Universitat Autònoma de Barcelona

ESSAYS IN LAW AND ECONOMICS

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Introduction

The civil justice system is crucial for the functioning of the economy. It determines the rules economic agents are supposed to comply with and the extent to which these rules are in fact obeyed. The legal system should provide individuals with an opportunity to exercises their rights, and if necessary obtain compensation for the any harms suffered. However, individual agents rarely have a detailed knowledge of the legislature and legal procedures. Moreover, they often find themselves unable to determine the value of their claim, the likelihood of prevailing in court or the optimal method of litigation. At the same time they have to interact with much better informed lawyers or corporate agents. In this thesis, I study how asymmetries of information influence the behavior of the agents in the market for legal services.

In Chapter 1, *Negotiations, Expertise and Strategic Misinformation*, I study a classical problem of pre-trail negotiations. I consider a situation in which a plaintiff suffers a harm of a random value from a defendant. To avoid a costly trial the parties engage in a pre-trial negotiation. The informed defendant offers a settlement to the uninformed plaintiff, who has to decide whether to settle the case or go to trial. I contribute to the existing body of research by allowing a plaintiff to contract with an attorney and receive some unbinding unverifiable advice from him during the negotiation. I begin by analyzing the problem for a fixed contract. I find that the result of the negotiation strongly depends on whether, under the given contract, the plaintiff or the attorney is more willing to resolve the case by trial. When the attorney is more keen to go to court, the plaintiff follows his advice for low offers, but always accepts high offers. In the opposite situation, the plaintiff follows the attorney only for some finite set of possible offers, and rejects any other offer. Then, I study the optimal contracts. I find that even though a contract which fully aligns the incentives of the plaintiff and the attorney is feasible, it is never optimal. I show that when the costs of the trial are low compared to the value of the claim the optimal contract is an hourly wage contract. In the opposite situation the contingent-fee contract is optimal. Moreover, I show that when the costs of the trial are low compared to the expected value of the claim the plaintiff is better-off under asymmetric than under complete information.

In Chapter 2, *Cherry-Picking and Career Concerns*, I study how career concerns influence the economic agents' choice of the tasks he performs. In particular, I am interested in how reputation concerns distort the decisions of young lawyers on whether to take a case. To address the question I build a model in which the agents, characterized by skill level, have to decide whether to perform or drop a task of a random difficulty. The chance of performing the task successfully depends on both the agent's skill level and its difficulty. Performing a task is costly, but the agent is rewarded for performing it in the form of either a fixed or a contingent fee. I compare the behavior of senior and junior agents. A senior agent is primarily interested in the monetary payoff, but a junior agent is also concerned with the market belief about his skill level. Importantly, the market does not observe the difficulty of the task and evaluates the agent's skill based solely on its outcome. I find that a junior agent faces a trade-off between appearing more successful by cherry-picking only the simplest tasks, and appearing more experienced by accepting any task received. I show that, typically, the second effect prevails and a junior agent performs more tasks than a senior agent. I extend the baseline model by endogenizing the agent's payoff. In particular, I suppose that the agent is offered a contract to perform a task for a principal who is uninformed about its difficulty. I show that the principal is better-off when dealing with a junior agent. To be precise, she is able to exploit the fact that a junior agent wants to appear experienced and can get the task performed at a lower price.

In Chapter 3, *Dynamics of Collective Litigation*, written with Andrés Espita de la Hoz, we study the challenges of forming collective litigation suits. An interesting feature of collective ligations is that the outcome of the trial depends on the number of litigants. Each new plaintiff may provide some useful evidence that increases the chance of prevailing in the case, or a minimal number of plaintiffs needs to be reached in order to file the case. We propose a dynamic model of litigation in which a defendant faces the arrival of plaintiffs over time. We focus on cases in which the defendant is privately informed about the scope of the harm she has caused (e.g., how many consumers have been exposed to a defective product). The main interest is the connection between the formation of collectives and the actions that defendants can take to interfere in this process. First, we show that when all the plaintiffs can strategically decide to file and settle the case the defendant can completely avoid any case being filed. However, if a fraction of plaintiffs never settles the case, the settlement negotiation with strategic plaintiffs may also fail and the collective litigation can form. Additionally, we study the effects of private settlements in this context. When the case can be settled privately, some plaintiffs receive less information and it becomes more difficult for them to learn about the scope of the harm. In particular, the plaintiffs do not change their decision on whether to file a case based on the history of past settlements. As a result they may lose on filing the case too rarely when the scope of the harm is high and collective litigation is likely to be successful, or they may file it too often in the opposite scenario. Importantly, in the latter case the defendant also loses on introducing the possibility of settling the case secretly.

Chapter 1

Negotiations, Expertise and Strategic Misinformation

1.1 Introduction

When two parties negotiate, they rarely do it on their own, but often hire experts. Politicians hire diplomats to represent them during international summits; investors use the expertise of investment banks during an acquisition process; and companies rely on consultancy firms while buying highly specialized means of production. Yet the role of experts during the negotiations has received little attention in economic research.

In this chapter I analyze the strategic role of expertise during negotiations, and how an uninformed party can use strategic contracting with an expert to improve its bargaining position. The environment that I study is illustrated through an example of civil litigation and pre-trial negotiations – arguably the most common example of negotiations with expertise. The chapter has two focus points. First, I analyze how the outcome of pre-trial negotiation depend on the incentives of the plaintiff and her lawyer. Second, I study the contracts the plaintiff and the attorney agree on.

I model pre-trial negotiation as a sequential game of incomplete information. I study a situation in which a plaintiff suffers a harm of an unknown value from a defendant. To obtain a compensation for a harm the plaintiff hires an attorney by proposing him a contract, which specifies how the compensation and the costs of the litigation will be split. After signing the contract the attorney and the defendant learn the true liability value, but the plaintiff remains uninformed. To avoid a costly trial the parties negotiate an out-of-court settlement. The defendant makes a take-it-or-leave-it settlement offer to the plaintiff. However, the plaintiff can consult her attorney before taking the final decision. The attorney makes an unverifiable and non-binding recommendation to the plaintiff on whether the settlement should be accepted or the case should be resolved by a trial.

At first, I study the problem for any fixed contract, that is, I treat the incentives of the agents as given. I begin with showing that if the incentives of the agents are perfectly aligned then the negotiation follows a complete information scenario. I also study cases in which the incentives of the plaintiff and the attorney are so misaligned that the recommendation of the attorney becomes irrelevant. In this situation the case is resolved by trial for low liability values, and is settled at a pooling offer for high liability values. Importantly, I find that in-between these extremes the result of the negotiation strongly depends on whether the attorney or the plaintiff is more willing to resolve the case by a trial. If the attorney is a more aggressive party (that is there are some settlement offers at which the attorney prefers trial, but the plaintiff prefers settlement), he recommends rejecting some offers that are profitable for the plaintiff. However, upon receiving a negative recommendation, the plaintiff cannot distinguish a situation in which the case should be settled from a situation in which the offer is too low and the case should be resolved by a trial. Thus, at least for sufficiently low settlement offers, she follows the recommendation of the attorney. Hence, in order to avoid the trial the defendant has to either make an offer high enough to convince the attorney and trigger a positive recommendation, or an offer high enough to convince the plaintiff to accept it despite a negative recommendation. In the opposite case, when the plaintiff is a more aggressive agent, she considers the attorney's recommendation only for some finite set of offers and rejects any other offer. To avoid the trial the defendant for each liability value makes the smallest offer that the attorney is willing to recommend and the plaintiff is willing to consider accepting .

Secondly, I analyze which contract should the plaintiff offer to the attorney. I find that although the contract which perfectly aligns the incentives of the agents is feasible, it is never optimal. To be precise, the optimal contract can be of two types. When the cost of the trial are relatively insignificant for the plaintiff, like e.g., under medical malpractice cases, she decides to bear it herself. I refer to this scenario as strategic misinformation, since it closely resembles strategic delegation (proposed by Vickers, 1985 and studied in the environment of civil litigation by Hay, 1997, and Choi, 2003).[1] Because the attorney does not bear the costs of trial, he be-

[1]The strategic delegation literature studies situations in which a principal delegates the decision – making process to an agent with different incentives in order to appear more aggressive and

comes very aggressive and is ready to mislead the plaintiff recommending rejection of some profitable settlement offers. Since the plaintiff accepts low settlement offers only if the attorney recommends doing so, the decision on settling is practically delegated and the defendant has to increase the settlement offer in order to avoid the trial. However, strategic misinformation improves the plaintiff's position only if the liability value is sufficiently low. For high liability values, the defendant can offer a settlement such that the plaintiff is very unlikely to obtain a higher payoff under the trial, and so is willing to accept it even if the recommendation of her attorney is negative. Thus, if the cost of the trial for the plaintiff's side is relatively high compared to the expected value of the liability, like under minor tort law cases, the plaintiff transfers the costs of trial to the the attorney. I refer to this scenario as case selling. By transferring the cost the plaintiff improves her payoff under the trial and forces the defendant to increase the settlement offers. Although the plaintiff can no longer completely rely on her attorney's recommendation and she may accept some unprofitable offers, on average she is compensated for her payoff under the trial.

The idea that knowing less can be advantageous during the negotiation appears firstly in Thomas Schelling's *The Strategy of Conflict* 1980. It was formally developed in Kessler [1998] in an adverse selection environment. In order to maximize information rent, the agent finds it optimal to remain uninformed about his own type with some probability. My model takes a different approach to the problem of ignorance as a strategic tool. Through contracting with an expert, the plaintiff may ensure becoming informed only when the settlement offer is high compared to the liability value. Since the uninformed plaintiff can credibly resolve the case by trial, the defendant has an incentive to increase the settlement offer. Alternatively, the plaintiff may decide to compromise on the quality of the information she receives, but simultaneously improve her bargaining position through transferring the costs of the outside option to an expert, in a manner also proposed by Schelling [1980].

The chapter relates to a literature on information design Kamenica and Gentzkow [2011]. However, in the environment that I study the attorney does not commit to the structure of messages he will send,[2] they are en-

achieve a better equilibrium. A canonical example is Cournot duopoly – the owner of one the firms can delegate the decision on setting the production level to a manager whose remuneration is based on the revenues rather than the profits. By doing so he credibly commits to increase of the production, changing the decision of his competitor and achieving higher profits (see Vickers, 1985).

[2]The model in which commitment is allowed yields qualitatively similar results, although better

dogenously decided by the contract the plaintiff and the attorney sign. In contrast with Kamenica and Gentzkow [2011], at the moment of designing the information the interest of the plaintiff and the attorney are aligned – both agents want to sign a contract which yields profitable settlements. The incentives of the agents diverge only during the negotiation, as any particular offer profitable for one may be unacceptable for the other. The purpose of distorting the information in my model is influencing a behavior of the third party – the defendant. Similar problem has been previously analyzed by Roesler and Szentes [2017] who design an optimal learning scheme for consumers taking into account the influence of the consumers information on the pricing behavior of a monopolist.

The negotiation process in the model borrows from two classes of models. Firstly, the negotiation is a signaling game: the informed party (the defendant) makes the offer and the uninformed party (the plaintiff) may infer the state of the world from it. This setting is similar to Reinganum and Wilde [1986].[3] However, I also introduce a third party, the informed attorney, who serves as an expert capable of providing additional information.

Secondly, I model expertise as a cheap-talk game Crawford and Sobel [1982], i.e., I suppose that the informed expert can send a costless, unverifiable message to his client. The model differs from a standard cheap-talk setting in at least three points. Firstly, the incentives of the expert are endogenously decided (similarly to Krishna and Morgan, 2008). Secondly, the client has an additional source of information, since the settlement offer also carries a signal about the true state of the world.[4] Finally, the influence of an expert is not limited to the decision of the client. The defendant anticipates the advice of the attorney, and adjust its offer accordingly.

I focus on the role the attorney plays as an expert (following Dana Jr and Spier, 1993). For simplicity, I ignore the fact that the attorney while providing his services during the trial may be affected by moral hazard.[5]

The agency problem during the negotiations has been previously studied by Fingleton and Raith [2005]. In their model the principal delegates

settlements for the plaintiff are achievable.

[3]And in contrast with e.g., Nalebuff [1987], who models pre-trail negotiations as a screening game.

[4]There are previous models studying the effect of having access to multiple sources of information. Krishna and Morgan [2001] analyze a situation in which there are multiple experts available. Moreno de Barreda [2013] describes a situation in which the client holds some private imprecise information about the state of the world.

[5]The problem of moral hazard in a civil litigation environment was studied e.g,. by Danzon [1983] and Emons [2000].

negotiation to a career concerned expert who may be able to observe the reservation price of the other party. The principal may choose between monitoring an expert and "closed-doors negotiations" under which only the outcome of the negotiation is observed. It turns out that the latter option is an optimal choice for the principal, since it gives less incentives for the low skill experts to pretend they are of a high skill.

The chapter is divided into six sections. In Section 1.2 I give an example of civil litigation. Section 1.3 describes the model and the solution concept. Section 1.4 is devoted to analyzing the possible outcomes of the negotiation. In Section 1.5, I determine which contracts the plaintiff and the attorney should agree on. I conclude in Section 1.6.

1.2 Example of civil litigation

Before introducing the model it is worth analyzing the litigation process on an example. Consider a common case of a car accident.[6] A careful driver faced an accident due to the behavior of a careless driver. The car of the careful driver was damaged and requires a repair. The victim demands a compensation for the reparation costs from the careless driver's insurance company.

As a benchmark suppose that the plaintiff (the careful driver) is capable of evaluating the liability, and knows that she can obtain $1000 in a court. However, she cannot deal with the bureaucracy herself and must be represented by an attorney. Moreover, bringing the case to a court is costly for both the attorney and the defendant (the insurance company) – each party incurs $100 if they go through a trial procedure. To avoid these costs the parties engage in a pre-trial negotiation. Suppose that the defendant holds the whole bargaining power and can make a take-it-or-leave-it offer to the plaintiff.[7] Additionally, suppose that instead of negotiating herself, the plaintiff can hand out the whole process (including the settlement decision) to her attorney. Imagine that the plaintiff and the attorney signed a contract, which delegates the negotiation to the attorney in exchange for 5% of the monetary compensation and an additional payment of $105 if the case is resolved by a trial. Under this contract, the attorney can obtain a payoff of $55 under the trial ($0.05 \times 1000 - 100 + 105$). Thus, she will

[6] Car accidents accounted for 60% of all the tort law cases filed in 1992 in the US.

[7] This is a common assumption since the defendants are typically institutions (70 % of cases in 2016 in the US) and the plaintiffs are typically individuals (82 % of cases in 2016 in the US). Moreover, the defendants gain on prolonging the negotiations and delaying the payment, wheres the plaintiffs prefer to obtain the compensation as early as possible.

reject any offer below \$1100 (since $0.05 \times 1100 = 55$). In order to avoid the trial, the defendant makes an offer of \$1100, more than the actual liability value. Even though the attorney and the plaintiff initially do not have strong bargaining position, due to strategic contracting they can capture the whole bargaining surplus.

In reality, although the negotiation process is usually handled by the attorney, the plaintiff cannot delegate the final decision.[8] Moreover, in the benchmark scenario the attorney plays only a role of a bureaucrat. In reality the attorneys hold knowledge about applicable rules and provide their uninformed clients a legal advise.

Suppose now that the plaintiff faces an uncertainty about the outcome of the case. With probability 0.8 she receives only compensatory damages of \$750, but with probability 0.2 she could get also high punitive damages obtaining \$2000 of compensation in total. The institutional defendant has professional lawyers employed or faced similar cases in the past and is able to recognize the true liability value. The plaintiff lacks knowledge on applicable legal rules and observes only the distribution on liability values. However, after receiving the offer she can turn to her attorney for an advice on whether the case should be settled or resolved by a trial. Imagine that the plaintiff and the attorney signed the same contract as in the benchmark. As long as the liability value is high this agreement does not perform well – since the plaintiff cannot ever obtain more than \$1795 under the trail (because $0.95 \times 2000 - 105 = 1795$), the defendant makes the smallest offer that provides her this payoff, namely \$1890 ($0.95 \times 1890 = 1795.5$). In this situation the plaintiff does not need an advise of her attorney and always accepts the offer. However when the liability value is low, this contract performs as well as in the benchmark scenario. Although, the defendant could propose \$640, which compensates the plaintiff's payoff under the trial, the attorney would never recommend settling on such an offer (since he obtains \$32 under this settlement compared to \$42.5 under the trial). After observing a negative recommendation the plaintiff would not be capable of recognizing whether she is deceived by her attorney or the liability value is high and the offer should not be accepted. Thus, she would decide to bring the case to the court. To avoid a costly trial the defendant must trigger a positive recom-

[8] With exception of a class action, the attorneys are forbidden to take a decision on accepting or rejecting the settlement unilaterally. In some extreme cases the disagreement between the lawyer and her client may lead to withdrawing the power of the attorney. For simplicity, I ignore this possibility throughout the chapter. I suppose that since the initial costs of investigation are already sunk it is always better for the attorney to proceed with the case. The main results do not change if this assumption is relaxed by introducing an additional participation constraint.

mendation of the attorney. To do so, the defendant makes an offer of \$850 (as $0.05 \times 850 = 42.5$, that is, the attorney's payoff under the trial), giving up the whole bargaining surplus. On average the plaintiff and the attorney obtain \$1058 ($0.2 \times 1890 + 0.8 \times 850 = 1058$), only \$2 less than under optimal contract.[9]

However using the benchmark contract is not always a good choice. It performs well when the liability value is low, but it leads to a poor payoff when the liability value is high. Thus, for example if the punitive damages are awarded with probability 0.8, the plaintiff would be better-off signing a contract, which gives a right to 8% of the compensation to the attorney, but does not include any additional payment in case of the trial. This way, when the liability value realization is high, the defendant has to offer \$2000 to the plaintiff. Although, the defendant could have pretended that the liability value is low by offering \$750 instead, the attorney would correctly advice his client to reject this settlement (since $0.08 \times 2000 - 100 = 0.08 \times 750$ the attorney is indifferent between wining \$2000 in the court and settling on \$750).

1.3 Model

I model civil litigation as a sequential game of incomplete information between three risk-neutral agents: the plaintiff (she), the attorney (he), and the defendant (it). I call the game *the litigation game*. It consists of two main parts: *the contract phase* and *the negotiation phase*. The structure of the game is presented in Figure 1.1.

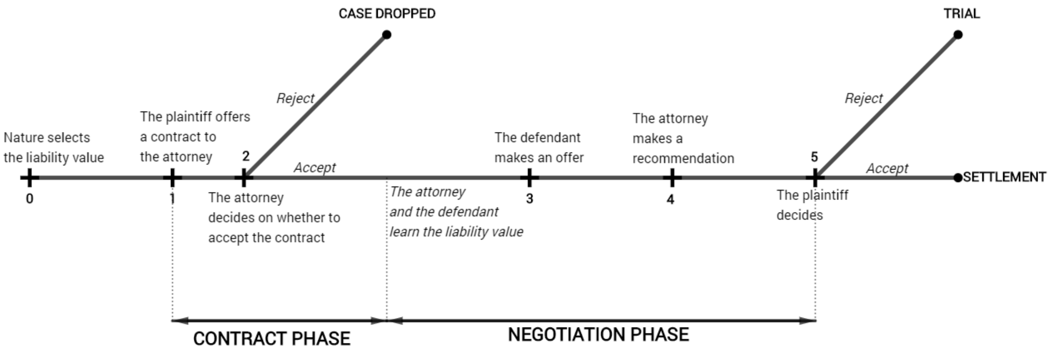
The game begins with the plaintiff suffering some loss for which the defendant is liable. At $\tau = 0$ nature selects the value of the liability drawing it from a commonly known uniform distribution along a range of $[0, \overline{x}]$. [10]

After the value of the liability is realized, but before it is observed by any agent, *the contract phase* of the game begins. At $\tau = 1$, the plaintiff and the attorney agree on a contract C. I assume that the contract is proposed by the plaintiff to the attorney, however the results are independent from

[9] The optimal contract does not include any share and includes a fixed payment and \$100 of an additional payment in case of trial. This contract would be also optimal in the benchmark scenario.

[10] There is an alternative interpretation for this way of modeling the value of the case. It can be that the actual value of the liability is known and is of a size $\overline{x}$, however, the probability of prevailing during the trial P is not known initially and requires some analysis by the attorney. When P is uniformly distributed on $[0, \overline{x}]$, the expected liability value $P\overline{x}$ remains uniformly distributed on the range of $[0, \overline{x}]$.

Figure 1.1: The litigation game



the choice of the identity of the agent making an offer. Moreover, contract C can depend only on the monetary payoff and the way the case was resolved, since unrealized settlement offers and the attorney's recommendations are not verifiable after the litigation is finished and thus they are not contractible. For simplicity I also suppose that the contract is linear and consists of four elements.[11] The attorney receives part of his payment independently from the way the case was resolved: $f_n \in \mathbb{R}$ denotes the basic fixed payment of the attorney,[12] and $s_n \in [0, 1]$ is the basic payment for the attorney in a form of a share of the compensation. The plaintiff may also offer additional payment for her attorney for trial representation: $f_t \in \mathbb{R}_+$ denotes the additional fixed payment for the attorney in case of the trial;[13] and $s_t \in [0, 1 - s_n]$ denotes an additional share payment for the attorney in case of a trial.

At $\tau = 2$, after observing the contract, the attorney decides whether to accept it. If the attorney rejects the contract, *the case is dropped*. If the attorney accepts the contract, he investigates the case at a cost c. At the end of this period both the defendant and the attorney learn the liability

[11] The contracts described in the chapter are analogous to the contracts used in practice. Partial results for general contracts, which allow for non-linearity and contractability of unrealized settlements offer and messages suggest that this assumption is not restrictive, although general contracts may behave differently for liability values sufficiently close to an upper bound of the distribution $\bar{x}$.

[12] Note that f_n is allowed to be negative. Due to this assumption the results of the model are independent from the choice of the agent holding the bargaining power during the contract phase.

