrium is equal to E_0).

Therefore, all that remains to be shown is that the type H defendant prefers the undefeated pooling equilibrium to E_0, prefers the undefeated separating equilibrium to E_0, or he and all the other players are exactly indifferent between the undefeated pooling and undefeated separating equilibria.

There must be some disclosure level $\tilde{d}$ such that both $p_H(\tilde{d}) > 0$ and $p_L(\tilde{d}) > 0$. Otherwise, the type L defendant would choose zero disclosure, the type H defendant would choose a single disclosure level with probability one, and E_0 would not be a mixed strategy equilibrium.

Therefore, there are four cases to consider: (1) the only pooling disclosure level is at zero and it leads to pooling in the settlement stage, (2) there is a positive pooling disclosure level and the type L defendant plays that level with probability one, (3) there is a positive pooling disclosure level and the type L defendant mixes between it and zero disclosure (there may also be a pooling disclosure level at zero if it leads to the separating equilibrium in the settlement stage), and (4) the only pooling disclosure level is at zero and it leads to separating in the settlement stage.

1. Suppose there is a pooling disclosure level at zero and it leads to pooling in the settlement stage. By the corollary to proposition 6.6, the type L defendant plays zero disclosure with probability one. In order for E_0 to not be equal to the undefeated pooling equilibrium, the type H defendant must play another disclosure level with a positive probability. However, the μ_1 associated with zero disclosure would be greater if the type H defendant chose it with probability one. That is, the type H defendant prefers the undefeated pooling equilibrium.
2. Suppose there is a pooling disclosure level at a positive level and the type L defendant plays it with probability one. Then, in order for E_0 to not be equal to a pooling equilibrium, the type H defendant must play another disclosure level with a positive probability, and as in the previous case, the type H defendant prefers the undefeated pooling equilibrium.
3. Suppose there is a positive pooling disclosure level (call it $\tilde{d}_1$) and the type L defendant also plays zero disclosure with a positive probability. The type H defendant prefers the undefeated separating equilibrium to any mixed-strategy equilibrium from this case, because the type H defendant's marginal benefit of increasing $\tilde{d}_1$ is greater than his marginal cost:
   (a) The type L must be indifferent between an expected cost of $L-k$ and an expected cost of $\tilde{x}_1(L+k)+(1-\tilde{x}_1)(\tilde{\mu}_1 H+(1-\tilde{\mu}_1)L-k)+c\tilde{d}_1$ where $\tilde{x}_1 = x_0+\tilde{d}_1$ and $\tilde{\mu}_1$ is the uninformed plaintiff's belief that the defendant is a type H if he observes $\tilde{d}_1$ in the disclosure stage.
   (b) Type L defendant indifference condition can be written as the following:

$$\tilde{\mu}_1 = \frac{2k\tilde{x}_1 + c\tilde{d}_1}{(1-\tilde{x}_1)(L-H)} \tag{18}$$

   (c) Differentiation of the equation delivers $F = \frac{d\tilde{\mu}_1}{d\tilde{d}_1} = \frac{c(1-x_0)+2k}{(1-\tilde{x}_1)^2(L-H)}$.
   (d) The type H's expected cost in the settlement stage is equal to $\tilde{\mu}_1 H+(1-\tilde{\mu}_1)L-k$, the derivative of which with respect to $\tilde{\mu}_1$ is equal to $-(L-H)$. By multiplying F by $-(L-H)$, then I have that the derivative of the type H's expected cost in the settlement stage with respect to $\tilde{d}_1$ is equal to $G \equiv -\frac{c(1-x_0)+2k}{(1-x_0-\tilde{d}_1)^2}$.
   (e) The final step is to compare his marginal benefit of increasing $\tilde{d}_1$ (i.e. -G) to his marginal cost of increasing $\tilde{d}_1$ (i.e. c):

$$-G = \frac{c(1-x_0)+2k}{(1-x_0-\tilde{d}_1)^2} > \frac{c(1-x_0)}{(1-x_0-\tilde{d}_1)^2} > c \tag{19}$$

   That is, given the type L defendant's indifference between zero disclosure and $\tilde{d}_1$, the type H defendant's marginal benefit from increasing $\tilde{d}_1$ and thereby decreasing his settlement offer $\tilde{\mu}_1 H+(1-\tilde{\mu}_1)L-k$ is greater than the marginal cost of c. Therefore, in this case, he prefers the undefeated separating equilibrium of the disclosure stage.
4. Suppose the defendant types pool only on zero disclosure and it leads to separating in the settlement stage. If the undefeated pooling equilibrium in the disclosure stage would lead to the undefeated pooling equilibrium in the settlement stage, then the type H defendant would prefer it to E_0. Therefore, any positive probability with which the type H defendant plays zero disclosure, it leads to the undefeated mixed-strategy equilibrium in the settlement stage. The type H defendant must play another disclosure level with positive probability in order for E_0 not to be exactly equal to the undefeated pooling equilibrium of the disclosure stage, and it cannot be more or less than the least-cost separating level of disclosure (otherwise, he would prefer the undefeated separating equilibrium of the disclosure stage or the type L defendant would mimic, respectively). Therefore, he must be exactly indifferent between the undefeated pooling equilibrium and the undefeated separating equilibrium. Further, both the undefeated pooling equilibrium and the undefeated separating equilibrium provide the type L defendant with a cost of $L-k$ and provide the plaintiff with his expected payoff from going to trial.