[13] f_t is supposed to be non-negative following the standard regulation forbidding an attorney to be charged for a trial. Moreover, in my model I do not distinguish between an hourly fee and a time-independent fixed fee, since in practice the amount of hours worked by the attorney is not observable for the plaintiff [Garoupa and Gomez-Pomar, 2007].

Table 1.1: Payoffs in the litigation game

	Plaintiff	**Attorney**	**Defendant**
Case dropped	0	0	0
Settlement	$(1-s_n)y - f_n$	$s_n y + f_n$	$-y$
Trial	$(1-s_n-s_t)x - f_n - f_t$	$(1+s_n+s_t)x + f_n + f_t - t^a$	$-x - t^d$

value realization x. Then *the negotiation phase* begins.

At $\tau = 3$ the defendant, having already observed the liability value, makes a take-it-or-leave-it offer $y \in \mathbb{R}_+$.

At $\tau = 4$, after observing the offer and the liability value, the attorney makes a recommendation r on whether the plaintiff should accept ($r = 1$) or reject ($r = 0$) the offer. The assumption reducing the set of possible messages to two is made without loss of generality, since once the offer has been made the plaintiff faces a binary choice.[14]

At $\tau = 5$ the plaintiff, having received both the offer and the recommendation, takes the decision p. She can either accept the offer ($p = 1$) ending the case by *the settlement*, or reject the offer ($p = 0$) and end the case by *trial*.

If the case is settled, the defendant makes the promised transfer (y) to the plaintiff, who afterwards transfers the agreed compensation to her attorney.

In case of a trial, the defendant and the attorney pay the fixed costs of the trial (t^d and t^a respectively), the court learns and assesses the liability value forcing the defendant to make a transfer x to the plaintiff. Afterwards, the plaintiff transfers the agreed compensation to her attorney. The payoffs of each of the players are summarized in Table 1.1.

Since *the litigation game* is an extensive form game of incomplete information I use perfect Bayesian equilibrium Fudenberg and Tirole [1991] as the solution concept. In *the litigation game* a PBE is constituted by a strategy profile for all the players and beliefs of the plaintiff such that all the players

[14] In reality the messages are offer dependent. For example, after receiving an offer of \$1000, instead of saying 'reject', the attorney would rather sat 'I believe we can obtain \$2000 in the court' (which in turn would be equivalent to saying 'accept' if the offer was \$3000). However, independently from the set of messages allowed, at any offer they can be always split in two subsets (one of which could be empty), these for which the plaintiff would accept and these for which the plaintiff would reject the offer. The attorney, once the offer has been made, has a preference on how the case should be resolved, and he sends (if possible) a message from a subset inducing his preferred solution.

are sequentially rational and the beliefs of the plaintiff are derived using the Bayes' rule on the equilibrium path. I restrict attention to equilibria in pure strategies; from now on I refer to them simply as PBE.

The litigation game merges features of a standard signaling game (the interaction between the plaintiff and the defendant) and a cheap talk game (the interaction between the plaintiff and the attorney); thus, it generates a plethora of equilibria.

Firstly, as in any cheap-talk game, there always exist babbling equilibria, under which the information between the plaintiff and the attorney is not transmitted only because none of the agents believe it may be transmitted. For example, the attorney may always recommend acceptance of the settlement offer because he believes that the plaintiff will ignore the recommendation anyway. In this case the plaintiff indeed ignores the attorney's recommendation, since she correctly believes that it is independent from the liability value realization and carries no information.

Secondly, PBE imposes a restriction on the beliefs about the liability the plaintiff can hold on the equilibrium path, but does not specify a way in which the plaintiff forms her beliefs out-of-equilibrium. The freedom in choosing out-of-equilibrium beliefs generates multiplicity of equilibria. Particularly, if the plaintiff has very high expectations about the liability value out-of-equilibrium, equilibria in which her bargaining position is artificially strengthen can be always sustained.[15]

To avoid these problems I focus on defendant-preferred equilibria. In these equilibria the communication between the plaintiff and the attorney is successful whenever possible. Moreover, the bargaining position of the plaintiff is not an artifact of out-of-equilibrium beliefs, but follows from the incentives of the plaintiff and the attorney. All the described equilibria satisfy the intuitive criterion Cho and Kreps [1987]. By construction all the selected equilibria are unique in terms of expected pay-off for each of the agents.

In the following sections I solve *the litigation game* by backward induction. Firstly (Section 1.4), I analyze the negotiations process treating the agents' incentives as given. Secondly (Section 1.5), I analyze which contract is signed by the agents at equilibrium.

[15]For example, the plaintiff may believe that whenever the offer y is lower than the defendant's costs of trial (t^d) the liability value is the highest possible ($\bar{x}$). In order to avoid the trail the defendant would always increase its offer to the threshold level, any lower offer would not be a part of the equilibrium path and the beliefs of the plaintiff would remain consistent.

1.4 Negotiation phase

Once the contract has been signed the negotiation begins. Depending on the particularities of $C = (f_n, s_n, f_t, s_t)$, the negotiation can lead to different types of equilibria: completely pooling, partially pooling or separating. The negotiation can end in a settlement or in a trial. Finally, the attorney's recommendation may be relevant or ignored by the plaintiff.

In this section I analyze the outcome of the negotiation for any contract. At first, I focus on the simpler contracts, for which s_t is set to 0. Then I describe the contracts with positive $s_t > 0$. The section starts with a discussion about the incentives of the agents as a function of the contract.

1.4.1 Agents' incentives

Before describing the outcome of the negotiation, it is worth understanding what drives agents' behavior. In this subsection I analyze how a contract with $s_t = 0$ shapes agents' incentives to settle and to go to trial.

For each agent I define *the willingness to settle* – the amount of money the agent is willing to give up from the judged compensation in order to avoid a trial. Since the defendant's costs of the trial are exogenous, the defendant is always willing to pay the additional amount t^d in order to avoid trial; that is, the defendant's willingness to settle is t^d.

The incentives of the attorney are contract-dependent. He is ready to accept any settlement offer y that at least compensates his payoff under the trial: $s_n y \geq s_n x - t^a + f_t$, i.e., $x - y \leq \frac{t^a - f_t}{s_n}$. In other words, as long as $s_n > 0$ the attorney's willingness to settle is:

$$\sigma^a(C) \equiv \frac{t^a - f_t}{s_n}. \tag{1}$$

If $f_t < t^a$ the attorney is ready to accept an offer smaller than the judged compensation, because he bears part of the costs of trial. If $f_t > t^a$, the attorney is overpaid for the trial, and his willingness to settle is negative. In other words, the attorney expects an additional payment for giving up the possibility of the trial.

For $s_n = 0$ the attorney's payment is independent from the liability value and the offer made. If $f_t < t^a$ the attorney always wants to avoid a trial so $\sigma^a(C) \equiv +\infty$. In contrast, if $f_t > t^a$, the attorney always prefers the trial to the settlement and $\sigma^a(C) \equiv -\infty$. Finally, if $f_t = t^a$ the attorney is always indifferent and $\sigma^a(C)$ can take any value.

An example of the attorney's strategy written in terms of his willingness to settle is:

$$r^a(x,y) \equiv \begin{cases} 1 & \text{if } y \geq x - \sigma^a(C) \\ 0 & \text{if } y < x - \sigma^a(C). \end{cases} \tag{2}$$

Under this strategy the plaintiff always recommends the settlement if and only if he weakly prefers it to a trial.

Analogous analysis can be done for the plaintiff. Firstly, suppose the plaintiff was aware of the realized liability value. She would be willing to settle at any offer y that at least compensates her payoff under the trial: $(1-s_n)y \leq (1-s_n)x - f_t$. As long as $s_n < 1$, the plaintiff's willingness to settle is given by:

$$\sigma^p(x;C) \equiv \frac{f_t}{1-s_n}. \tag{3}$$

If $s_n = 1$, the plaintiff's payoff is constant over the liability values. Thus, she would always avoid the trial if $f_t > 0$, which sets her willingness to settle to $\sigma^p(C) \equiv +\infty$. If $f_t = 0$ the plaintiff is always indifferent between the trial and the settlement and $\sigma^p(C)$ can take any value.[16]

The plaintiff's willingness to settle also can be translated to her best response. An example of plaintiff's strategy that is always a best response is:

$$p^{BR}(y,r) \equiv \begin{cases} 1 & \text{if } y \geq \mathbb{E}^p[x|y,r] - \sigma^p(C) \\ 0 & \text{if } y < \mathbb{E}^p[x|y,r] - \sigma^p(C). \end{cases} \tag{4}$$

Finally, it is useful to define *the congruence coefficient* at a given contract $\Phi(C)$, which measures the difference between the attorney and the plaintiff's willingness to settle

$$\Phi(C) \equiv \sigma^p(C) - \sigma^a(C). \tag{5}$$

The coefficient $\Phi(C)$ answers the question of "how much an offer under which the plaintiff is willing to settle must be increased in order to convince the attorney," and is analogous to the bias of the sender in cheap-talk literature. The sign of Φ determines the more aggressive agent: if $\Phi(C) > 0$, the attorney is less willing to settle than the plaintiff; if $\Phi(C) < 0$ the attorney is more willing to settle. Finally, if $\Phi(C) = 0$, the incentives of these two agents are perfectly aligned.

[16] The indeterminacy of $\sigma^a(C = (f_n, s_n = 0, f_t = t^a, s_t = 0))$ and $\sigma^a(C = (f_n, s_n = 1, f_t = 0, s_t = 0))$ can be resolved at the equilibrium; this problem is further discussed in Section 1.5.

1.4.2 Negotiation phase equilibria

If the information was complete, the defendant could ignore the attorney and offer the plaintiff a settlement that compensates her payoff under a trial:

$$y^{CI}(x) \equiv \max\{0, x - \sigma^p(C)\}. \tag{6}$$

The plaintiff, knowing the true realization of the liability value, would always agree on such a settlement offer, independently from the attorney's recommendation.

However, in the asymmetric information environment the settlement offer plays a triple role. First, it frames the settlement terms. Second, it signals the liability value to the plaintiff. The higher the offer, the higher the plaintiff's expectations of the compensation are. Finally, the offer triggers a recommendation of the attorney, which can play a relevant role in this environment.

Since the plaintiff does not know the true liability value, she may condition her decision on the informed attorney's recommendation. However, she cannot blindly follow the attorney, because their incentives may differ, and the attorney's recommendation follows his own interest rather than the interest of his client. Depending on how the incentives of the attorney and the plaintiff are set, the negotiation can follow one of four possible scenarios described in the following subsections: *perfectly informative equilibrium* (when $\Phi(C) = 0$), *misinformative equilibrium* (when $\Phi(C) > 0$ and $\sigma^a(C) \geq -t^d$), *partially informative equilibrium* (when $\Phi(C) < 0$ and $\Phi(C) \geq -t^d - \sigma^p(C)$), and *uninformative equilibrium* (otherwise).

Completely aligned incentives

If the incentives of the plaintiff and the attorney are completely aligned, that is the congruence coefficient $\Phi(C) = 0$, the plaintiff can always trust her attorney and may simply follow his recommendation. This situation, replicates exactly the complete information scenario, thus I refer to it as *perfectly informative equilibrium*.

Proposition 1.1. *Consider a contract C for which $\Phi(C) = 0$. Then there exists a defendant-preferred PBE of the negotiation phase called perfectly informative equilibrium in which:*

(i) the defendant's offer is

$$y(x) = \max\{x - \sigma^p(C); 0\}, \tag{7}$$

(ii) the attorney's recommendation is

$$r(x,y) = r^a(x,y), \tag{8}$$

(iii) the plaintiff's decision is

$$p(y,r) = \begin{cases} r \text{ if } y < \overline{x} - \sigma^p(C) \\ 1 \text{ if } y \geq \overline{x} - \sigma^p(C). \end{cases} \tag{9}$$

Aggressive attorney

When the plaintiff is more willing to settle than the attorney, that is $\Phi(C) > 0$, and she observes a positive recommendation from her attorney, she knows the offer is good enough to be accepted.

However, interpreting the negative recommendation is not simple for the plaintiff. On one hand, the plaintiff may believe that the defendant is trying to take an advantage of her lack of information to make an unacceptably low offer. On the other hand, she may believe that the offer is indeed profitable, but the attorney is trying to deceive her in order to obtain the trial premium.

At equilibrium, if the plaintiff observes too low an offer and a negative recommendation, she should reject it. She would think that there are more possible liability value realizations for which the observed offer is unacceptably low (and the defendant is trying to take advantage of the plaintiff's lack of information), than those under which the offer should be indeed accepted. The opposite happens when the offer is high enough. Even if the recommendation is negative, the plaintiff will realize that there are more possible liability value realizations for which the offer should be indeed accepted (and the attorney is just trying to obtain the trail premium). Thus, the offer is accepted.

Notice that for very high liability values, the defendant does not need to bother with convincing the attorney; it can simply make the lowest offer that os always accepted by the plaintiff. I denote such an offer by $\dot{y}$. Also, I denote the lowest liability value under which $\dot{y}$ is made by $\dot{x}$. The values of $\dot{y}$ and $\dot{x}$ are as follows:

$$\dot{y} = \max\{0, \frac{1}{2}\overline{x} - \sigma^p(C), \overline{x} - 2\sigma^p(C) - t^d, \overline{x} - \Phi(C) - \sigma^p(C)\}, \tag{10}$$

$$\dot{x} = \max\{0, \overline{x} - 2\sigma^p(C) - 2t^d, \overline{x} - 2\Phi(C)\}. \tag{11}$$

In a well-behaving case, the pair $(\dot{x}, \dot{y})$ solves the following system of equations:

$$\begin{cases} \dot{y} - \sigma^p(C) = \frac{1}{2}(\overline{x} + \dot{x}) \\ \dot{x} - \min\{t^d, -\sigma^a(C)\} = \dot{y} \end{cases} \tag{12}$$

The first condition states that a perfect Bayesian plaintiff is indifferent between accepting and rejecting offer $\dot{y}$. The second condition states that the defendant at liability value $\dot{x}$ is indifferent between making an offer $\dot{y}$ and going to a trial (or ensuring the settlement by obtaining a positive recommendation of the attorney). In these cases $\dot{y} = \max\{\overline{x} - 2\sigma^p(C) - t^d, \overline{x} - \Phi(C) - \sigma^p(C)\}$ and $\dot{x} = \{\overline{x} - 2\sigma^p(C) - 2t^d, \overline{x} - 2\Phi(C)\}$. It may also happen that the equilibrium becomes completely pooling ($\dot{x} = 0$) and $\dot{y}$ simply compensates the average payoff of the plaintiff under the trial ($\dot{y} = \max\{0, \overline{x} - 2\sigma^p(C) - 2t^d\}$).

The behavior of the defendant for liability values below $\dot{x}$ depends on the incentives of the attorney. If the attorney does not gain too much by resolving the case by trial ($\sigma^a(C) \geq -t^d$), then it is profitable for the defendant to increase the overall offer, convince the attorney to make a positive recommendation, and ensure a settlement, rather than face trial. This scenario is presented in Figure 1.2. Since it is driven by the attorney misleading his client in order to obtain the trial payoff, I refer to this equilibrium as a *misinformative equilibrium*.

On the other hand, if the attorney is overly aggressive ($\sigma^a(C) < -t^d$) then the offer under which he is willing to make a positive recommendation becomes so high that the defendant would rather face a trial than convince the attorney.[17] This scenario is presented in Figure 1.3. Since no information is transited between the attorney and the plaintiff at equilibrium, I refer to this situation as an *uninformative equilibrium*.

Proposition 1.2. *Consider a contract C for which $\Phi(C) > 0$ and $\sigma^a(C) \geq -t^d$. Then there exists a defendant-preferred PBE of the negotiation phase called misinformative equilibrium in which:*

(i) the defendant's offer is

$$y(x) = \begin{cases} 0 & \text{if } x < \sigma^a(C) \\ x - \sigma^a(c) & \text{if } x \in [\sigma^a(C), \dot{x}] \\ \dot{y} & \text{if } x > \dot{x}, \end{cases} \tag{13}$$

[17] I apply a convention that in this situation an offer $y = 0$ is made. There exist also equilibria at which the defendant makes some other offers. However, in any equilibrium the case is resolved by trial for liability values $[0; \dot{x})$.

Figure 1.2: Misinformative equilibrium

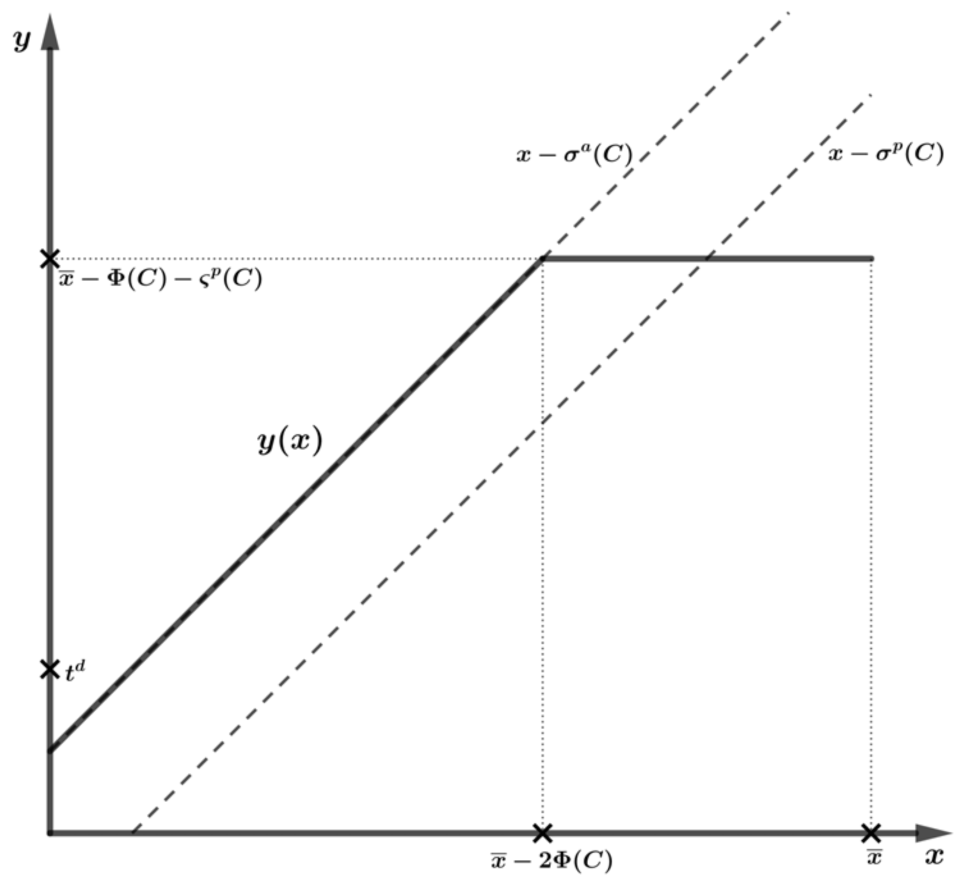
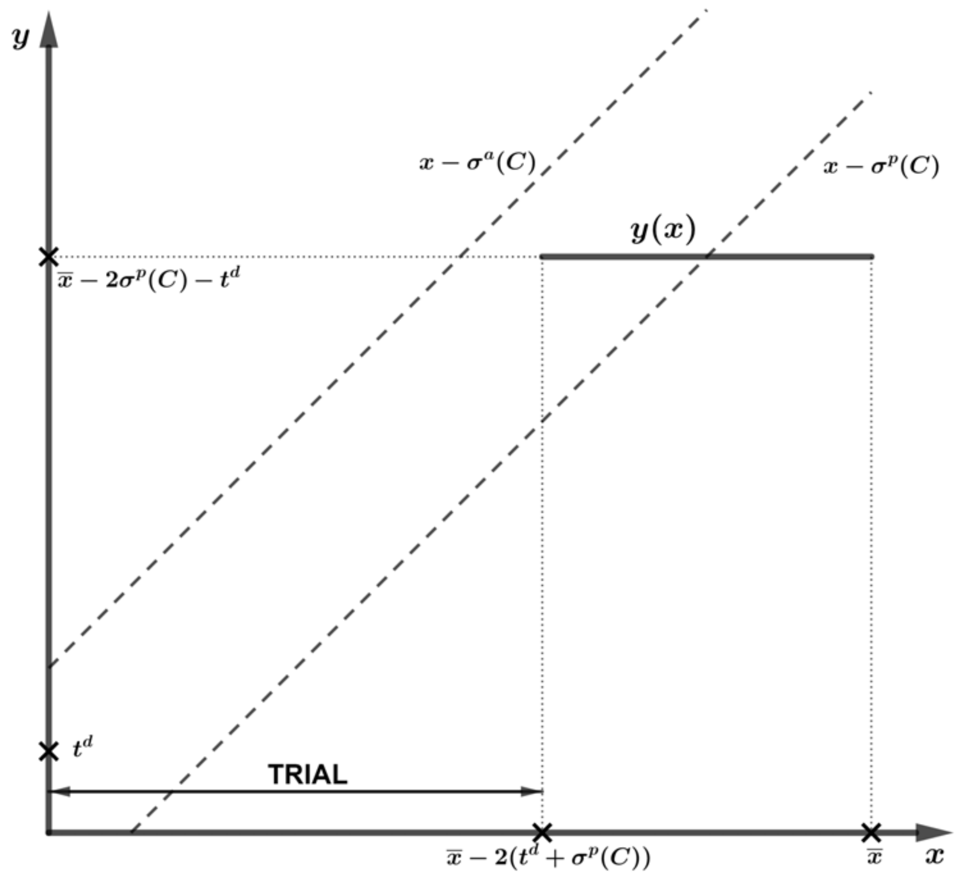


Figure 1.3: Uninformative equilibrium (aggressive attorney)



(ii) the attorney's recommendation is:

$$r(x, y) = r^a(x, y); \tag{14}$$

(iii) the plaintiff's decision is:

$$p(y, r) = \begin{cases} r & \textit{if } y < \dot{y} \\ 1 & \textit{if } y \geq \dot{y}. \end{cases} \tag{15}$$

Proposition 1.3. *Consider a contract C, for which $\Phi(C) > 0$ and $\sigma^a(C) < -t^d$. Then there exists a PBE of the negotiation phase called uninformative equilibrium in which:*

(i) The defendant's offer is:

$$y(x) = \begin{cases} 0 & \textit{if } x < \dot{x} \\ \dot{y} & \textit{if } x \geq \dot{x}, \end{cases} \tag{16}$$

(ii) the attorney's recommendation is:

$$r(x, y) = r^a(x, y), \tag{17}$$

(iii) the plaintiff's decision is:

$$p(y, r) = \begin{cases} 0 & \textit{if } y < \dot{y} \\ 1 & \textit{if } y \geq \dot{y}. \end{cases} \tag{18}$$

Aggressive plaintiff

When the attorney is more willing to settle the case than the plaintiff (that is $\Phi(C) < 0$), and the plaintiff observes a negative recommendation from her attorney, she knows the offer is too low to be accepted.

However, a positive recommendation does not have a simple interpretation for the plaintiff. It also can be that the liability value is low and the offer should indeed be accepted by the plaintiff. However, it also can be the case that the liability value is high and the offer should be rejected, but the attorney tries to deceive his client in order to avoid a costly trial.

Despite the misalignment in the attorney and plaintiff's incentives, a positive recommendation may still carry some information and the trail can hereby be avoided. Imagine the plaintiff observes some offer y and a positive recommendation. The plaintiff is willing to accept some offer (y), as long as she believes that it compensates her pay-off under the trial on average. In other words, the amount of the liability values at which the plaintiff expects to be worse off under the trial than under the settlement at the offer y must be at least as high as those at which the plaintiff expects to be better off. For this to happen, there can exist only a finite amount of offers the plaintiff is willing to accept given a positive recommendation, and they must be sufficiently spread apart.[18]

Those offers can be thought as "standard" offers, typically made for a given case. If the plaintiff receives such an offer, she considers the recommendation of her attorney. However, if she receives some untypical settlement proposal, she believes it has been made in order to deceive her and always rejects it.

Knowing how the plaintiff will behave, the defendant sticks to the standard offers. For some cases it means that it overpays compared to complete information, in other cases it can obtain a settlement at a lower offer. On average, the payoffs of both the plaintiff and the defendant are equivalent to the complete information scenario.

Given that in this case the attorney transmits only some information to the plaintiff, the equilibrium is called a *partially informative equilibrium*. It is depicted in Figure 1.4. An example of it is given below.

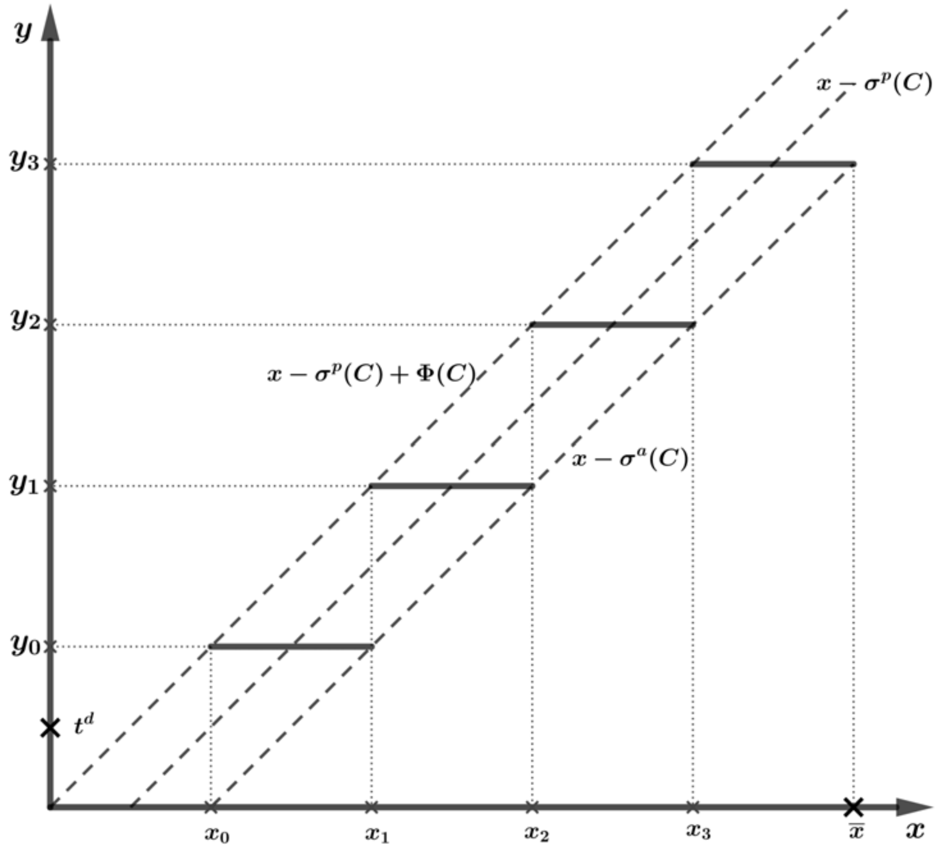
Example 1.1. *Imagine the plaintiff litigates against the defendant for a liability of value between* 0 *and* 40. *To proceed she hires an attorney under contract* $C = (f_n = 0, s_n = 0.5, f_t = 5, s_t = 0)$. *The trial is equally costly for the attorney and the defendant:* $t^a = t^d = 15$. *In this case, the plaintiff's willingness to settle is* $\sigma^p(C) = \frac{5}{0.5} = 10$, *the attorney's willingness to settle is* $\sigma^a(C) = \frac{15-5}{0.5} = 20$, *and the congruence coefficient is* $\Phi(C) = 10 - 20 = -10$.

Imagine that typically in this situation two offers are made. If the harm was low the defendant pushes the case to be dropped (offers $y = 0$*), whereas* $y = 20$ *is typically offered if the harm was high. Below, I show that this two offers indeed are part of an equilibrium.*

Firstly, I analyze the best response of the defendant, if it believes that the plaintiff is ready to accept $y = 0$ *and* $y = 20$ *given a positive recommendation of the attorney. Since* $\varsigma^a(C) = 20$, *the attorney is willing to give up to* 20 *from the liability value in order to obtain a settlement. In other words, he will recommend accepting* $y = 0$ *for any liability value not greater than* 20 *and will accept* $y = 20$ *for all the other liability values (since* $\overline{x} = 40$ *and* $40 - 20 = 20$*). Thus, the defendant will insist on dropping the case if* $x \leq 20$ *and will offer* 20 *to otherwise settle.*

[18] More precisely, there is a finite number of not overly high offers the plaintiff is willing to accept. For example, a rational plaintiff would always accept an offer higher than $\overline{x}$.

Figure 1.4: Partially informative equilibrium



Secondly, I verify whether a Bayesian plaintiff should indeed accept those offers. If she observes $y = 0$ *and a positive recommendation, she correctly believes that the liability value is uniformly distributed between* 0 *and* 20*. Then her expected payoff under the trial is* $0.5(1/2(0 + 20) - 5) = 0$*, and her expected payoff under the settlement is* $0.5 \times 0 = 0$*. So she accepts the decision to drop the case. Analogously, if she receives* $y = 20$ *and a positive recommendation of the attorney, she correctly believes that the liability value is uniformly distributed between* 20 *and* 40*. Then her expected payoff under the trial is* $0.5(\frac{1}{2}[20 + 40]) - 5 = 10$ *and her expected payoff under the settlement is* $0.5 \times 20 = 10$*. So she also accepts the settlement.*

To formally describe a partially informative equilibrium, I derive two sequences. The first sequence (x_k) divides the continuum of liability values in subintervals. In each subinterval (x_k, x_{k+1}) the defendant makes one standard offer (y_k). The sequence of standard offers constitutes the second sequence.

Each standard offer (y_k) must satisfy two conditions. First, the plaintiff cannot lose on average on accepting it, that is, $\frac{1}{2}(x_k + x_{k+1}) - \sigma^p(C) \leq y_k$. Second. the defendant cannot have an incentive to make any other offer, that is, for all $x \in (x_k, x_{k+1})$ and $-y_k > -x - t^d$ and there does not exist $y' < y_k$ such that $p(y', r(y')) = 1$.

I begin with defining recursively the sequence x_k, which divides the liability values into subintervals. First, I derive the upper bound of the first subinterval (x_0):

$$x_0 \equiv \begin{cases} 0 & \text{if } -\Phi(C) \geq \sigma^p(C) \\ \sigma^a(C) & \text{if } -\Phi(C) < \sigma^p(C). \end{cases} \tag{19}$$

At the firs subinterval $(0, x_0)$ the case is dropped – that is the plaintiff accepts an offer $y = 0$. Note that whenever $x_0 = 0$ this subinterval is empty. Second I define the upper-bounds of further subintervals, by setting:

$$x_{k+1} \equiv x_k - 2\Phi(C) \quad \forall k \in \{0, 1, 2....\}. \tag{20}$$

Finally, the upper bound of the last subinterval is simply given by the maximal liability value $\overline{x}$. Its lower bound is denoted by K, where:

$$K \equiv \min\{k \in \mathbb{N} | x_{k+1} \geq \overline{x}\}. \tag{21}$$

Knowing how the continuum of liability values is partitioned, I derive an offer that the defendant makes in each element of the partition. Every such an offer on average compensates the plaintiff's payoff under the trail:

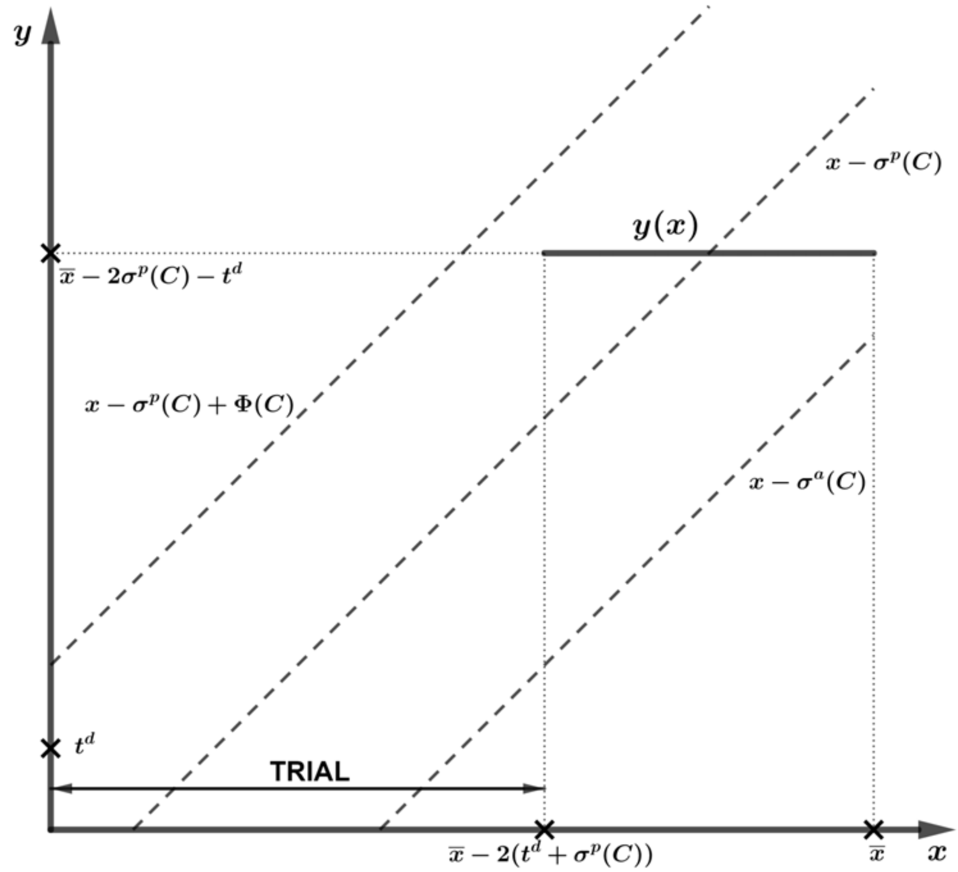
$$y_k \equiv \begin{cases} \frac{1}{2}(x_k + x_{k+1}) - \sigma^p(C) & \text{for } k < K \\ \frac{1}{2}(x_K + \overline{x}) - \sigma^p(C) & \text{for } k = K. \end{cases} \tag{22}$$

To simplify the notation, I denote the set of the "standard" offers which the plaintiff is ready to accept by $\mathbf{Y}^*$, where:

$$\mathbf{Y}^* \equiv \begin{cases} \{y_k\}_{k \leq K} \cup \{0\} & \text{if } -\Phi(C) < \sigma^p(C) \\ \{y_k\}_{k \leq K} & \text{if } -\Phi(C) \geq \sigma^p(C). \end{cases} \tag{23}$$

This equilibrium exists only if the incentives of the plaintiff and the attorney are not too misaligned ($\Phi(C) + \sigma^p(C) \geq -t^d$). Otherwise, the

Figure 1.5: Uninformative equilibrium (aggressive plaintiff)



defendant prefers to go to trial rather than make a standard offer for some liability values. The attorney's recommendation looses its value and the equilibrium becomes uninformative. The uninformative equilibrium with an aggressive plaintiff is depicted in Figure 1.5.

Proposition 1.4. *Consider a contract C for which $\Phi(C) < 0$ and $\Phi(C)+\sigma^p(C) \geq -t^d$. Then there exists a defendant-preferred PBE of the negotiation phase called partially informative equilibrium in which:*

(i) The defendant's offer is: [19]

$$y = \begin{cases} 0 & \textit{if } x \leq x_0 \\ y_k & \textit{if } x \in (x_k; x_{k+1}] \textit{ and } k < K \\ y_K & \textit{if } x > x_K; \end{cases} \tag{24}$$

(ii) the attorney's recommendation is:

$$r(x, y) = r^a(x, y); \tag{25}$$

(iii) the plaintiff's decision is:

$$p(y) = \begin{cases} 0 & \textit{if } y \notin \mathbf{Y}^* \textit{ and } y < y_K \\ r & \textit{if } y \in \mathbf{Y}^* \textit{ and } y < y_K \\ 1 & \textit{if } y \geq y_K. \end{cases} \tag{26}$$

Proposition 1.5. *Consider a contract, for which $\Phi(C) < 0$ and $\Phi(C) + \sigma^p(C) < -t^d$. Then there exists an uninformative equilibrium in which the defendant, the attorney, and the plaintiff follow the strategies described in Proposition 1.3, and it is a defendant-preferred equilibrium.*

Table 1.2 presents the comparison of the equilibria in terms of: expected total gain of the attorney and the plaintiff, negotiation outcome, agent relevant for generating the offer and existence condition. Note that each equilibrium can potentially become completely pooling, as a consequence of the plaintiff being radically willing to settle. The defendant can then simply make an offer $\dot{y}$ (or y_K in case of partially informative equilibrium) for every liability value.

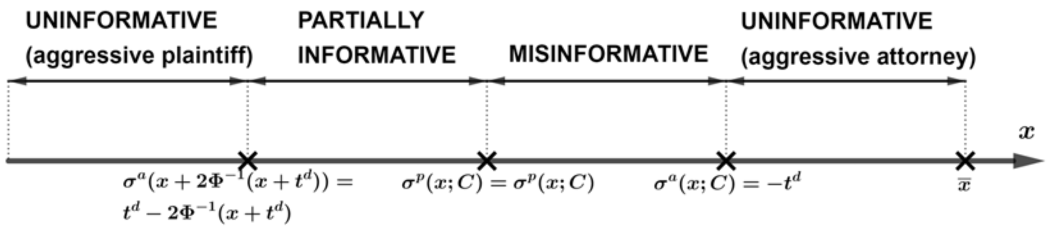
The uninformative equilibrium is the only one at which the trial is not avoided. The reduction in the plaintiff's willingness to settle always increases the profits of the plaintiff's side, as long as the constraints on equilibrium existence are satisfied. The attorney's willingness to settle plays an additional role only at the misinformative equilibrium – it initially increases the payoff, but then starts having a negative effect for too high values.

[19] If $x_0 = 0$, the offer $y = 0$ is never made on the equilibrium path, and if the liability value is s.t. $x = x_0 = 0$ the defendant makes an offer y_0. If $x_0 > 0$ and the liability value is s.t. $x = x_0$ the defendant makes an offer 0.

Table 1.2: Equilibria comparison

	Total expected profit of the plaintiff and the attorney	Outcome	Pivotal agent	Existance
Perfectly inf.	$\frac{\overline{x}}{2} - t^a + \frac{1}{2}\frac{(t^a)^2}{\overline{x}}$	Settlement	Identical preferences	$\Phi(C) = 0$
Misinf.	$\frac{\overline{x}}{2} - \sigma^a(C) - \frac{2\Phi(C)^2}{\overline{x}} + \mathbb{1}_{\sigma^a(C)>0}\frac{1}{2}\frac{\sigma^a(C)^2}{\overline{x}}$	Settlement	Attorney (low x); Plaintiff (high x)	$\Phi(C) > 0$ and $\sigma^a(C) \geq -t^d$
Partially inf.	$\frac{\overline{x}}{2} - \sigma^p(C) + \mathbb{1}_{-\Phi(C)<\sigma^p(C)}\frac{1}{2}\frac{(\sigma^p(C)+\Phi(C))^2}{\overline{x}}$	Settlement	Plaintiff	$\Phi(C) < 0$ and $\Phi(C) \geq -t^d - \sigma^a$
Uninf.	$\frac{\overline{x}}{2} - t^a + 2\frac{t^d+t^a}{\overline{x}}(t^d + \sigma^p(C))$	Trial (low x); Settlement (high x)	Plaintiff (high x)	$\Phi(C) < 0$ and $\Phi(C) < -t^d - \sigma^a$ or $\Phi(C) > 0$ and $\sigma^a(C) > -t^d$
C. pooling	$\max\{0, \frac{\overline{x}}{2} - \sigma^p(C)\}$	Settlement	Plaintiff	$\sigma^p(C)$ sufficiently high

Figure 1.6: Positive s_t



1.4.3 Agents' behavior under contracts with trial premium in the form of a share

If the contract includes a positive share trial premium ($s_t > 0$), the agents' willingness to settle is not constant over liability values, that is,

$$\frac{\partial}{\partial x}\sigma^p(x, C) = \frac{s_t}{1 - s_n} \tag{27}$$

$$\frac{\partial}{\partial x}\sigma^a(x, C) = -\frac{s_t}{s_n}. \tag{28}$$

The plaintiff's willingness to settle is increasing with the liability value realization, whereas the attorney's willingness to settle is decreasing. The pace of this process depends on both share payments included in the contract.

Consequently, $\Phi(x, C)$ is increasing in the liability value realization. Thus, the negotiation may follow different scenarios, depending on the liability value realization. For very low liability values the equilibrium behaves as if it was uniformative. As the liability value increases, the equilibrium becomes partially informative and then misinformative. For very high liability values it again behaves in an uniformative manner. The thresholds are presented in Figure 1.6.

The equilibria under a contract with a positive s_t are described in detail in the Appendix A.3. I derive the thresholds at which the equilibrium changes its properties – importantly, the order of the thresholds is always the same, though it may happen that properties of some equilibria types are not exhibited.[20]

[20]Since some thresholds may appear below 0 or above $\overline{x}$.

1.5 Contract phase

Before the negotiation begins, the plaintiff and the attorney agree on the contract $C = (f_n, f_t, s_n, s_t)$, specifying both the way the compensation and the costs are shared – and thus setting the incentives for both agents. The agents can predict the expected outcome of the negotiation phase of every possible contract, which I have described in Section 1.4. For convenience, I assume that the contract is proposed by the plaintiff.[21] Moreover, I assume that the expected liability value is higher than the costs of trial for each agent, that is, $\frac{\overline{x}}{2} \geq t^a$ and $\frac{\overline{x}}{2} \geq t^d$.[22]

If the plaintiff does not behave strategically, she could offer some contract C leading to the perfectly informative equilibrium – setting $f_t = (1 - s_n)t^a$. Under this contract, the settlement is always reached, but the defendant obtains all the bargaining surplus $t^a + t^d$. The plaintiff gains only in avoiding a trial whenever it would lead to a negative payoff.[23]

However, the plaintiff may obtain a strategic advantage through contracting. One way of achieving this is by decreasing f_t to push the costs of the trial to the attorney and improve the plaintiff's bargaining position. To keep the incentives of the attorney at least partially aligned, the plaintiff would compensate the change in f_t by an increase in s_n. If this behavior is taken to the limit, *the Case Selling Contract* (C^S) is signed, where:

$$C^S = (f_n = -\Pi + c, s_n = 1, f_t = 0, s_t = 0). \tag{29}$$

Under C^S, the plaintiff gives up the complete right to compensation, in exchange for a fixed payment that amounts to the expected profits,[24] keeping the right to make a decision to accept or reject the settlement. The contract leads to a partially informative equilibrium. Even though the attorney is willing to settle under C^S, the decision is taken by the plaintiff, who is always indifferent between the settlement and the trial and thus has a strong

[21] In the model, since the plaintiff proposes the contract, she will receive all the surplus. However, contracts differing only by the size of f_n yield the same total surplus for the plaintiff and the attorney. Therefore, if the bargaining power is shared between the plaintiff and the attorney (or the attorney holds the bargaining power), the optimal contracts will remain the same, except that f_n will be higher.

[22] If this assumption is relaxed and $t^a > t^d > \frac{\overline{x}}{2}$, which can happen for a very minor torts, a contract that leads to a pooling equilibrium should be signed. This contract is described in details in the Appendix A.4. Otherwise, a Case Selling Contract described in this section should be signed.

[23] Since negative settlement offers are not allowed.