□

1. Suppose there is a pooling disclosure level at zero and it leads to pooling in the settlement stage. By the corollary to proposition 6.6, the type L defendant plays zero disclosure with probability one. In order for E_0 to not be equal to the undefeated pooling equilibrium, the type H defendant must play another disclosure level with a positive probability. However, the μ_1 associated with zero disclosure would be greater if the type H defendant chose it with probability one. That is, the type H defendant prefers the undefeated pooling equilibrium.
2. Suppose there is a pooling disclosure level at a positive level and the type L defendant plays it with probability one. Then, in order for E_0 to not be equal to a pooling equilibrium, the type H defendant must play another disclosure level with a positive probability, and as in the previous case, the type H defendant prefers the undefeated pooling equilibrium.
3. Suppose there is a positive pooling disclosure level (call it $\tilde{d}_1$) and the type L defendant also plays zero disclosure with a positive probability. The type H defendant prefers the undefeated separating equilibrium to any mixed-strategy equilibrium from this case, because the type H defendant's marginal benefit of increasing $\tilde{d}_1$ is greater than his marginal cost:
   (a) The type L must be indifferent between an expected cost of $L-k$ and an expected cost of $\tilde{x}_1(L+k)+(1-\tilde{x}_1)(\tilde{\mu}_1 H+(1-\tilde{\mu}_1)L-k)+c\tilde{d}_1$ where $\tilde{x}_1 = x_0+\tilde{d}_1$ and $\tilde{\mu}_1$ is the uninformed

plaintiff's belief that the defendant is a type H if he observes $\tilde{d}_1$ in the disclosure stage.

(b) Type L defendant indifference condition can be written as the following:

$$\tilde{\mu}_1 = \frac{2k\tilde{x}_1 + c\tilde{d}_1}{(1-\tilde{x}_1)(L-H)} \tag{18}$$

(c) Differentiation of the equation delivers $F = \frac{d\tilde{\mu}_1}{d\tilde{d}_1} = \frac{\frac{c(1-x_0)+2k}{2}}{(1-\tilde{x}_1)\ (L-H)}$.

(d) The type H's expected cost in the settlement stage is equal to $\tilde{\mu}_1 H + (1-\tilde{\mu}_1)L - k$, the derivative of which with respect to $\tilde{\mu}_1$ is equal to $-(L-H)$. By multiplying F by $-(L-H)$, then I have that the derivative of the type H's expected cost in the settlement stage with respect to $\tilde{d}_1$ is equal to $G \equiv -\frac{\frac{c(1-x_0)+2k}{2}}{(1-x_0-\tilde{d}_1)}$.

(e) The final step is to compare his marginal benefit of increasing $\tilde{d}_1$ (i.e. -G) to his marginal cost of increasing $\tilde{d}_1$ (i.e. c):

$$-G = \frac{c(1-x_0)+2k}{(1-x_0-\tilde{d}_1)^2} > \frac{c(1-x_0)}{(1-x_0-\tilde{d}_1)^2} > c \tag{19}$$

That is, given the type L defendant's indifference between zero disclosure and $\tilde{d}_1$, the type H defendant's marginal benefit from increasing $\tilde{d}_1$ and thereby decreasing his settlement offer $\tilde{\mu}_1 H + (1-\tilde{\mu}_1)L - k$ is greater than the marginal cost of c. Therefore, in this case, he prefers the undefeated separating equilibrium of the disclosure stage.

4. Suppose the defendant types pool only on zero disclosure and it leads to separating in the settlement stage. If the undefeated pooling equilibrium in the disclosure stage would lead to the undefeated pooling equilibrium in the settlement stage, then the type H defendant would prefer it to E_0. Therefore, any positive probability with which the type H defendant plays zero disclosure, it leads to the undefeated mixed-strategy equilibrium in the settlement stage. The type H defendant must play another disclosure level with positive probability in order for E_0 not to be exactly equal to the undefeated pooling equilibrium of the disclosure stage, and it cannot be more or less than the least-cost separating level of disclosure (otherwise, he would prefer the undefeated separating equilibrium of the disclosure stage or the type L defendant would mimic, respectively). Therefore, he must be exactly indifferent between the undefeated pooling equilibrium and the undefeated separating equilibrium. Further, both the undefeated pooling equilibrium and the undefeated separating equilibrium provide the type L defendant with a cost of $L-k$ and provide the plaintiff with his expected payoff from going to trial.

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