[24] Since up-front payments for the plaintiff's are limited by the regulator in the US, typically the plaintiff and the attorney will sign a contract that includes a share payment for the attorney, which increases in the liability value instead.

bargaining position.[25] The plaintiff's willingness to settle is determined at equilibrium by $\sigma^p(C^S) = \frac{1}{2}\max\{0, t^d - t^a\}$. If $\sigma^p(C^S)$ had taken any different value, the attorney would reject the contract, because it would either lead to a trial or to a settlement on too low offers. So the total profits of the plaintiff's side under the Case Selling Contract are

$$\Pi(C^S) = \frac{1}{2}\overline{x} + \min\frac{1}{2}\{0, t^d - t^a\} - c. \tag{30}$$

Therefore, the bargaining surplus is either equally divided by the plaintiff's side and the defendant ($t^d > t^a$); or each side takes the part of the bargaining surplus equal to its costs ($t^d < t^a$).

Otherwise, the plaintiff may use the information transmission process as a strategic tool. As long as the plaintiff observes a negative recommendation, at least for low offers, she can credibly threaten the defendant with a trial. By increasing f_t and decreasing s_n the plaintiff can make the attorney more and more aggressive, thus making him progressively keener to make a negative recommendation, even for profitable offers. If this behavior is taken to a limit, *the Strategic Misinformation Contract* (C^M) is signed:

$$C^M = (c; 0; t^a, 0) \tag{31}$$

Under C^M, the plaintiff keeps the complete right to compensation, in exchange for ensuring the attorney that all his costs would be covered. The contract leads to a misinformative equilibrium. It can be viewed as an approach to replicate strategic delegation by the plaintiff. Even though the plaintiff is very willing to settle, she is unable to recognize the real value of the liability and must rely on her attorney's recommendation. Since the attorney is always indifferent, he can always credibly threaten the defendant with recommending a trial.

The defendant, realizing that without a positive recommendation of the attorney it would face a trial, increases the offer. If the plaintiff could always credibly condition her behavior on the recommendation of the attorney, this contract would perfectly replicate strategic delegation and allow the plaintiff to recover the total bargaining surplus ($t^a + t^d$). However, for very high offers, despite the negative recommendation of the attorney, the plaintiff must realize that she should not hope for a higher payoff under a trial and, hence, her trial threat loses credibility. Thus, the plaintiff is able to recover all the bargaining surplus only if the liability value is sufficiently low. Sometimes, especially when the expected liability is relatively

[25] Since this contract is a limit of a sequence of contracts leading to partially informative equilibrium, under which $s_n \to 1$ and $f_t \to 0$, the attorney can always offer a contract with a marginally bigger f_t and a marginally smaller s_n, to make sure that the plaintiff's preferences are strict.

small compared to the aggregated costs of trial, it is actually worth sacrificing some part of the bargaining surplus for low liability values in order to increase the minimal unrejectable offer $\dot{y}$ and decrease the probability of facing it. So, increasing the disparity in the agent's incentives brings gain through improving the offers made for low liability values, but it also brings the cost of decreasing the offer made for high liability values and increasing its probability. Therefore, the incentives congruence coefficient is eventually set for $\Phi(C^M) = \min\{t^a + t^d; \frac{\overline{x}}{4}, \frac{\overline{x}-t^a}{3}\}$.[26]

The expected profits under strategic misinformation contract are

$$\Pi(C^M) = \begin{cases} \frac{\overline{x}}{2} + \min\{t^d, \frac{\overline{x}}{4} - t^a, \frac{\overline{x}}{3} - \frac{4}{3}t^a\} - \frac{\Phi(C^M)^2}{\frac{\overline{x}}{2}} - c & \text{if } \Phi(C^M) \geq \frac{\overline{x}}{2} \\ \frac{\overline{x}}{2} - t^a - c & \text{if } \Phi(C^M) < \frac{\overline{x}}{2}. \end{cases} \tag{32}$$

Proposition 1.6 states that one of the two contracts described above (C^S, C^M) is an optimal contract if the case is worth pursuing. The choice of the contract depends on the structure of the costs and the expected value of the case. It can be described in terms of two coefficients. Firstly, *the plaintiff's cost-to-value ratio* (PCV), which describes the severity of the costs of trial compared to expected value of the case for the plaintiff's side is

$$PCV = \frac{t^a}{\frac{\overline{x}}{2}}. \tag{33}$$

Secondly, *the defendant's cost-to-value ratio* (DCV), which outlines whether the defendant should be more concerned about the potential value of compensation or the cost of a trial is

$$DCV = \frac{t^d}{\frac{\overline{x}}{2}}. \tag{34}$$

Proposition 1.6.

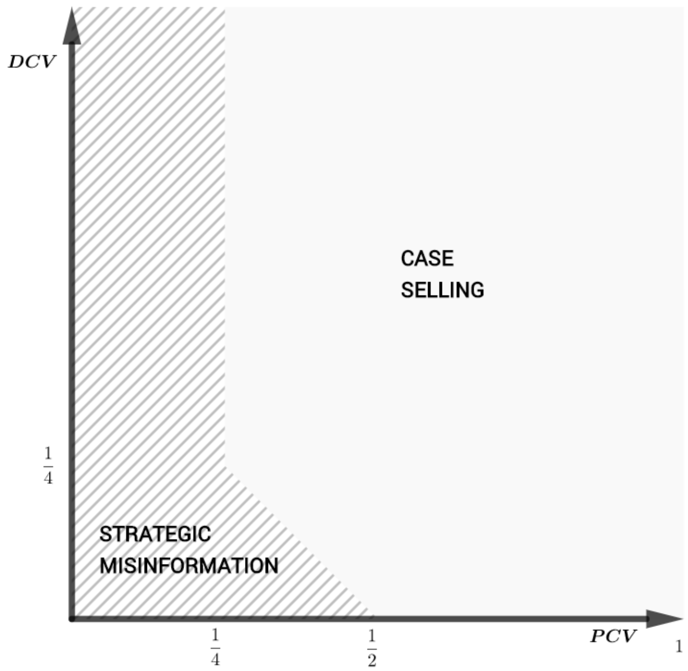
(i) The Strategic Misinformation Contract (C^M) is an optimal contract if and only if $\Pi(C^M) \geq 0$ *and:*

(a) either $PCV \leq \frac{1}{4}$ or,

(b) $PCV + DCV \leq \frac{1}{2}$.

[26] Which pins down the attorney's willingness to settle to $\max\{-t^d, t^a - \frac{\overline{x}}{4}, \frac{\overline{x}-t^a}{3}\}$. If the attorney's willingness to settle was any different, the plaintiff would offer a contract with a marginally higher s_n and marginally lower f_t to ensure the strict preferences of the attorney.

Figure 1.7: Contract choice



(ii) The Case Selling Contract (C^S) is an optimal contract if and only if $\Pi(C^S) \geq 0$ *and:*

(a) $PCV \geq \frac{1}{4}$,

(b) and $PCV + DCV \geq \frac{1}{2}$.

(iii) Otherwise, dropping the case is optimal.

Interestingly, a contract with $s_t > 0$ is never optimal. The reason is that contracts including positive s_t make the attorney relatively aggressive for high values of x, but not for small values of x for which an aggressive attorney actually brings a strategic advantage. The optimal choice of the contract in terms of PCV and DCV is depicted in Figure 1.7.

If the cost of trial for the plaintiff or the aggregated cost of trial is sufficiently small compared to the expected value of the liability, strategic misinformation is an optimal contract. Since the cost of the trial are relatively unimportant, the minimal unrejectable offer is high and the plaintiff is able to recover more than her payoff under the trial with high probability. This situation may correspond to cases like medical malpractice or major accidents, where the procedure of the trial is fairly standard (and thus the costs of trial are sufficiently low), and the compensation can reach high levels.

Corollary 1.1 states that under the Strategic Misinformation Contract the plaintiff's side may obtain a higher payoff than the one achieved under complete information. The intuition behind this surprising result is that the lack of information gives the plaintiff an opportunity to credibly condition her decision on the attorney's recommendation. Thus, even though from a legal perspective the attorney only plays a role of an adviser, *de facto* he takes the final decision. Unlike the plaintiff, the attorney can be incentivized to be arbitrarily aggressive through a contract. So it is the lack of information that allows the plaintiff to strategically delegate the negotiation. The difference in the plaintiff's side payoff under complete and asymmetric information is depicted in Figure 1.8.

Corollary 1.1. *The payoff of the plaintiff's side is higher under asymmetric than under symmetric information, whenever:*

(i) $DCV > PCV$ *and* $PCV < \frac{1}{4}$ *or;*

(ii) $DCV \leq PCV$ *and* $DCV > (PCV + DCV)^2$

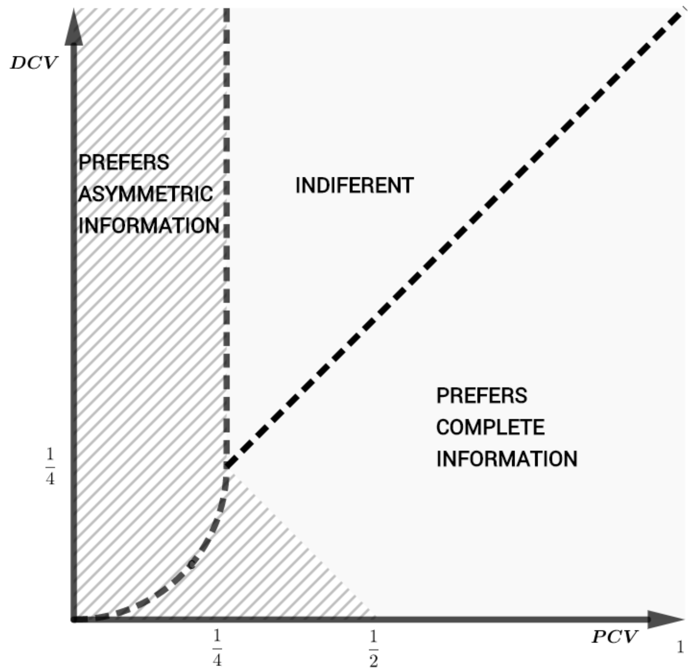
However, as the plaintiff's costs of trial grow, the inability to credibly to reject a high offer becomes a more serious problem for the plaintiff. The strategic misinformation replicates strategic delegation only for a small range of x and it becomes optimal to sign either case selling or pooling contracts. Alternatively, for high values of t^a, it may be the case that a change in the plaintiff's optimal contract is driven by an increase in the defendant's cost of trial, since obtaining information through the partially informative equilibrium is easier, and the case selling contract becomes a better option.

It is worth noting that the decision to drop the case is not driven by the plaintiff's side costs of trial (t^a). The case is always settled in the equilibrium and the costs of trial are never paid. The plaintiff decides to drop the case only if she faces high initial costs c.

1.6 Conclusions

The chapter has examined the strategic role of experts during the negotiations using pre-trial negotiations as an illustration. In my model, the plaintiff faces a harm of an unknown value, for which she has a right to

Figure 1.8: Plaintiff's preferences over information structure



be compensated by the defendant. In order to execute the liability, the plaintiff hires the attorney offering him a contract. Before the trial begins, parties try to reach a settlement through negotiation. The negotiation is modeled as a signaling game in which the defendant (who is aware of the liability value) makes a take-it-or-leave-it offer to the plaintiff. Before taking the final decision the plaintiff consults her attorney.

The incentives of the plaintiff and the attorney are endogenously set by a contract that specifies the division of the compensation and the costs of the litigation. It occurs that a strategic plaintiff would never propose a contract that leads to a complete information transmission.

The plaintiff may use different choices in order to improve her bargaining position. Firstly, when the trial costs are high, she might set a high share payment for the attorney, but transfer all the trial costs to him. The share payment ensures that the attorney's recommendation remains useful. Transferring the costs of the trial improves the bargaining position of the plaintiff. Secondly, when the trial costs are low, she may turn her lack of knowledge into an advantage through strategic misinformation. By strongly rewarding her attorney in case of trial, the plaintiff ensures a positive recommendation only if the settlement offer is sufficiently high. Since under the negative recommendation she remains uncertain about the liability value realization, she can credibly threaten the defendant with a trial; and hence she increases her bargaining position.

Strategic misinformation can be seen as an approach to replicate strategic delegation by the plaintiff in an environment where she cannot credibly transfer the right to take the settlement decision to the attorney. However, strategic misinformation functions only if the liability value realization is sufficiently low; for very high offers the plaintiff cannot credibly use a trial threat despite the negative recommendation of the attorney. Interestingly, strategic misinformation may yield higher payoffs for the plaintiff than an optimal contract in complete information scenario.

Apart from identifying a new channel through which contracting can bring a strategic advantage during the negotiations, the model also helps to understand some phenomena present in the market for legal services. It explains why the bifurcated fee contracts[27] are prevailing in the market – those are the only contracts that enable strategic misinformation.[28] It also shows why the negotiations are usually handed to the attorneys even though the final decision on settlement is always made by the plain-

[27] Contracts that include an additional payment for the attorney in case of a trial.

[28] Some empirical analysis of contracts on the market for legal services is provided e.g., by Helland and Tabarok (2003).

tiffs. Making the attorney an adviser through the negotiations allows the strategic use of the information structure.

The model leaves space for future extensions. It ignored the problem of moral hazard, risk aversion, or liquidity constraints on either of the sides. The model is also applicable in other situations, in which the negotiation is handled in a presence of an expert whose advice is not binding for the parties. This includes negotiating contracts for sportspersons or artists by their agents, behavior of real-estate agents negotiating on behalf of property owners, or the role of consultants in buyer-seller environment. Detailed analysis of these scenarios is left for future research.

Chapter 2

Cherry-picking and Career Concerns

2.1 Introduction

Well-established lawyers accept a case whenever the expected reward is high enough to compensate the cost of handling it. But the decision facing young lawyers is more complicated – they need to consider not only the immediate monetary reward but also the effect of their action on their reputation. On one hand, a young lawyer may be afraid that a potential failure in court will be associated not with the difficulty of the lawsuit, but rather to his poor ability. Hence, he may refuse a well-paid case in order to protect his reputation. On the other hand, the mere decision to litigate shows the lawyer's confidence in his skill and helps to establish a good reputation. Hence, a young lawyer may eventually decide to accept the case even for a modest payment.

While I focus on the example of lawyers, the influence of career concerns on task selection goes beyond the example of the market for legal services. Reputation considerations influence, for instance, young entrepreneurs' decision on whether to set up a start-up, investment bankers' decision when performing an M&A, and actor's decision about taking a new role.

The influence of career concerns on task selection raises a number of questions. Will junior agents cherry-pick only the simplest tasks in order to build their reputation through the improvement of their success rates? Or will they perform as many tasks as possible to appear confident and ready for any challenge? How do career concerns influence markets? Are clients better off dealing with junior or with senior agents? How do the contracts signed with junior and senior agents compare?

To address the previous questions I propose a formal model in which an agent receives a task of random difficulty and decides whether to perform it or not. The task may result in either success or failure, and the probability of success depends on both the task's difficulty and the agent's skill level. Performing the task is costly for the agent, but he receives a reward for performing it. Moreover, the agent not only cares about the monetary payoff but he may also be concerned with his reputation, that is, the market's evaluation of his skill level.

I compare the behavior of senior and junior agents. A senior agent has a well-established reputation and the outcome of a single task has a minor impact on it. Hence, a senior agent is primarily concerned about the monetary payoff. In contrast, a junior agent strongly considers the impact of the task outcome on the beliefs of the market about his type.

First, I focus on the analysis of an agent's decision. That is, I take the reward he is proposed as given. I find that career concerns result in the two opposing effects described above. Since a high-skilled agent is more likely to succeed than a low-skilled agent, success improves the agent's reputation and failure tarnishes it. Hence, the agent has an incentive to cherry-pick only the simplest tasks. However, since a high-skilled agent is expected to perform more tasks than a low-skilled agent, the mere fact of performing the task improves the agent's reputation. So, the agent has an incentive to accept any task received. Typically, the second effect prevails and junior agents perform more tasks than senior agents. However, when the monetary reward is very high the opposite can happen.

Second, I endogenize the reward of the agent. I assume that he may be offered a contract including a contingent fee and a fixed fee by a principal. Performing the task is costly for both the principal and the agent, but the principal earns a profit if the task is successful. The principal does not observe either the agent's skill level or the difficulty of the task, so the agent plays a double role: he provides a service necessary to perform the task, and he decides whether the task is worth performing.

I show that the principal is better off dealing with a junior than with a senior agent. Although a junior agent is ready to perform some tasks that lead to a monetary loss only to improve his reputation, the principal does not bear the cost of this inefficiency. She is able to exploit the agent's career concerns by cutting the reward offered.

Finally, I compare the predictions of my model when the principal holds the bargaining power, with a situation in which the agent has the bargaining power. Although most of the findings are independent of the choice of a player with a strong bargaining position, the details of the contracts signed differ significantly. In particular, when the principal holds a strong bargaining position the contracts are fully fixed-fee based, whereas when the agent has the bargaining power the contracts are fully contingent fee based.

The chapter contributes primary to the large body of literature on career concerns. The seminal paper by Holmström [1982, 1999] studies a market in which the production depends on the labor supplied, the talent of the worker, and a random shock. The supply of labor is not contractible, but the agent has an incentive to provide it in order to appear talented and receive a higher wage in the future. This framework was later extended by Gibbons and Murphy [1992] to analyze properties of contracts in a dynamic environment. Dewatripont et al. [1999a,b] verify the robustness of the findings and extend the model to multi-tasking. Early models of career concerns focus on the effort provision problem at a given task, rather than on the problem of task selection. Moreover, they assume that the information is symmetric, that is, the agent does not observe his talent. The fact that the agent is able to recognize his skill level plays an important role in my model. In particular, it provides a junior agent with an incentive to perform more tasks than a senior agent.

Several papers study the effect of career concerns on the incentives to provide and acquire expertise. Milbourn et al. [2001] show that managers may engage in the over-acquisition of information in order to appear more informed. Levy [2004] argues that this intuition reverses when the decision to ask for advice is public. Ottaviani and Sørensen [2006a,b] analyze a cheap talk game in which the sender has no exogenous conflict of interest with the receiver, but is concerned with his reputation. They find that when the sender wants to be perceived as accurate, he does not report the information truthfully. Although I assume that the agent is better able to predict the outcome of the task than the principal and, he serves as an expert, the ability to evaluate the task difficulty is independent from the agent's type. Hence, in my model the information transmission is not distorted because the agent aims at appearing better informed than he is. However, a career concerned agent may want to perform more tasks than an agent who is not concerned with his reputation. Hence, he has an incentive to pretend that the task has a higher probability of success.

The effects of the observability of the action on the behavior of a career-concerned agent has been studied by Prat [2005] and Fingleton and Raith [2005].[1] Both papers argue that observing the action of a career concerned

[1]Similar problems have been studied in the context of privacy regulation, e.g., by Daughety and Reinganum [2010] and Jann and Schottmüller [2016].

agent gives him an incentive to engage in costly signaling, and it may therefore endogenously generate a moral hazard problem. Although I study a very different setting, some of the results are in line with these findings. Particularly, I show that when the market only imperfectly observes the decision of the agent, the incentive to perform too many tasks diminishes. Ben-Porath et al. [2017] take a different approach to the problem of outcome observability. They propose a model in which a career concerned agent chooses whether to disclose the outcome of the task. It results in the agents taking excessive risk and disclosing only "surprisingly good results."

Already in his seminal paper, Holmström [1982, 1999] hints at the possibility of career concerns influencing investment decisions. He suggests that career concerned agents may be overly cautious. Ely and Välimäki [2003] propose a model which confirms this intuition. They study a situation in which an informed agent chooses whether to take an action. The agent of a good type has an interest aligned with a principal, that is, he prefers to take the action only when necessary, whereas an agent of a bad type always wants to take action. When career concerns are introduced, in order to build reputation, the agent of good type too rarely takes action. The problem of agent choosing between a safe action and a risky action has been studied by Fu and Li [2014] and Chen [2015]. In their models the outcome of the safe action is fixed, but the outcome of the risky action depends on the agent's skill. Chen [2015] focuses on the investment choice of a manager, and Fu and Li [2014] study the case of a political decision on the implementation of a reform. Both papers find that an agent has an incentive to engage into excessive risk-taking in order to signal his type. Similarly, in my model the agent faces an incentive to perform too many tasks. However, in my setting this incentive can be counterbalanced by an incentive to perform only the simplest tasks. Moreover, I show that if the contracts are endogenously determined, the principal is not only unharmed by the agent's career concerns, but is also able to exploit them.

2.2 Model

I model the task selection as a game between an agent and a market. The agent is characterized by an ability level (i) which is either high (H) or low (L). Independently of his ability level, with probability λ the agent receives a task characterized by a difficulty level $\theta \in [0, 1]$. Once the task has been received the agent observes its difficulty and decides whether to perform it or not. Performing the task is costly for the agent (c), however, he receives a monetary reward for performing it. The reward may be in the form of either a fixed-fee payment (g), or a payment contingent on the task being performed successfully (γ). The probability of the task being handled successfully depends on both the agent's ability and the difficulty of the task. It is given by $P(S) = p_i \times \theta$, where p_H is standardized to 1 and $p_L < p_H$. The timing of the game is presented in Figure 2.1.

The agent is not only interested in the monetary payoff, but he also cares about his reputation, that is, the belief that the market holds about him being of a high type. For simplicity, I follow a typical assumption that the career concerns enter the utility function of the agent linearly. The weight of career concerns in the agent's utility is denoted by β. The market observes whether the task was handled successfully (S), it failed (F), or it was not performed at all ($\emptyset$). However, it does not know the agent's type, the task difficulty, and does not observe whether the task was received by the agent. Thus, the payoff of the junior agent can only depend on the task outcome (ω). In the baseline model I focus on a simpler case in which the reward is fully contingent, that is, $g = 0$. Moreover, I assume that $\gamma p_L > c$, that is, there are some tasks which yield a positive expected monetary payoff for the low-type agent. These assumptions are relaxed in Section 2.4. In Section 2.6 I allow for the contracts to be endogenously determined.

The agent's utility as a function of the task outcome is thus given by the following expression:

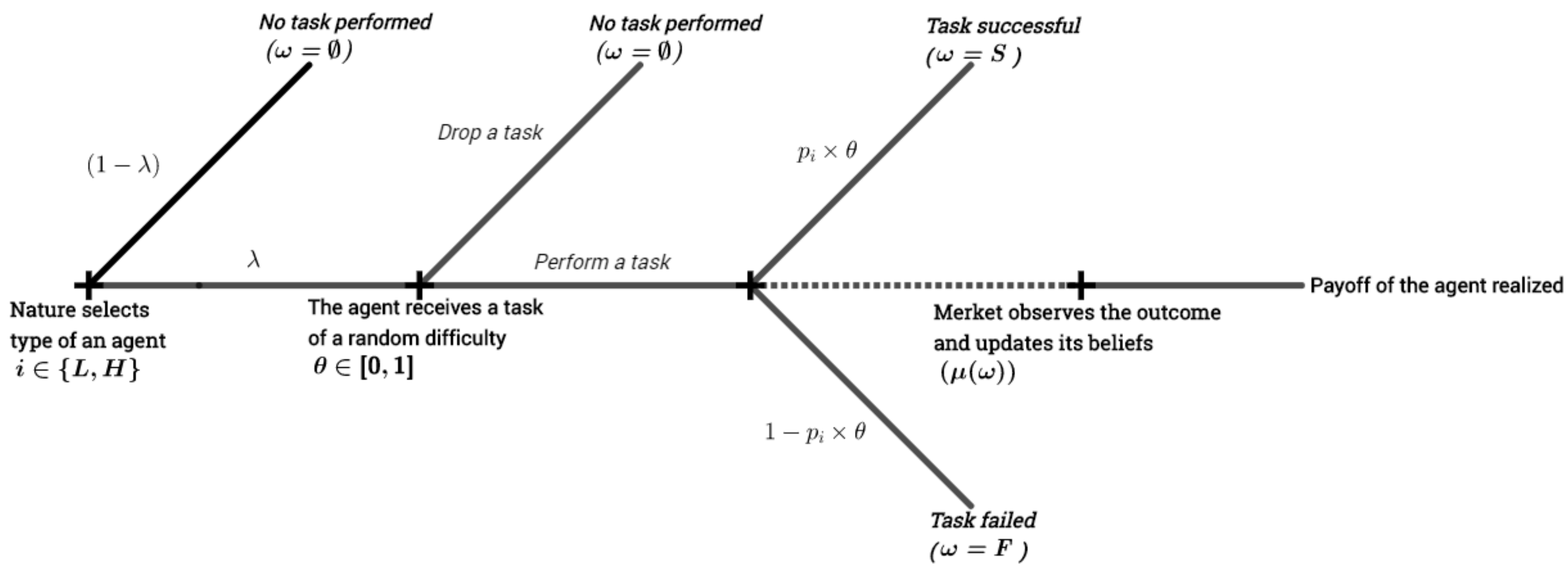
$$u(\omega) = \begin{cases} \gamma - c + \beta\mu(S) & \text{if } \omega = S \\ -c + \beta\mu(F) & \text{if } \omega = F \\ \beta\omega(\emptyset) & \text{if } \omega = \emptyset \end{cases}. \tag{35}$$

The market holds a prior belief that the task difficulty is uniformly distributed on the interval $[0, 1]$.[2] The prior probability that the market assigns to the agent being of a high type is denoted by μ. The market follows Bayes' rule. It believes that the agent of type i only performs tasks in some set of task difficulty levels denoted by Θ_i, and therefore updates its beliefs in the following way:

$$\mu(S) = \mu \frac{\int_{\theta \in \Theta_H} \theta d\theta}{\mu \int_{\theta \in \Theta_H} \theta d\theta + (1-\mu) p_L \int_{\theta \in \Theta_L} \theta d\theta}; \tag{36}$$

[2]The results of the chapter hold for more general distributions. Sufficient conditions on the distributions for the results to hold are provided in Appendix B.1.

Figure 2.1: Task selection game



$$\mu(F) = \mu \frac{\int_{\theta \in \Theta_H} (1-\theta) d\theta}{\mu \int_{\theta \in \Theta_H} (1-\theta) d\theta + (1-\mu) \int_{\theta \in \Theta_L} (1-p_L) \theta d\theta}; \tag{37}$$

$$\mu(\emptyset) = \mu \frac{1 - \lambda + \lambda \int_{\theta \notin \Theta_H} d\theta}{1 - \lambda + \lambda\mu \int_{\theta \notin \Theta_H} d\theta + \lambda(1-\mu) \int_{\theta \notin \Theta_I} d\theta}. \tag{38}$$

Since whenever the task is observed to have been successful or to have failed, the market has to realize it was received in a first place, the parameter λ enters the beliefs only if no task was performed and acts as a noise on the empty signal. The market can have problems with interpreting this information also for other reasons not considered in the model – the outcome of some task may not be observed, or a share of the market may suffer from a selection bias. The qualitative results of the model are independent from the source of the noise.

I use Perfect Bayesian Equilibrium in pure strategies (PBE, Fudenberg and Tirole, 1991) as the solution concept. In the context of my model, a PBE consists of a decision of the agent on whether to perform the task for each skill level and the task difficulty, and the beliefs of the market about the agent's type for each outcome observed. The agent acts optimally, treating the beliefs of the market as given. The market forms its beliefs using Bayes' rule whenever possible, and correctly conjectures the set of task difficulty levels the agent of each type chooses to perform.

2.3 Equilibria of the game with contingent payments

As a reference consider an agent who is not concerned with his reputation, that is, $\beta = 0$. I refer to such an agent as *a senior agent*, that is, an agent who already has an established position. In this scenario the agent of each type performs only those tasks which yield a positive expected utility. In other words, the senior agent of type i is characterized by a *monetary cut-off* task difficulty θ_i^M, and he would perform only the tasks s.t. $\theta \geq \theta_i^M$, where:

$$\theta_i^M = \frac{c}{p_i \gamma}. \tag{39}$$

In contrast, *a junior agent* cares about his reputation (that is, $\beta > 0$). The junior agent's choice depends on the beliefs of the market, which in turn have to be consistent with the agent's choice. This game yields multiplicity of equilibria.

Firstly, if the prior belief of the market about the agent's type is sufficiently high, and the agent is strongly concerned about his reputation, an equilibrium in which no task is performed can be sustained. This is due to the fact that the market can hold any belief upon observing an event that is never a part of an equilibrium path. Particularly, the market can believe that any agent performing a task is of a bad type with probability 1 ($\mu(\omega \neq \emptyset) = 0$). In turn, the agent may indeed restrain himself from accepting even very easy tasks, losing the monetary payoff but maintaining his reputation. As a result, no task is ever performed on the equilibrium path, and the beliefs of the market turn out to be consistent.

Secondly, if the agent is strongly concerned about his reputation then equilibria in which the agent is always indifferent between performing and not performing any task can be sustained. In this equilibrium, the high-skilled agent selects only some difficult tasks, and the low-skilled agent only some easy tasks. This way, failing a task is associated with an increase in the agent's reputation, which compensates the monetary loss.

Finally, there always exists a threshold equilibrium in which the agent of each type has a difficulty threshold and performs only tasks that are simpler than his threshold. This equilibrium follows the standard intuition that the agent should prefer succeeding in a task over failing in it, thus, he has an incentive to perform only those tasks in which he is relatively likely to succeed.

The equilibria of the game are summarized in Proposition 2.1.

Proposition 2.1. *If the agent receives only contingent payment γ, then:*

(i) if $\gamma - c \leq \mu$ there exist equilibria in which no task is performed,

(ii) if β is sufficiently large, there exist equilibria in which the agent is always indifferent between performing and not performing any task,

(iii) there always exists an equilibrium in which an agent of type i is characterized by a threshold θ_i, and performs only the tasks s.t. $\theta \geq \theta_i$.

(iv) No other equilibrium exists.

Although (especially if the agent is mostly concerned with his reputation) there exist up to three types of equilibria, not all of them are equally plausible. The equilibria in which no task is performed can be sustained only if the market has a strong belief that only low-skilled agents could ever consider performing any task. The equilibria in which the agent is indifferent between dropping and performing any task are based on an unlikely coincidence that the tasks are selected in a way in which the reputation concerns exactly counterbalance the monetary payoffs. Finally, these equilibria lead to the paradoxical result that being successful harms the reputation of the agent.

Corollary 2.1. *If the agent receives only contingent payment γ, then the threshold equilibrium is the unique equilibrium type in which succeeding improves the reputation of the agent, that is, $\mu(S) \geq \mu$.*

In the rest of the chapter I focus on the threshold equilibrium. Proposition 2.2 describes it in detail.

Proposition 2.2. *There always exists a unique threshold equilibrium, in which:*

(i) The cut-off task θ_i for an agent of type i satisfies:

$$\theta_i = \frac{1}{p_i}\Big(\frac{\beta\big(\mu(\emptyset) - \mu(F)\big) + c}{\beta\big(\mu(S) - \mu(F)\big) + \gamma}\Big). \tag{40}$$

(ii) The posterior probability $\mu(\omega)$ that the market assigns to the agent being of a high-skilled type upon observing an event ω is:

$$\mu(S) = \frac{\mu(1-\theta_H^2)}{\mu(1-\theta_H^2) + (1-\mu)(1-\theta_L^2)p_L}, \tag{41}$$

$$\mu(F) = \frac{\mu(1-\theta_H)^2}{\mu(1-\theta_H)^2 + (1-\mu)[(1-\theta_L)^2 + (1-\theta_L^2)(1-p_L)]}, \tag{42}$$

$$\mu(\emptyset) = \frac{\mu(1-\lambda+\lambda\theta_H)}{1-\lambda+\lambda\mu\theta_H + \lambda(1-\mu)\theta_L}. \tag{43}$$

Although a closed-formed solution for the cut-off tasks cannot be obtained, several insights from Proposition 2.2 can be highlighted. Firstly, the posterior beliefs of the market follow an intuitive property – success always improves the reputation of the agent, failure always tarnishes it. Not performing a task also harms the reputation of the agent. Typically, not performing a task is better for the reputation than failing in it. However, in equilibria in which the agents are very selective (that is, c close to $p_L\gamma$ and β low), this property can be reversed:

$$\mu(S) > \mu > \mu(\emptyset) \lesseqgtr \mu(F). \tag{44}$$

Secondly, the ratio between the cut-off tasks of high-skilled and low-skilled agents is the same for the junior and the senior agent, and it corresponds to the ratio of skill levels:

$$\frac{\theta_H^M}{\theta_L^M} = \frac{\theta_H}{\theta_L} = \frac{p_L}{p_H} = p_L. \tag{45}$$

The low-skilled type is always more selective than the high-skilled type. This property is a consequence of the fact that the agent faces a pay-off that is not directly dependent on his type, but dependent on the task outcome.

Thirdly, the cut-off tasks are always interior. No agent would ever find it profitable to perform a task of the highest difficulty $\theta = 0$, since it is impossible to succeed in it. Moreover, if the agent is highly skilled, he must be willing to perform some tasks around the simplest one $\theta = 1$, since he is almost certain to succeed in them. As a result, the low-type agent also has an incentive to perform at least some tasks in order to mimic the high type.

Finally, the threshold equilibrium is unique. This happens due to the fact that the more selective the agent is, the more informative observing $\omega = \emptyset$ is. Suppose the agent is not very picky. Then, a lot of instances of observing no task performed come simply from the fact that no task was received by the agent, and the empty signal does not carry much information about the agent's type. Thus, the agent would have the profitable deviation of not performing some difficult tasks and improving his reputation by raising his success rate. On the contrary, if the agent was very selective, an event $\omega = \emptyset$ would typically come from the agent's decision. Since the low-skilled agent rejects a task more often, not performing a task becomes a significantly negative signal, and the agent has the profitable deviation of improving his reputation by accepting more tasks. It occurs that there exists a unique pair of cut-off levels where the incentives to be more and less selective are balanced.

Interestingly, the junior agent is not necessarily more selective than the senior agent. It is rather the case that the junior agent is less responsive to changes in prices than the senior agent. If the reward is high (or the cost of performing the task is low), the junior agent is indeed more selective. However, if the reward is low (or the cost is high), the junior agent performs some tasks that yield an expected monetary loss, which the senior agent would not do.

The reputation incentives of the agent can be illustrated by *a reputation cut-off*: θ_i^R. It corresponds to an equilibrium cut-off difficulty for the agent who cares only about reputation (that is, $\beta \to \infty$).[3] The reputation cut-off depends only on the parameters μ, p_L, and λ, and thus, it complements the monetary cut-off θ^M. Naturally, the actual cut-off difficulty for the junior agent should lie in-between of what the monetary payoff and the career concerns induce him to do. So, if $\theta_i^M < \theta_i^R$, that is, the expected monetary benefits from performing the task are relatively high, the junior agent will

[3]Note that this equilibrium is a special case of the equilibrium described in Proposition 2.2.

not perform some tasks that are profitable. However, if $\theta_i^M > \theta_i^R$, the junior agent will perform some tasks that yield an expected monetary loss. Note that since $\frac{\theta_H^M}{\theta_L^M} = \frac{\theta_H^R}{\theta_L^R}$, it is always the case that the behavior of high- and low-type agents goes in the same direction. That is, if the high-type senior agent performs more tasks than the high-type junior agent, then the low-type senior agent will also perform more tasks than the low-type senior agent. This result is summarized in Proposition 2.3.

Proposition 2.3. *If the ratio of the cost of performing the task to the monetary reward for performing it successfully (θ_H^M) is higher (lower) than a cut-off selection level of the high-skilled when the agent is only concerned about his reputation (θ_H^R), then the junior agent will also perform less (more) tasks than a senior agent. That is, for $i \in \{H, L\}$:*

$$\theta_i > \theta_i^M \text{ if and only if } \theta_H^R > \theta_M^H, \tag{46}$$

$$\theta_i < \theta_i^M \text{ if and only if } \theta_H^R < \theta_M^H. \tag{47}$$

This result can be explained as follows. Ideally, the agent would like to appear both successful and experienced. That is, he would like to perform a task with high probability, and have a high success likelihood for any task performed. Clearly, being successful signals a high skill level, since the high-type agent is more likely to succeed in performing any given task. But being experienced (that is, rarely dropping a task) also improves the agent's reputation. Merely accepting a task signals that the agent is expecting to perform a task successfully, and is thus likely to be highly skilled.

To be precise, the incentive to appear successful can be measured by the expected reputation change of the agent when he performs the task: $\big(\mu(S)\theta p_i + \mu(F)(1-\theta p_i)\big) - \mu$, and the incentive to appear experienced by the reputation loss due to not performing any task: $\mu - \mu(\emptyset)$. Traditional career concerns models assume symmetric information, that is, they suppose that the agent does not observe his type. In the context of my model this would imply $\mu(\emptyset) = \mu$ removing the incentive to appear experienced and leaving only the incentive to appear successful.

The overall effect of the reputation incentives on the agent's behavior depends on the monetary incentives. For values of θ_H^M very close to 1, that is, in a situation where only a few tasks are profitable, accepting some unprofitable tasks makes the agent appear both successful and experienced. The agent accepts some tasks that yield a negative monetary payoff, because he is very likely to be successful in performing them and they can help to establish his reputation. Moreover, dropping the task would be seen as a negative signal by the market, which gives an additional reason

Table 2.1: θ_H^R numerical values for $\mu = 0.5$.

$\lambda \backslash p_L$	**0.2**	**0.4**	**0.6**	**0.8**
0.2	0.08	0.15	0.22	0.29
0.4	0.07	0.13	0.19	0.27
0.6	0.05	0.11	0.15	0.23
0.8	0.04	0.07	0.11	0.17
0.9	0.02	0.04	0.08	0.12

for the agent to perform some unprofitable tasks. As θ_H^M decreases, being successful at a monetary unprofitable tasks becomes quite unlikely, and there is no expected gain of reputation for performing them. However, not accepting a task strongly harms the agent's reputation, and he will eventually decide to perform some tasks even at an expected monetary loss. Finally, if θ_H^M becomes very low, even the tasks with very little chance of success become profitable in expectation. However, the agent drops some of them, in order to avoid failure and the associated reputation loss.

Interestingly, numerical approximations of θ_H^R presented in Table 2.1 suggest that it tends to be relatively low.[4] That is, the incentive to appear experienced tends to be stronger than the incentive to appear successful. Even for an extreme parametrization of the model, the monetary reward would have to be over three times as high as the costs of performing the task for the junior agent to perform fewer tasks than the senior agent. For more reasonable parametrizations, this ratio oscillates between 4 and 25.

2.4 General payoffs

In this section I relax the assumptions made in the previous one. In particular, I allow the agent to be rewarded both through a contingent fee (γ), and in the form of a fixed payment (g). I assume that both forms of payment must be non-negative. However, I allow for $\gamma p_L < c - g$, that is, a situation in which the senior agent of a low type (or of both types) would decide not to perform any task.

Most of the intuitions presented in propositions 2.1 – 2.3 also extend to this case. In particular, the threshold equilibrium still exists and the junior

[4]Table 2.1 presents θ_H^R as a function of λ and p_L. The influence of changes in μ is negligible and is ignored.

agent still under-reacts to changes in prices.

However, it is no longer true that the cut-off difficulties are always interior. If the fixed payment is sufficiently above the cost of performing the task, the agents of both types will decide to perform every task. On the contrary, if the total payment is very low it is possible that the low type or even both types will stop performing any task.

Moreover, if the total monetary profit under success $g+\gamma-c$ is negative, there may exist two types of equilbrium. In one type of equilibrium, the market does not expect any task to be performed. Successfully completing a task is still considered a positive signal, but the reputation gain from succeeding in a task is not sufficient to justify the monetary loss. In the other, the market does expect some tasks to be performed, thus observing an empty signal is harmful for the reputation and the agent will decide to perform some simple tasks in order to protect his reputation.

Proposition 2.4 describes the conditions on the monetary payoffs for each type equilibrium to exist.

Proposition 2.4. *In the environment where there is a fixed payment (g) and a contingent payment (γ) the following PBE satisfying $\mu(S) \geq \mu(\emptyset)$ exists.*

(i) If

$$c - g \leq -\beta \frac{\mu(1-\mu)(1-p_L)}{1+(1-\mu)(1-p_L)}, \tag{48}$$

there exists an equilibrium in which all tasks are performed and the beliefs of the market are given by (40)-(43) in Proposition 2.2.

(ii) If

$$c - g > -\beta \frac{\mu(1-\mu)(1-p_L)}{1+(1-\mu)(1-p_L)} \quad \textit{and} \tag{49}$$

$$c - g - p_L\gamma < \frac{1-\mu}{\mu(1-\lambda+\lambda p_L)+(1-\mu)}, \tag{50}$$

there exists a threshold equilibrium in which:

$$\theta_i = \frac{1}{p_i} \frac{\beta(\mu(\emptyset)-\mu(F))+c-g}{\beta(\mu(S)-\mu(F)+\gamma}, \tag{51}$$

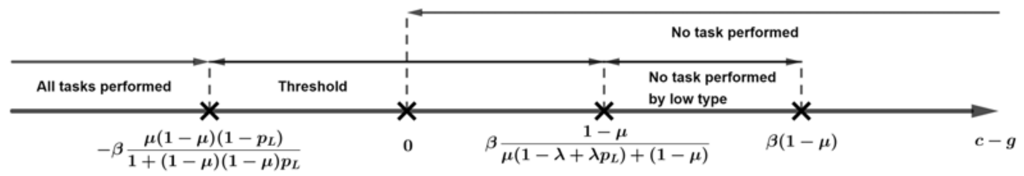
and the beliefs of the market are given by (40)-(43) in Proposition 2.2.

(iii) If

$$c - g - p_L\gamma \geq \beta \frac{1-\mu}{\mu(1-\lambda+\lambda p_L)+(1-\mu)} \quad \textit{and} \tag{52}$$

$$c - g - \gamma \leq \beta(1-\mu) \tag{53}$$

Figure 2.2: Equilibria on the market with fixed-fee contracts



there exists an equilibrium in which the low-skilled agent does not perform any task and the cut-off difficulty for the high type is given by (51). The beliefs of the market are given by (40)-(43) in Proposition 2.2.

(iv) If

$$c - g - \gamma \geq 0, \tag{54}$$

there exists equilibria in which no task is ever performed and the beliefs of the market satisfy:

$$\mu(S) \leq \mu + \frac{c-g-\gamma}{\beta}, \tag{55}$$

$$\mu(F) \leq \mu + \frac{c-g}{\beta}. \tag{56}$$

Finally, let me mention that in many markets although the outcome of the task is observable, it is not contractible. Hence, only fixed-fee payments can be used. It can happen due to either regulatory restrictions as, for example, in the market for criminal attorneys in the United States, or technical difficulties, as in the market for medical services.

The behavior of the agent in the market where only fixed-fee contracts ($\gamma = 0$) are available is a corollary of Proposition 2.4, and is presented in Figure 2. At equilibrium, a junior agent will refuse to perform some difficult tasks, even if his cost is fully covered, in order to avoid a potential reputation loss due to failure. In other words, the price which ensures the agent will perform any task is strictly higher than the cost of performing the task. Similarly, although there always exists an equilibrium in which no task is performed at a monetary loss, as long as the loss is not very high, there also exists an equilibrium where the agent still performs some simple tasks in order to prevent the reputation loss.

2.5 Comparative Statics

The sign of the comparative statics of the Perfect Bayesian Equilibrium of the model is ambiguous in most of the cases. The absence of a clear direction is a consequence of the fact that the changes in the parameters of the model influence not only the payoffs of the agent, but also the learning process of the market. Hence, the sign of comparative statics often depends on the initial cut-off levels. Although the change in θ_i may be ambiguous, it is often possible to precisely determine the sign of the change in the reputation cut-off θ_i^R.

The reputation cut-off θ_i^R is independent from the value of the reputation β. A change in β only determines how concerned the junior agent is with his reputation, compared to the monetary payoff. Particularly, the higher the reputation value, the closer the actual cut-off to the reputation cut-off will be.

On the contrary, changes in the probability of receiving the task λ do not influence the pay-off structure of the agent directly, but strongly influence the updating process of the market. The higher is the λ, the easier it is for the market to interpret observing no task performed ($\omega = \emptyset$). Consequently, the reputation loss for not performing the task increases and the cut-off difficulties decrease. As λ goes to 1 the market realizes that observing an empty signal is always a consequence of the agent's choice. Refusing to perform a task leads to greater reputation loss than failing in performing it, and the reputation cut-off converges to 0. That is, the junior agent always performs more tasks than the senior agent.[5]

Similarly, an increase in the market's prior μ does not influence the payoff of the agent directly, it improves the reputation of the agent under any outcome. Intuitively, it leads to an increase in the reputation cut-off. Although the change in the prior positively influences the agent's reputation under each outcome, the effect is strongest when no task is performed. It happens because the market cannot recognize whether the task was not received or whether it was received and rejected. Consequently, the belief of the market after observing an empty signal is strongly bound to the prior. This intuition does not have to hold for the overall cut-off. Particularly, a local increase in the market's prior increases the cut-off difficulty level if and only if the variance of the posterior under not performing the task is

[5]Interestingly, the opposite is not the case. That is, when λ converges to 0 (the agent almost never receives the task), it may still be the case that the junior agent performs more tasks than a senior agent. This is due to the fact that even though the agents do not have any incentive to appear experienced, there may exist some simple, but in expectations unprofitable, tasks that the agents are only performing to improve their success record.

higher than the excepted variance of the posterior under performing the task at a cut-off difficulty, that is,

$$\mu(\emptyset)(1-\mu(\emptyset)) > \theta_H \mu(S)(1-\mu(S)) + (1-\theta_H)\mu(F)(1-\mu(F)). \tag{57}$$

This result can be interpreted as follows, an increase in the prior belief of the market incentivizes the agent to take an action which reveals less information to the market.

Finally, the overall influence of an increase in the skill level of the low type (p_L) is difficult to assess. It directly increases the low-skilled agent payoff under performing any task, since the agent is more likely to succeed now. However, an increase in p_L also makes it harder for the market to recognize the type of the agent. Firstly, because the agents of both types now have more similar cut-offs. As a result, not performing a task is less harmful for the agents reputation, which pushes them to perform fewer tasks. Secondly, the agents of both types expect more similar outcomes of the tasks performed. That is, being successful is now less beneficial for the agent's reputation, but failing is less harmful. The sign of this effect is ambiguous. For very high selection levels it gives an incentive to become less selective, and for very low selection levels it gives an incentive to become more selective. The overall effect strongly depends on the initial cut-offs and the market's prior. Numerical simulations suggest that the high type tends to be more selective and the low type tends to be less selective in response to the increase of p_L.

The comparative statics are summarized in Proposition 2.5.

Proposition 2.5. *If the cut-off difficulty level of the agent is interior it has the following comparative statics.*

(i) The cut-off difficulty level of the agent who is concerned with both his reputation and the monetary payoff (θ_i) is:

  (a) increasing in β if and only if $\theta_i^R > \theta_i$, and decreasing otherwise;

  (b) decreasing in λ;

  (c) increasing in μ if and only if $\mu(\emptyset)(1-\mu(\emptyset)) > \theta_i p_i \mu(S)(1-\mu(S)) + (1-\theta_i p_i)\mu(F)(1-\mu(F))$, and decreasing otherwise.

(ii) The cut-off difficulty level of the agent who is only concerned with his reputation (θ_i^R) is:

  (a) unaffected by β;

  (b) decreasing in λ;

  (c) increasing in μ.

2.6 Endogenous contracts

In the baseline model I considered a situation in which the payoffs of the agent were exogenous. In this section I extend the analysis to the case in which the agent's payoffs are endogenously determined by a contract signed with a principal.

To be precise, I suppose that at the beginning of the game the agent (he) meets with a principal (her). The principal holds a project which brings a revenue v if it is successfully performed, and no revenue if it fails. In order for the project to be realized, the principal contracts with the agent. The probability of the project being successful depends on both the difficulty of the task and the skill level of the agent, analogously to the baseline model. The agent, but not the principal, observes both the characteristics of the project and his skill level. Performing the project is costly for both the principal (who faces a cost denoted by d) and the agent (who faces a cost c). As in the baseline model, the agent cares not only about the monetary payoff but is also career concerned.

In contrast with the baseline model, I suppose that the contract between the principal and the agent is private, that is, it is not directly observed by the market. This assumption is made to eliminate a direct effect of the characteristics of the contract the agent is signing on the beliefs of the market. That is, at the moment of agreeing on the contract, both the agent and the principal treat the beliefs of the market as given. Although the market does not observe the contract and whether it was accepted, in equilibrium it correctly conjectures the pay-off structure and the selection cut-offs, and forms its beliefs using Bayes' rule as described in Section 2.3.

As in Section 2.4, the contract consists of two variables: the fixed payment (g), which is always transferred from the principal to the agent, and the contingent payment (γ), which is transferred from the principal to the agent only if the task is performed successfully. Both forms of payment are assumed to be non-negative, which can be either a result of regulatory restrictions or a liquidity constraint of the agent. The payoffs of the game are presented in Table 2.2.

Finally, I make a few simplifying assumptions. The agent is assumed to always meet a principal, that is, $\lambda = 1$ ($\theta_L^R = \theta_H^R = 0$). The principal's prior belief is that the task is profitable, that is, $\frac{1}{2}v(\mu + (1-\mu)p_L) \geq d + c$. Also, to avoid corner solutions I suppose that the costs for the agent are significant enough to always reject an empty contract ($g = 0$, $p = 0$), that is $\beta < c$.

As shown in Section 2.4, if the agent is offered a contract which always yields a negative monetary payoff there may exist two equilibrium types

Table 2.2: Payoffs of the game with endogenous contracts

	Principal	**Agent**
Success	$v - \gamma - g - d$	$\gamma + g - c + \beta\mu(S)$
Failure	$-g - d$	$g - c + \beta\mu(F)$
Task not performed	0	$\beta\mu(\emptyset)$

– one in which no task is performed, and one in which some tasks are performed. To ensure continuity of the problem, I focus on the latter case. Moreover, as shown in Appendix B.3, if $\lambda = 1$ there can exist two equilibrium types – one in which all tasks are performed, and one in which some tasks are not performed. I also focus on the latter case.[6]

In this scenario, the agent plays a double role. On one hand, he is a service provider. He performs a project and the probability of the project being successful depends on his skill level. On the other hand, he is an expert. He holds superior knowledge about the project's characteristics and decides whether the project is worth performing at all.

A natural application of the model is a market for civil attorneys. In this context, the principal is a plaintiff who holds a case which can be brought to court. In order to litigate the plaintiff needs to hire an attorney who serves as the agent. The litigation is costly for both players – the attorney needs to put time and effort into the process, and the plaintiff, in addition to the payment for the attorney, bears the monetary costs of the trial. The probability of the plaintiff prevailing in court depends on both the skill of her attorney and the difficulty of the case, and the attorney is likely to be better informed on both. Moreover, the attorney is likely to care not only about her monetary reward but also about establishing his reputation, which can help to bring him future clients or move up on a corporate ladder.

The model can also be applied in a corporate finance environment. An entrepreneur, who serves as the agent in the context of my model, holds an idea for a start-up. To set up a successful company the entrepreneur needs not only to put time and effort in it, but it also requires financing. The financing can be provided by a venture capital firm, that is, the principal. The probability of the start-up yielding a profit depends on both the skill of the entrepreneur and the quality of the idea (difficulty of the task),

[6] In other, words I focus on a limit of a sequence of equilibria when λ is going to 1.

both of which are better known to the entrepreneur. Moreover, the entrepreneur cares not only about the direct monetary profits, but also about developing his portfolio and establishing a good reputation, which helps to get financing for future projects.

In the two following subsections I analyze the game. Firstly, I study the case in which the principal has the bargaining power and proposes the contract to the agent. Secondly, I discuss the opposite situation.

2.6.1 Principal with bargaining power

I begin by studying a situation in which the principal holds the bargaining power, that is, she makes a take-it-or-leave-it contract offer to the agent. Although the principal is allowed to propose a menu of contracts, it is never necessary to do so.[7] Hence, I ignore this possibility through the subsection.

Firstly, consider a case in which the principal deals with a senior agent, that is, $\beta = 0$. In this situation, the principal should propose a simple contract which covers the agent's cost exactly, that is, $g = c$ and $\gamma = 0$. This contract ensures that the participation constraint of the agent is always binding and the principal captures the whole surplus. Moreover, since the agent is always indifferent between accepting and rejecting this contract,[8] in equilibrium he accepts it only when the task yields positive expected profit for the principal. In other words, the monetary cut-offs are given by the following expression:

$$\theta_i^M = \frac{1}{p_i}\Big(\frac{c+d}{v}\Big). \tag{58}$$

Secondly, consider a scenario in which the principal deals with a junior agent, that is, $\beta > 0$. Clearly, proposing a contract that covers the agent's cost is no longer optimal. Since $\lambda = 0$, $\theta_i^R = 0$ and not performing a task harms the agent reputation. Given that the agent cost of performing the task is covered, he would accept such a contract independently from the difficulty of the task and her own skill level.

In order to improve her pay-off and ensure that only profitable tasks are performed, the principal has an incentive to cut the fixed fee paid. By cutting the fixed fee below the costs the principal ensures that only the agent who expects a significant reputation gain would perform the task.

[7] It is a direct consequence of Lemma 25 provided in the Appendix.

[8] If the principal would like to ensure strict preferences of the agent, she can propose a contract with a marginally smaller fixed payment, but a positive and marginally small contingent payment.

Since the agent who expects a significant reputation gain from performing the task is also the agent who is likely to succeed in performing it, the principal does not need to use contingent-fee payment to ensure that only the tasks with a high likelihood of success are performed. Due to this effect, the principal does not have an incentive to include any contingent-fee payment. Although the contingent fee is more attractive for the agent who is more likely to be successful, it is cheaper for the principal to cut the fixed fee instead of including the contingent fee.

The main results of the model with an endogenous contract and strong bargaining position of the principal are summarized in Proposition 2.6.

Proposition 2.6. *If the contract is endogenously determined and proposed by the principal it is always entirely fixed-fee based, that is, $g > 0$ and $\gamma = 0$. Moreover:*

(i) $g = c$ *if the agent is senior, and* $g < c$ *if the agent is junior,*

(ii) the junior agent performs more tasks than the senior agent,

(iii) the principal earns a non-negative expected profit for any task performed, and she earns higher overall expected profit when the agent is junior.

Although the closed-form solution for g in the optimal contract cannot be obtained, it is always positive and it ensures that the principal makes a strictly positive expected profit for any task performed. Overall, the principal earns a higher expected profit dealing with a junior agent, than when she deals with a senior agent.

Even though the junior agent is paid less than the senior agent, he performs more tasks in equilibrium. Indeed, the principal cuts the offered fee to the junior agent, but the decrease is never sufficient to ensure that only the tasks that yield an overall positive expected profit ($\theta p_i v - c - d$) are performed. When the principal deals with a senior agent, in equilibrium he internalizes the total cost of performing the task (as $g = c$), hence, only the tasks that yield an overall positive expected profit are performed. However, when the principal deals with a junior agent, he internalizes only part of the costs (as $g < c$) and some are performed only because the agent is afraid of the reputation loss due to the refusal to perform a task and they yield an overall loss. To be precise, the junior agent of type i performs a task only if it is above a threshold θ_i such that:

$$\frac{1}{p_i}\frac{p+d}{v} < \theta_i = \frac{1}{p_i}\frac{c - g + \beta\big(\mu(\emptyset) - \mu(F)\big)}{\beta\big(\mu(S) - \mu(F)\big)} < \theta_i^M. \tag{59}$$

2.6.2 Agent with bargaining power

In this subsection I analyze the situation in which the agent holds a strong bargaining power, that is, he makes a take-it-or-leave-it contract offer to the principal. In this scenario the interaction between the principal and the agent is a signaling game. The principal forms her beliefs about the likelihood of the task being successful based on the offer received. Although Perfect Bayesian Equilibrium requires the principal to use the Bayes' rule on the equilibrium path, it remains silent about events that are of zero probability in the equilibrium. In the context of my model it means that almost any contract can be supported as part of some Perfect Bayesian Equilibrium.[9]

Hence, I focus on equilibria satisfying three properties. Firstly, I suppose that the participation constraint of the principal must be binding. In other words I suppose that that agent indeed has a strong bargaining position and is able to capture the whole surplus. Secondly, among the equilibria in which the principal earns zero profit, I choose the one that minimizes the adverse selection problem. That is, the one in which the least unprofitable projects are performed. Finally, I ignore the equilibria, in which the principal rejects any contract proposed on the equilibrium path.

The selected equilibrium satisfies the commonly used Intuitive Criterion Cho and Kreps [1987].[10] The selected equilibrium is then the one preferred by the high-type agent receiving the simplest task, that is, the agent who is sure to succeed. This is due to the fact that no contract is artificially removed from being accepted in equilibrium only because the principal holds low (either in- or out-of-equilibrium) beliefs about the likelihood of success of the task under this contract. Naturally, the agent who is sure to succeed benefits the most in being able to propose more contracts.

It turns out that when the agent has bargaining power, independently of whether he is junior or senior, a unique fully share-based contract is proposed. The equilibrium behavior is driven by the agent who is sure to succeed. From his perspective, the contingent and the fixed fee are perfect substitutes. Hence, in order to differentiate from agents with a lower probability of success, he proposes a fully share-based contract. Indeed,

[9]Particularly, one could choose some contract that yields a non-negative profit for at least some type of agent at some difficulty levels, and suppose that the principal holds a belief that the task will fail for sure at any other contract.

[10]Unfortunately, typically used refinements like the Intuitive Criterion or the D1 Criterion, which restrict the out-of-equilibrium beliefs, are not sufficient to select a unique equilibrium. For example, an equilibrium in which any given contract is never used on the equilibrium path can be always supported.

some agents who face a very low probability of success will decide that the costs of performing the task are too high and will not mimic the high type. However, some agents with mid-range probabilities of success will still find it profitable to propose a fully contingent fee based contract and perform the task. In the equilibrium, the principal makes zero expected profits, thus:

$$\gamma = v - \frac{d}{\frac{1}{2}\big(\mu(1+\theta_H) + (1-\mu)(1+\theta_L)p_L\big)}. \tag{60}$$

The cut-off difficulty levels follow exactly those described in Section 2.3, that is, the senior agent of type i accepts the task if it is above the threshold θ_i^M:

$$\theta_i^M = \frac{1}{p_i}\frac{c}{\gamma}. \tag{61}$$

The junior agent also takes into account the posterior beliefs of the market about his type. Hence, at a fixed reward γ, he accepts more tasks. To be precise, he performs a task only if it is above the threshold θ_i:

$$\theta_i = \frac{1}{p_i}\frac{c + \beta\big(\mu(\emptyset) - \mu(F)\big)}{\gamma + \beta\big(\mu(S) - \mu(F)\big)}. \tag{62}$$

Even the senior agent performs some socially inefficient tasks, that is, some tasks s.t. $c + d > vp_i\theta$. The junior agent has an additional incentive to perform the task due to reputation concerns. Hence, the junior has to ask for a smaller reward, to credibly signal that the principal is unlikely to operate at a loss. Despite the decrease in γ, overall, the junior agent performs more tasks than the senior agent.

The results of the model with an endogenous contract and strong bargaining position of the agent are summarized in Proposition 2.7.

Proposition 2.7. *If the contract is endogenously determined and proposed by the agent it is always entirely contingent fee based, that is, $g = 0$ and $\gamma > 0$. Moreover:*

(i) the junior agent charges a lower fee than the senior agent,

(ii) the junior agent performs more tasks than the senior agent,

(iii) some tasks yielding a negative total expected profit are always performed.

Compared to the scenario in which the principal holds full bargaining power, the model in which the agent has a strong bargaining position gives a very different prediction about the form of the contract. In the first scenario the contract is fully fixed-fee based, in the second the contract is fully contingent fee based.

In both scenarios the junior agent receives a lower payment than a senior agent, yet he accepts more tasks. This is due to the fact that not performing a task is associated with a reputation loss. When the principal holds the bargaining power she is able to exploit it and cut the price for performing the tasks. When the agent holds the bargaining power he is forced to cut the reward in order to convince the principal that she will not be operating at a loss.

Finally, although in both cases career concerns result in some unprofitable tasks being performed, the costs of this inefficiency are never borne by the principal. Clearly, when the agent holds the bargaining power and the principal's participation constraint is already binding, she cannot bear any additional costs. Interestingly, when the principal holds the bargaining power, not only is she unharmed by facing a junior rather than a senior agent, but actually she obtains a higher expected profit when dealing with a junior agent.

2.7 Conclusion

This chapter studies how career concerns influence task selection. I show that a career concerned agent faces two opposing incentives when deciding whether to perform a task of random difficulty. On one hand, he has an incentive to accept only the simplest tasks in order to appear more successful. On the other hand, he has an incentive to accept any task in order to appear more experienced. Overall, the latter effect tends to prevail, and a career career-concerned agent tends to perform more tasks than an agent who cares only about the monetary payoff. Moreover, when the agent's payoff is endogenously determined through contracting with a principal, the principal is able to exploit the agent's career concerns by offering a lower price for performing the task.

Several questions are left for future research. Firstly, the model assumes that the value of reputation is independent from his skill level. In some scenarios it does not have to be a case. For example, a low-skilled lawyer can value his reputation more, as a good reputation enables promotion to a partner position, making his income less dependent on the outcome of the tasks he performs. Secondly, I suppose that there is only one task that can arrive to the agent each period. In reality, the agent may receive and perform multiple tasks, and the market may not observe the number of tasks received. Finally, the model ignores a possible distortion in matching between principals and agents, which may arise due to the presence of career concerns, especially when junior and senior agents compete against each other.[11]

[11] Some effects of career concern on a job assignment have previously been studied by Mukherjee [2008] and Martinez [2009].

Chapter 3

Dynamics of Collective Litigation

3.1 Introduction

Settlement negotiations between a defendant and a plaintiff do not occur in a vacuum. Their outcomes are used by third parties (e.g., other plaintiffs) as an input when designing their own litigation strategies. Previous settlements may directly affect the outcomes that can be expected from a trial. Additionally, they also allow other parties to learn about features of the environment.

As an example, consider an individual that is harmed after consuming a product. He, naturally, takes into account observed past behavior of the producer and other harmed consumers to decide whether to start a law suit, when to do it, and whether to do it alone or join with others. Likewise, whatever he chooses to do will likely affect the information available as well as the incentives of future harmed consumers. In this litigation setting, as in many others, it is natural to consider that the defendant is better informed than each individual plaintiff about the underlying environment. For instance, a firm has privileged knowledge about the safety measures taken during production, which determine the extent to which consumers are exposed to a possible harm. In such a case, the actions of the firm are used by interested parties to make inferences about its private information. This feature remains underexplored in the study of litigations in which more than one plaintiff may be involved.

A case that illustrates the main features of the litigation environment that we are studying is the Baxter dialysis crisis [Diermeier and Dickinson, 2012]. In the fall of 2001, more than 50 patients in seven countries within a few days of going through dialysis. The deaths did not occur all at once, it was rather a sequential process. As deaths occurred, health authorities (initially in Spain) discovered a connection between the cases: the same type of dialyzer (a filter used during a hemodialysis) was used in all the diseased patients.

The manufacturer of the dialyzers (Baxter International) was the first one to find out the cause of the deaths: a fluid used to identify leaks remained in the dializers, evaporating during the treatment, and entering the patients' bloodstream. The manufacturer was better informed about the scope of the crisis. It had privileged knowledge about the number of patients that could have been exposed to the faulty dialyzers. In the aftermath of this crisis, the manufacturer settled with the families of all patients.

In this chapter, we study the dynamics of settlement negotiations between a privately-informed defendant and several potential plaintiffs arriving over time. We focus on two main issues: how collectives form and the extent to which the defendant can affect this process. We present three main findings. First, the ability to settle with each individual plaintiff is a very effective tool for the defendant to avoid the formation of a collective. Second, if there is an endogenous chance of a break down in negotiations with plaintiffs arriving late, then settlements with plaintiffs arriving early on can endogenously fail. In this setting, making an offer so low that the plaintiff is willing to reject it is the only way in which the defendant is able to credibly reveal her private information. Finally, we show that the availability of secret settlements may be harmful for the defendant.

We propose a model in which a defendant faces the random arrival of plaintiffs over three periods. In each period, one plaintiff can arrive with some exogenous probability. The defendant is privately informed about the actual value of the probability of arrival, which the plaintiffs do not know. This probability can be interpreted as a safety characteristic of a product that determines, for example, the extent to which a population of consumers has been exposed to a risk (e.g., a defective product).

The three periods in our model need not be taken in a literal sense. The last period can be interpreted as a deadline prescribed by the court for the plaintiffs' opt out choices. In that sense, the first period is meant to capture an initial phase in which there is no previous information that can influence plaintiff decisions, for instance, because the defendant is a new firm in the market or because there is no precedent of an accident of the same kind. The second period intends to capture an intermediate stage in which information about the case may potentially exist but there is still room for the arrival of additional plaintiffs.

We assume that the outcome of a trial is affected by the number of litigants. This may be because trial costs can be divided among the litigants, because each additional litigant provides evidence that increases the chance of prevailing in the case, or because there are some administrative requirements for the minimal amount of plaintiffs being allowed to litigate collectively. In our model, plaintiffs' entry is endogenous, i.e., after arrival a plaintiff decides whether to file the case. If the case is filed, the defendant gets to make a settlement offer. We study two cases: one in which all settlements are publicly observed and one in which the defendant can settle secretly. Whenever an offer is rejected, the plaintiff can join a (potentially collective) lawsuit.

Plaintiffs can be of two types: strategic or behavioral. A plaintiff is *behavioral* if he strictly prefers to file the case and go to trial. A possible interpretation is that a fraction of plaintiffs are vengeful, benefit from the publicity given to the case, or otherwise derive utility from going to trial. Alternatively, it can also be seen as a fraction of plaintiffs that overestimate payments from going to court. A plaintiff is said to be *strategic* if his optimal choice depends on the actions of other plaintiffs. On one hand, a strategic plaintiff arriving in the last period faces no uncertainty about a payoff and bases his litigation strategy on the actions he has observed. On the other hand, in the first two periods a plaintiff's optimal choice depends on his beliefs about the probability of arrival of the new litigants (as well as on the conjecture about the strategy of those that arrive).

There are two sources of externalities in our model. First, there is the payoff externality arising from the assumption that outcomes of trial depends on the number of litigants. Second, there also exist information externalities. When a plaintiff does not file the case or settles secretly other players do not observe the arrival. This affects the beliefs and filing decisions of subsequent plaintiffs.

As a benchmark, we start our analysis in Section 3.3.1 assuming that the probability of arrival is commonly known. In this case, only behavioral plaintiffs go to trial. Strategic plaintiffs file the case whenever someone has already chosen to go to trial, or if the probability of arrival of a behavioral plaintiff is sufficiently high. If the case is filed, an strategic plaintiff always accepts the settlement offer. The equilibrium behavior of strategic plaintiffs resembles the equilibrium in divide-and-conquer strategies identified in the literature (Segal, 1999; Che and Spier, 2008). If the fraction of behavioral plaintiffs is low, the mere capability of the defendant to paying off future plaintiffs is enough to prevent any filing from strategic plaintiffs.

In Section 3.3.2, we introduce asymmetric information and study the case in which all settlements are publicly observed. The equilibrium in divide-and-conquer strategies persists if there are not enough behavioral plaintiffs. However, if the fraction of behavioral plaintiffs is above a certain threshold our predictions change. In the first two periods, negotiations with a strategic plaintiff are a signaling game. In any separating equilibrium, the offer by a defendant facing a high arrival rate is always accepted by a strategic plaintiff. On the other hand, in the showcase equilibrium, the offer by a defendant facing a low arrival rate is rejected with some positive probability. That is, the inability to settle with a fraction of plaintiffs gives rise to failed negotiations between a privately-informed defendant and strategic plaintiffs (who would have otherwise settled). The defendant facing low arrival trades off the probability of an agreement for lower offers. Moreover, after observing a settlement, a plaintiff in the second period is relatively more inclined to file the case than if offers were always accepted for both types of defendants.

In Section 3.3.3, we allow the defendant to hide the occurrence of a settlement (and the arrival of the plaintiff involved) from other players. We show that the availability of secret settlements does not necessarily benefit the defendant. Privacy regimes are only meaningful in the first period. This is because plaintiff's choices in the last period do not depend on beliefs. In equilibrium, the filing decision in the second period cannot depend on whether a settlement was observed in the first period. As a result, a strategic plaintiff's filing decision in the second period depends more closely on the prior belief than when all settlements are public. For a prior low (high) enough, a strategic plaintiff never (always) files in the second period. On the other hand, for intermediate priors filing decision in the second period depends on how often a strategic plaintiff rejects the offer in the first period. This gives raise to multiple equilibria, even when a unique outcome is selected in each negotiation.

As argued above, in the absence of behavioral plaintiffs our model has a unique equilibrium in which the defendant avoids the formation of a collective. This coincides with the equilibrium in divide-and-conquer strategies discussed by Che and Spier (2008) in anstatic context with complete information.[1] More broadly, this point has also been made in the literature in contracting with externalities (Segal, 1999 and 2003; Segal and Whinston, 2000). Besides considering the effects of exogenous breakdowns in the negotiations, we differ in that our focus is on a dynamic context with a privately-informed defendant.

[1] In addition to the static model with complete information, Che and Spier (2008) consider the following two extensions. First, they consider the case in which bilateral negotiations between the defendant and each plaintiff are sequential instead of simultaneous. Second, they allow for private information on the side of the plaintiffs. Divide-and-conquer strategies are used by the defendant in both extensions, although asymmetric information on the side of the plaintiff generates trials in equilibrium.

This chapter closely relates to the literature on litigation in dynamic environments. Some papers consider environments with symmetric information (Deffains and Langlais, 2011; Bernhardt and Lee, 2014) while others study private information on the side of the plaintiffs (Che, 1996; Daughety and Reinganum, 2011). For example, Daughety and Reinganum [2011] focus on privately-informed plaintiffs deciding whether to file a case. The central trade-off for the plaintiffs is between acting early to motivate other plaintiffs to join and waiting to be more informed about the number of other plaintiffs. Private information on the defendant's side is a feature that, to the best of our knowledge, has not been explored.

The effects of secret settlements have been studied in other environments. Daughety and Reinganum [2005] study a dynamic setting in which consumers choose whether to purchase a product taken into account their beliefs about the likelihood of being harmed by the product. The availability of secret settlements between the firm and harmed consumers results in a privately-informed firm, which gives prices a signaling role. This asymmetric information may reduce demand, making it preferable for the firm to commit to only settling publicly. We complement this analysis by focusing on a way in which the secret settlements can influence the litigation process itself.

This chapter belongs to the broader literature on collective action in a dynamic environment. A wide array of collective action models have been firstly studied by [Olson, 1965]. Recently, the interest in the dynamics of collective action is mostly related to collective investment with a particular focus on crowdfounding [Alaei et al., 2016]. Two papers are particularly related. Liu [2018] presents a dynamic setting with both payoffs and information externalities. Investors choose whether and when to invest in a project. Each investor receives a private signal about the probability of rhe success of the project. An investor can enter the project early, baring the risk that the project may not receive enough support, but revealing her optimistic view of the prospects of the project. On the other hand, the investor can also wait to observe whether her peers support the project before committing herself. The main difference with our setting is that we consider a party (the defendant) that intervenes (through settlement offers) in the formation of the collective.

In Deb et al. [2019], buyers decide whether to purchase a product in a crowdfunding campaign. Buyers face an opportunity cost of purchasing the product and waiting until the campaign success. Thus, buyers only but if the probability of success is high enough. The arrival rate of buyers is commonly known in their model. Similar to our setting, their model considers players (donors) that intervene in the actions of buyers (through donations). However, while the objective of donors is to maximize the probability of success of the campaign, the objective of the defendant in our context is to minimize the probability of the collective litigation occurring.

The rest of the chapter continues as follows: Section 3.2 introduces the model, Section 3.3 presents the analysis and main results. Finally, Section 3.4 concludes.

3.2 Model

In the case of the commonly studied individual ligation, the outcome of the trial depends mostly on the merit of the case. However, the outcome of a collective litigation also depends on the number of litigants. Firstly, some number of plaintiffs need to be reached, in order to file a collective case. Secondly, each new plaintiff may provide some useful evidence and increases the chance of prevailing in the case.

We propose a simple dynamic model of collective litigation. We model the collective litigation as a four-period sequential game between *a defendant* and three potential *plaintiffs*. In period $t = 0$ there is an accident with a random scope (i). The accident has a high scope ($i = H$) with a commonly-known probability μ and a low scope ($i = L$) with probability $1 - \mu$. We suppose that the plaintiff does not observe the scope of the harm, but the defendant does. Therefore, through the chapter we refer to the scope of the harm as the characteristic of the defendant. That is, we call a defendant who is liable for an accident with a high (low) scope simply a high-type (low-type) defendant. In each following period ($t = 1, 2, 3$), with probability λ_i one plaintiff suffers a harm. λ_H is assumed to be larger than λ_L, that is, an accident of high scope is more likely to result in a harm. After arrival, the plaintiff decides whether to file the case or not. Filing the case results in a cost f for the plaintiff.[2]

After the case is filed, the plaintiff is approached by the defendant, who makes a take-it-or-leave-it settlement offer (S_t). The offer consists of two variables: the monetary transfer ($s_t \in \mathbb{R}$) and the secrecy regime ($\zeta_t \in \{0, 1\}$, where $\zeta_t = 0$ denotes a secret settlement). After receiving the offer, the plaintiff makes a decision (a_t) on whether to accept it ($a_t = 1$) and settle the case, or to reject it ($a_t = 0$) and litigate the case.

[2]This cost can be interpreted not only as an administrative cost, but also as an opportunity cost. If the plaintiff decides to file a collective litigation case, he at least temporarily gives up the opportunity to litigate the case individually.

Moreover, we assume that with probability η the plaintiff is *behavioral*. A behavioral plaintiff can be seen as either vengeful or pro-social. He always files the case and rejects any settlement.[3] In contrast, with probability $1-\eta$ the plaintiff is *strategic* and takes the decisions in order to maximize his expected payoff.

The sequence of events within each period t, for $t = 1, 2, 3$, is presented in Figure 3.1.

The outcome of the litigation depends on the number of participants that litigate. We focus on the simplest situation, in which there is a minimal number of litigants required for the collective litigation to be successful. The closest collective litigation form to this scenario is a class action, when some number of representative plaintiffs must team up to file the case.[4] If the litigation is successful, the defendant is forced to transfer the compensation $w > f$ to each of the participants. Otherwise, the collective litigation fails and no transfers are realized.[5] We focus on the most interesting scenario, in which the minimal number of participants is set to two.[6] We assume that $\lambda_H w > f > \lambda_L w$, that is, if the scope of accident is known to be low in the second period the plaintiff would never start a collective litigation, but he may consider it if the scope of the harm is high. Overall, the payoff of the defendant is given by $-\big(\sum_t a_t s_t + \mathbb{1}_{k>1} kw\big)$ and the payoff of the period t plaintiff is given by $a_t s_t + (1-a_t)\mathbb{1}_{k>1} w$, where $\mathbb{1}_{k>1}$ is the indicator function taking a value of 1 if there is more than 1 litigant at the end of the game, and 0 otherwise.

Unlike the defendant, the plaintiff does not observe the scope of an accident. Instead, he forms a belief about the probability of each state of the world using Bayes' rule. We denote the probability which the plaintiff arriving in period t and observing some history h_t assigns to the scope of the

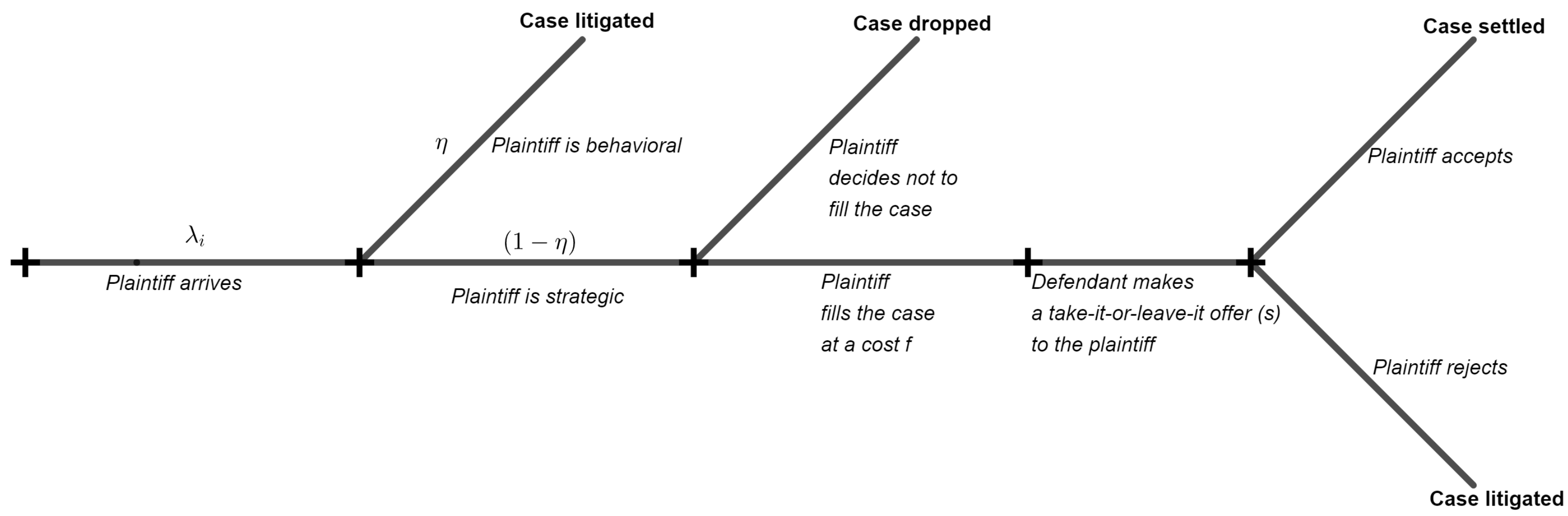
[3] Although the model requires some exogenous probability of settlement failure, the qualitative results do not depend on the particular assumption made. It can simply be assumed that there is some exogenous probability η that the settlement negotiation will fail, for example, because the defendant failed to identify the plaintiff.

[4] In the model we allow for the plaintiffs to settle the case even after a minimal number of the representative plaintiffs has been already reached, which corresponds to an opt-in rule. In the United States an opt-out rule is used instead, that is, once the class action case is filed subsequent plaintiffs are automatically participating in the litigation. However, in terms of payoffs, the choice of participation rule is irrelevant in our model.

[5] The model is easily extendable for the case in which the payoff from the litigation is described by a strictly increasing sequence w_k. However, whether the negotiation at some period t with history h_t result in a separating or a pooling equilibrium depends on the particular choice of the sequence.

[6] If $k = 1$ the model is a simple sequence of ultimatum games. If $k = 3$ only the decision of the first period plaintiff is relevant, hence there is no incentive to manipulate the information for the defendant.

Figure 3.1: Sequence of events in periods 1-3



harm being high by μ_{t,h_t}. We assume that h_t is a pair of two variables: the number of previous litigants (k_t) and the number of public settlements by period t (n_t). In other words, we suppose that a plaintiff does not observe the terms of previous settlements, but only a number of publicly settled cases. The plaintiff also updates his beliefs after receiving an offer from the defendant. We denote by $\mu_{t,h_t}(S_t)$ the probability which the t-th period plaintiff assigns to the scope of the harm being high after observing a history h_t and an offer S_t.

We solve the game by backwards induction, looking for Perfect Bayesian Equilibria (PBE) satisfying the D1 criterion [Banks and Sobel, 1987]. That is, we look for a strategy profile for all the strategic plaintiffs and the defendant of each type and the beliefs of the plaintiffs, such that the players are sequentially rational and their beliefs follow Bayes' rule whenever possible. Moreover, we require that when the plaintiffs observe some action of the defendant that has a 0 probability on the equilibrium path, that is, they cannot use the Bayes rule, they believe that it comes from a defendant type who is "more likely" to profit with this action compared to her equilibrium payoff. In practice, the D1 criterion selects the separating equilibrium with the least probability of litigation.

3.3 Analysis

Before analyzing the fully-fledged model we consider two simpler scenarios. Firstly, we study the game under symmetric information. Secondly, we consider a situation when the information is asymmetric, but all the settlements are public. Only then do we move to the most complex case, when secret settlements are allowed.

3.3.1 Symmetric information model

We start the analysis by considering a symmetric information scenario, in which both the plaintiffs and the defendant observe the scope of the harm and hence the probability of the arrival (λ) of future plaintiffs.

Clearly, independently of the period analyzed, a strategic plaintiff always files the case if there is already at least one other litigant. He realizes that the case will be certainly successful if he joins the litigation, and the costs of filing the case will be covered. After the case is filed, the negotiation between the plaintiff and the defendant is a simple ultimatum bargaining game. The defendant proposes a settlement transfer equal to w, which is always accepted in equilibrium.[7] Since the scope of the harm is known, the selected secrecy regime is irrelevant.

If a strategic plaintiff does not observe any past litigants, he files the case only if the proportion of behavioral plaintiffs is sufficiently high. He realizes that if he litigates any future strategic plaintiff will necessarily settle the case; hence, the collective litigation can be successful only if at least one behavioral plaintiff arrives. We denote this probability by ρ_t. Naturally, $\rho_3 = 0$, and $\rho_t = \lambda\eta + (1-\lambda\eta)\rho_{t+1}$ for $t < 3$. Once the case is filed, the negotiation is a simple ultimatum bargaining game. The defendant proposes a settlement offer which exactly covers the expected payoff of the plaintiff, that is, $\rho_t w$, and the case is settled in equilibrium.

The equilibrium of the symmetric information model is summarized in Proposition 3.1.

Proposition 3.1. *If $k_t > 0$ a strategic plaintiff files the case independently of the period. After a case is filed, the defendant makes an offer $s_{t,k=1} = w$, which is always accepted by the strategic plaintiff.*
If $k_t = 0$ a strategic plaintiff files the case if and only if $\rho_t \geq \frac{f}{w}$.

Proposition 3.1 shows that when the information is symmetric the litigation is completely driven by the behavioral plaintiffs. Importantly, it implies that if all the plaintiffs are strategic (that is, $\eta = 0$) no case is ever filed independently of how high λ and w are. Each plaintiff realizes that even if he files the case and decides to litigate, future plaintiffs will free-ride on his decision by settling the case. Hence, it is always optimal to drop the case. Moreover, if η is low the probability of successful collective litigation is small. Hence, a strategic plaintiff never files the case unless there are previous litigants. The cut-off values for η are provided in Corollary 3.1.

Corollary 3.1. *If $\eta < \frac{1-\sqrt{1-\frac{f}{w}}}{\lambda}$, then no strategic plaintiff files the case unless $k_t > 0$.*
If $\eta \in [\frac{1-\sqrt{1-\frac{f}{w}}}{\lambda}, \frac{f}{w\lambda})$, then a first-period strategic plaintiff always files the case, but a second-period strategic plaintiff files the case only if $k_2 = 1$.
If $\eta > \frac{f}{w\lambda}$ then a strategic plaintiff in periods 1 and 2 always files the case.

It is worth observing that in standard individual litigation models the settlement can be seen as a positive outcome. It allows the plaintiff to be

[7] To be precise, if $k_3 = 2$ there are two possible outcomes of the subgame in the final period. One in which the final plaintiff settles the case, and one in which he litigates the case. Since they result in the same payoffs for all the players, we ignore the latter possibility.

compensated for the harm by the defendant without incurring litigation costs for both parties and the state. However, in the context of collective litigation this assertion is not necessarily correct. Indeed, if all the plaintiffs were represented by a single lawyer who negotiated settlement terms on their behalf (as it may happen in a class action), it could be socially beneficial to settle the case. But, in our model, the defendant settles the case with each plaintiff separately and is capable of preventing collective litigation. In fact, the mere capability of the defendant to pay off future plaintiffs is enough to prevent any case from being filed.[8]

3.3.2 Asymmetric information with public settlements

Before we introduce the possibility of manipulating the information, we study a simpler case in which the information is asymmetric, but all the settlements are public. We focus on the scenario in which $\eta \geq \frac{f}{\lambda_H w}$, that is, we assume that there exist beliefs that are sufficiently high for a strategic plaintiff to file the case even if no previous litigants are observed. We denote the difference between arrival rates by $\Delta\lambda \equiv \lambda_H - \lambda_L$. Moreover, to ensure the uniqueness of the equilibrium we assume that $1 - \lambda_L > \lambda_H$.[9]

Some results from the model with symmetric information still hold. Particularly, in period 3 there is no uncertainty about future arrivals, hence, a strategic plaintiff files the case only if $k_3 > 0$ and settles it for a transfer of w. Similarly, if a strategic plaintiff arriving in period 2 observes a past litigant, that is, $k_2 = 1$, he does not face any uncertainty about his payoff. Hence, he always files the case and settles it for a transfer w.

However, if no past litigants are observed in early periods, the results from the symmetric information model no longer hold. Consider a strategic plaintiff who arrives in period 1 or 2. He realizes that even if he decides to litigate, a strategic plaintiff in the future will always settle the case. Therefore, the litigation can be successful only if a behavioral plaintiff arrives. Similarly to subsection 3.3.1 we denote the probability of the arrival of at least one behavioral plaintiff in the future periods conditional on the state of the world i by ρ_t^i, where $\rho_3^i = 0$, and $\rho_t^i = \lambda_i \eta + (1 - \lambda_i \eta)\rho_{t+1}^i$ for $t < 3$. The difference between these probabilities in each state of the world is denoted by $\Delta\rho_t \equiv \rho_t^H - \rho_t^L$. Since the probability of arrival of a new behavioral plaintiff is higher when the scope of the accident is large than

[8]This problem is discussed in more in detail in Che and Spier [2008].

[9]This condition ensures that the marginal cost for the defendant of an additional plaintiff joining the litigation is always higher when the scope of harm is high than when it is low. If this assumption is violated, for some choices of η no separating equilibrium exists, but there are multiple pooling equilibria satisfying the D1 criterion.

when the scope is low, the case is filed by a strategic plaintiff only when he assigns sufficiently large probability to the scope of the harm being high.

When the case is filed the defendant would like to achieve a settlement with a high probability at a low offer. Naturally, the offers a strategic plaintiff is willing to accept depend on his belief about the state of the world. In particular, if the plaintiff believes that the scope of the harm is low, he is willing to accept a relatively low offers. As a result, the defendant always has an incentive to pretend that the scope of the harm is low. However, in equilibrium, a plaintiff can recognize the scope of the harm based on the offer made by the defendant. Since when the scope of the harm is low the defendant does not expect many future litigants to arrive, her expected cost of failing to achieve a settlement is small compared to the defendant of a high type. Hence, she is more willing to risk a rejection of her offer. To be precise, in equilibrium the defendant of each type makes an offer exactly compensating the expected payoff of the plaintiff in the realized state of the world. The plaintiff always accepts the offer coming from the high-type defendant, but he rejects the offer coming from the low-type defendant with some positive probability.

The outcome of the litigation strongly depends on the plaintiff's prior μ. A strategic plaintiff can anticipate the outcome of the negotiation, he realizes that he will always be compensated for his expected payoff under litigation. Hence, if a strategic plaintiff does not hold a strong belief that the scope of the harm is high, he will decide to drop the case, unless there are previous litigants. In order to simplify the exposition we describe the decision of the strategic plaintiff in terms of the likelihood ratio l_{t,h_t}:

$$l_{t,h_t} \equiv \frac{\mu_{t,h_t}}{1-\mu_{t,h_t}}. \tag{63}$$

To be precise, a strategic plaintiff arriving in period $t < 3$ and observing some history $h_t = (0, n_t)$ files the case only if the likelihood ratio of his beliefs is above a threshold $\check{l}_t$:

$$\check{l}_t \equiv \frac{\frac{f}{w} - \rho_t^L}{\rho_t^H - \frac{f}{w}}. \tag{64}$$

The numerator of (64) represents the expected payoff of the plaintiff if the scope of the harm is low, and the denominator the expected payoff of the plaintiff if the scope of the harm is high. Note that, $\check{l}_1$ can be negative for some parametrizations of the model, but $\check{l}_2$ is always positive. That is, it can be that the first-period plaintiff files the case independently of his beliefs, but the second-period plaintiff always decides to do so only if he assigns a sufficiently high probability to the scope of the harm being high.

Since the plaintiff arriving in the first period can face only one history, that is, his own arrival, it is easy to see that he will always decide to file the case if and only if the likelihood ratio of the prior ($l \equiv \frac{\mu}{1-\mu}$) is above a threshold $\hat{l}$:

$$\hat{l} \equiv \frac{\lambda_L}{\lambda_H}\check{l}_1. \tag{65}$$

However, the second-period strategic plaintiff's decision may depend on the history. Naturally, if the prior value is sufficiently low, the second-period strategic plaintiff will always decide to drop the case unless $k_2 = 1$. To be precise, if a second-period strategic plaintiff finds it unlikely that the scope of the harm is high even after observing an arrival in period 1, he never starts a litigation. In other words, if l is below a threshold $\underline{l}$ the second-period strategic plaintiff never files the case, unless $k = 1$, for:

$$\underline{l} \equiv \frac{\lambda_L^2}{\lambda_H^2}\check{l}_2. \tag{66}$$

Analogously, if the prior is sufficiently high, the second-period plaintiff always files the case. To be precise, the prior must be high enough for the plaintiff to believe that the case is worth litigation, even if he observes only his own arrival. In other words, if the likelihood ratio of the prior is above a threshold $\bar{l}$, the second-period plaintiff always files the case, for:

$$\bar{l} \equiv \frac{\lambda_L(1-\lambda_L)}{\lambda_H(1-\lambda_H)}\check{l}_2. \tag{67}$$

Note that $\bar{l} > \hat{l}$, that is, if the second-period plaintiff always files the case, then a first-period plaintiff also always files the case. However, the relation between $\underline{l}$ and $\hat{l}$ depends on the particulars of the model. If λ_L is sufficiently close to λ_H, then $\underline{l} > \hat{l}$. That is, there exists a range of priors for which the first-period plaintiff always starts the litigation, but a second-period plaintiff never does. It happens whenever information about the scope is less relevant than the amount of periods during which a behavioral plaintiff may arrive. Whenever λ_H and λ_L are far apart $\underline{l} < \hat{l}$. Naturally, in this situation the second-period plaintiff may observe $h_2 = (0, 0)$ even when a plaintiff arrived in the first period, but decided not file the case. Hence, the beliefs of the second-plaintiff observing a history $h_2 = (0, 0)$ are higher if $l < \underline{l}$, than if $l \geq \underline{l}$. However, they are never high enough for the strategic plaintiff in the second period to start a litigation.

The prior influences not only the decision of a strategic plaintiff to file the case, but also the probability of the settlement negotiation failing. In particular, the probability of rejecting the low offer in the first period depends on the prior level. It happens because in any PBE satisfying the D1 criterion, the probability of the rejection of a low offer is just high enough to ensure that the defendant of a high type prefers certain settlement at the high offer to risking litigation and making a low offer. When the prior is low, the threat of litigation is more efficient in the first period, since without a past litigant a second-period plaintiff will not file the case. Hence, the probability of rejection of the low offer is smaller. To be precise, we denote by $\underline{p}_{1,0}$ the probability of rejecting the low offer in the first period, which makes the defendant of the high type indifferent between making the high and low offer when the second-period strategic plaintiff never starts the litigation:

$$\underline{p}_{1,0} \equiv \frac{\Delta\rho_1}{\Delta\rho_1 + 2\lambda_H(1-\lambda_H\eta)}. \tag{68}$$

Analogous probability, when the second-period strategic plaintiff always files the case is denoted by $\bar{p}_{1,0}$:

$$\bar{p}_{1,0} \equiv \frac{\Delta\rho_1}{\Delta\rho_1 + 2\lambda_H(1-\lambda_H\eta) - \lambda_H^2\eta(1-\eta)}. \tag{69}$$

The equilibrium is described in detail in Proposition 3.2.

Proposition 3.2. *In any PBE equilibrium satisfying the D1 criterion, when only public settlements are available and $k_t > 0$, a strategic plaintiff files the case independently of the period. After the case is filed, the defendant makes an offer $s_{t,k=1} = w$, which is always accepted by the strategic plaintiff.*
If $k_t = 0$:

(i) a strategic plaintiff arriving in period 3 never files the case,

(ii) a strategic plaintiff arriving in period $t = 1, 2$ files the case if and only if $l_{t,h_t} \geq \check{l}_t$. After the case is filed the defendant makes an offer $s^i_{t,0} = \rho^i_t w$. The offer $s^H_{t,0}$ is always accepted by the strategic plaintiff, but the offer $s^L_{t,0}$ is rejected with probability $p_{t,0}$, where $p_{2,0} = \frac{\Delta\rho_2}{\Delta\rho_2+\lambda_H}$; $p_{1,0} = \underline{p}_{1,0}$, if $l \geq \bar{l}$, and $p_{1,0} = \bar{p}_{1,0}$ otherwise.

3.3.3 Asymmetric information with endogenous secrecy regime

In this subsection we allow for the secrecy regime to be endogenously determined. That is, while making an offer the defendant chooses not only a transfer size (s_t) but also decides whether the potential settlement will be public (ζ_t).

Allowing for private settlements does not influence the decision of the plaintiff in the final period, since he does not face any uncertainty about the payoff. Hence, a strategic plaintiff in period 3 files the case if and only if at least one previous litigant is observed, and always settles it at w. Since the decision of the plaintiff in the final period is independent from the scope of the harm, but depends only on the number of litigants, the choice of secrecy regime in period 2 is irrelevant. From the perspective of the defendant, whether the settlement is private or public is irrelevant, it is only relevant that it is reached.

However, the decision on the privacy regime in the initial period plays an important role. The strategic plaintiff in period 2 starts the litigation only if he assigns sufficiently high probability to the scope of the harm being high. Hence, the defendant profits when the scope of the harm appears to be low.

Naturally, the choice of the privacy regime matters only for some range of prior beliefs. If the prior is very low ($l < \underline{l}$), the second-period strategic plaintiff never starts the litigation. Analogously, if the prior is sufficiently high ($l \geq \bar{l}$), the second-period plaintiff always files the case. However, in-between these extremes there is a potential to influence the decision of the second-period plaintiff through the secrecy regime.

Yet, in equilibrium, any attempt to change the behavior of the second-period plaintiff must fail. In other words, if the secrecy regime is endogenous, the decision of the second period plaintiff must be independent from observing a previous settlement (that is, it must be independent from the realization of n_2). To illustrate why this must be the case, suppose that the strategic plaintiff in the second period starts the litigation if and only if he observes a previous arrival. Naturally, the high-type defendant would then always settle the case privately, in order to limit future litigation. In contrast, the low-type defendant would always make a public settlement offer. Since she faces a low probability of any subsequent plaintiff arriving, the possibility of the case being filed in the second period is not very costly for her. Therefore, she would prefer to signal her type to the first-period plaintiff and ensure a certain settlement through choosing a public settlement. However, if only the low-type defendant settles the case publicly in the first period, the second-period plaintiff would never file the case after observing $n_2 = 1$.

Since a second-period plaintiff never conditions his decision on observing a settlement in a previous period, his behavior depends on the prior belief even more than in the model with only public settlements available. If he holds a high enough prior, he will always file the case in the second period. We refer to this type of an equilibrium as a *high-litigation equi-*

librium. On the contrary, if the prior is low, the second-period strategic plaintiff never starts the litigation. We refer to this type of an equilibrium as a *low-litigation equilibrium*. The prior threshold above which the second-period plaintiff always files the case depends on the first-period negotiation process itself. In particular, it is influenced by the probability with which the first-period strategic plaintiff rejects the low offer. The higher this probability is the less likely it is that the defendant manages to achieve a settlement when the scope of the harm is low. Hence, the second-period plaintiff holds a stronger belief that the lack of litigants results from a successful settlement with a high-type defendant and is more willing to start the litigation. To be precise, if the probability of rejecting the low offer during the first-period negotiation is p, then the second-period strategic plaintiff always files the case if and only if $l \geq \tilde{l}(p)$, and never starts the litigation otherwise, for

$$\tilde{l}(p) \equiv \check{l}_2 \frac{\lambda_L\big(1 - \lambda_L\eta - p\lambda_L(1-\eta)\big)}{\lambda_H\big(1-\lambda_H\eta\big)}. \tag{70}$$

The equilibrium is described in detail in Proposition 3.3.

Proposition 3.3.

(a) If $l \leq \tilde{l}(\underline{p}_{1,0})$ there exists a PBE satisfying the D1 criterion called a low-litigation equilibrium, in which:

(i) If $k_t > 0$ any strategic plaintiff always files the case. After the case is filed the defendant makes an offer with a monetary transfer $s_{t,k=1} = w$, which is always accepted by the plaintiff.

(ii) A strategic plaintiff arriving in the first period files the case if and only if $l \geq \check{l}_1$. After the case is filed, the defendant makes an offer with a transfer $s^i_{1,0} = \rho^i_1 w$. The offer $s^H_{1,0}$ is always accepted by the strategic plaintiff, and the offer $s^L_{1,0}$ is rejected with probability $\underline{p}_{1,0}$.

(iii) If $k_t = 0$, a strategic plaintiff arriving in the second or third period never files the case.

(b) If $l \geq \tilde{l}(\bar{p}_{1,0})$ there exists a PBE satisfying the D1 criterion called a high litigation equilibrium, in which:

(i) If $k_t > 0$ any strategic plaintiff always files the case. After the case is filed the defendant makes an offer with a monetary transfer $s_{t,k=1} = w$, which is always accepted by the plaintiff.

(ii) If $k_t = 0$ a strategic plaintiff arriving in the first or second period always files the case. After the case is filed, the defendant makes an offer with a transfer $s^i_{t,0} = \rho^i_t w$. The offer $s^H_{t,0}$ is always accepted by the strategic plaintiff, and the offer $s^L_{t,0}$ is rejected with probability $p_{t,0}$, where $p_{1,0} = \bar{p}_{1,0}$, and $p_{2,0} = \frac{\Delta\rho_2}{\Delta\rho_2+\lambda^H}$.

(iii) If $k_3 = 0$ a strategic plaintiff in the third period never files the case.

No other PBE satisfying the D1 criterion, in which the decision of a strategic plaintiff on whether to file the case is binary, exists.

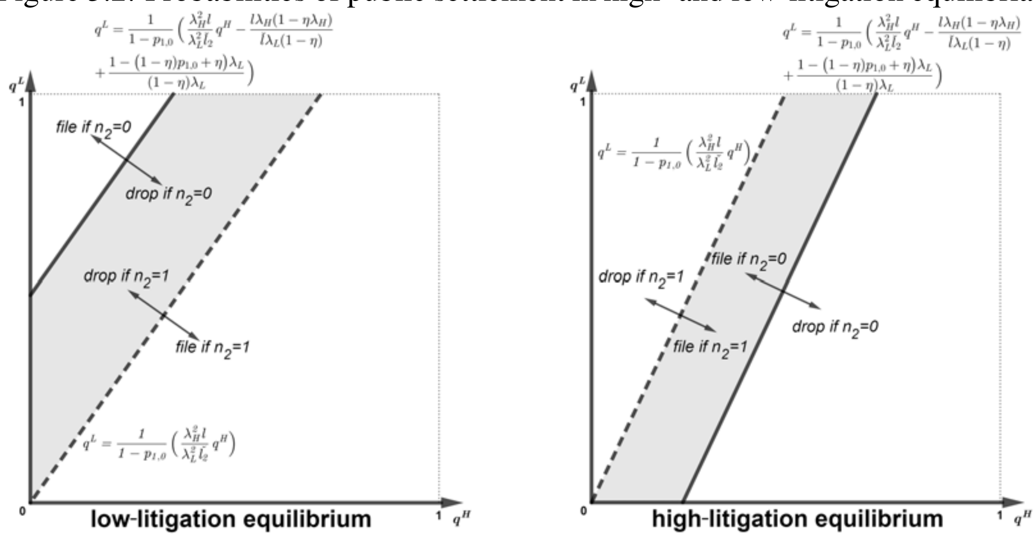
The exact choice of secrecy regime cannot be pinned down in equilibrium. To be precise, any pair of probabilities of making a public settlement offer by each type of defendant in period 1 can be sustained as an element of some PBE satisfying the D1 criterion, as long as the decision of the second-period plaintiff is unaffected by the choice of the secrecy regime in the first period. Figure 3.2 presents a set of pairs of probabilities (q^H,q^L) of proposing a public settlement that can be an element of an equilibrium. In particular, a decision to always settle the case secretly can always be supported as an element of the equilibrium. It implies that introducing the possibility of settling the case privately is equivalent in terms of payoffs to allowing only secret settlements. This result is summarized in Corollary 3.2.

Corollary 3.2. *Any PBE satisfying the D1 criterion of the game with endogenous secrecy regime is payoff-equivalent to some PBE satisfying the D1 criterion of the game in which only secret settlements are available.*

Importantly, Corollary 3.2, does not state that only secret settlements have to be used on the equilibrium path. For example, there always exists an equilibrium in which the defendant of at least one type always settles the case publicly. Yet, if secret settlements are available observing the history of the past settlements never changes the decisions of the plaintiffs, and they behave as if all the settlements had been secret.

Note that $\tilde{l}(\bar{p}_{2,0}) < \tilde{l}(\underline{p}_{2,0})$, and there is a region of prior values for which the low- and high-litigation equilibra coexist. Naturally, in this region there also exist equilibria in which the second period strategic-plaintiff starts the litigation with any probability. To simplify the analysis, we focus only on the equilibria in which the decision to file the case is binary. The multiplicity can be seen as an example of "self-fulfilling prophecy." Suppose that the agents during the first-period negotiation conjecture that a second-period plaintiff always files the case. Then, the probability of

Figure 3.2: Probabilities of public settlement in high- and low-litigation equilibria



rejecting a low offer must be high, in order to prevent the high-type defendant from making it. Hence, it becomes unlikely that the low-type defendant ensures a settlement in period 1, and the second-period plaintiff assigns larger probability to the scope of the harm being high whenever he observes no previous litigants (that is, $k_2 = 0$). As a result, he always files the case and the conjecture of the agents in the first period is correct. On the contrary, if the agents during the first-period negotiation believe that a second-period strategic plaintiff never starts the litigation, the probability of rejecting the low offer can be small. As a result the second-period plaintiff finds it likely that observing no litigants follows from the low-type defendant settling the case in the previous period. Hence, he indeed does not file the case.

Figure 3.2 presents the decision of a second-period strategic plaintiff as a function of probabilities with which the defendant of each type proposes a public settlement (q^H, q^L). The dashed line going through the origin represents the ratio of q^H and q^L for which a second-period strategic plaintiff is indifferent between filing and dropping the case if a public settlement in the first period is observed. For all the combinations of q^H to q^L to the south-east of the dashed line the high-type defendant is relatively more likely to settle the case publicly than the low-type defendant and a second-period plaintiff always files the case after observing a public settlement. The opposite is the case for points north-west of the dashed line. Analogously, the solid line represents the combinations of q^H and q^L for which a second-period strategic plaintiff is indifferent between filing and dropping the case if he observes no previous arrival. Now, moving to the north-west would result in the plaintiff always filing the case upon observing no arrival, and moving to the south-east in always dropping the case in this situation. Since in the equilibrium the decision of a second-period strategic plaintiff must be independent from realization of n_2, only the strategies represented by the shaded area in-between the solid and the dashed lines can be supported as a part of some equilibrium. When the solid line is above the dashed line (as in the left graph) there exist low-litigation equilibria. When the opposite is true (as in the right graph) there exist high-litigation equilibria.

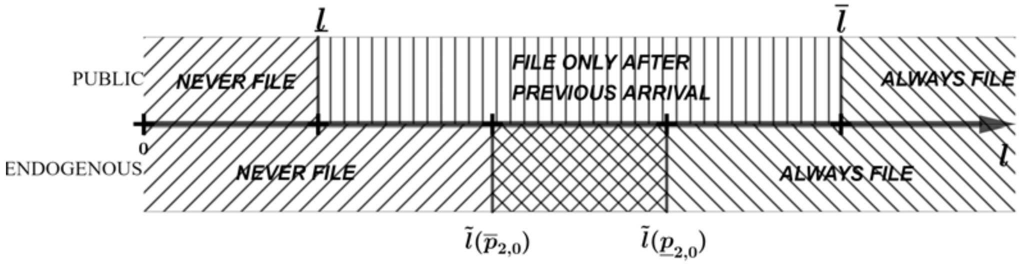
Figure 3.3 presents the comparison of a second-period strategic plaintiff's decision in two versions of the model. The upper part of the figure represents the decision of a second-period strategic plaintiff when all the settlements are public, and the lower part of the figure represents this decision when the secret settlements are available. Naturally, if $l \leq \max\{\hat{l}, \underline{l}\}$, (that is, the second-period strategic plaintiff never starts litigation even when all the settlements are public), or if $l \geq \bar{l}$ (that is, the second period plaintiff always files the case even when all the settlements are private), the equilibrium path and the payoffs of the players remain unchanged. However, in-between these extremes the outcome of the game changes. To be precise, when all settlements are public a second-period strategic plaintiff conditions his decisions on the realization of n_2, whereas if private settlements are available he always takes the same decision. In particular, when $l < \tilde{l}(\bar{p}_{2,0})$ he never starts the litigation, and when $l > \tilde{l}(\underline{p}_{2,0})$ she always starts the litigation. For values of $l \in [\tilde{l}(\bar{p}_{2,0}), \tilde{l}(\underline{p}_{2,0})]$ both behaviors can be supported as part of the equilibrium path.

The effect of availability of the secret settlements on the payoffs of the player strongly differ between the low- and high-litigation equilibria. We begin by analyzing the first case.

In the low-litigation equilibrium, the defendant gains on introducing the possibility of settling the case. There is a direct effect of a strategic plaintiff in the second period never starting the litigation. Due to it, the defendant never has to pay the compensation to him or litigate against him. Moreover, there is also an indirect effect of the change in the behavior of a second-period plaintiff on the negotiation process in the first period. In particular, a first-period plaintiff accepts a low offer with a higher probability. Hence, the defendant also gains on limiting the probability of the litigation in the first period.

A plaintiff in the first period remains unaffected by introducing the possibility of settling the case secretly. However, a second-period plaintiff

Figure 3.3: Comparison of the decisions of the strategic plaintiff in period 2 if $k_2 = 0$.



loses with it. Firstly, both a strategic and a behavioral plaintiff are less likely to face a previous litigant. Secondly, a strategic plaintiff now has less information to evaluate the scope of the harm. Thus, it happens more often that he drops the case even though the scope of the harm is high. Also, a plaintiff in the final period of the game looses on introducing the possibility of settling the case secretly. Since the negotiation in the first period fails less often, and a second-period strategic plaintiff never even files the case, a plaintiff in the final period is less likely to face previous litigants and obtain a compensation from the defendant.

In contrast, in the high-litigation equilibrium the defendant would be better off if he could commit to always settling the case publicly. Then, a second-period strategic plaintiff could always distinguish a history in which there was a previous arrival from a history in which no arrival happened, and he will file the case only in the first scenario. However, if the privacy regime is endogenous when the defendant faces a strategic plaintiff in the first period, it is tempting for her to settle the case privately. Hence, a plaintiff in the second period cannot distinguish between the histories with sufficient precision and he always files the case.

Similarly to the low-litigation equilibrium a first-period plaintiff is not affected by endogenizing the secrecy regime in high-litigation equilibrium, but a second-period strategic plaintiff loses when secret settlements are allowed. He receives less information through observing the history, and more often files the case in the low state of the world. Interestingly, both the strategic and the behavioral plaintiff in the final period of the game are better off when secret settlements are allowed. Since a second-period plaintiff is more likely to file the case conditional on the scope of the harm being low, the negotiation in the second period fails more often and a plaintiff in the final period is more likely to face a previous litigant. The changes in the *a priori* expected payoffs of the players are presented in Table 3.1. To simplify the expressions we denote the difference in the probability of rejection of the low offer in the first period in high- and low-litigation equilibria by $\Delta p_{1,0} \equiv \frac{\Delta\rho_1}{\Delta\rho_1+2\lambda_H(1-\lambda_H\eta)-\lambda_H\eta(1-\eta)} - \frac{\Delta\rho_1}{\Delta\rho_1+2\lambda_H(1-\lambda_H\eta)}$.

3.4 Conclusion

We study the dynamics of settlement negotiations between a privately-informed defendant and several potential plaintiffs arriving over time. We propose a model in which a defendant faces the random arrival of plaintiffs over three periods. In each period, one plaintiff can arrive with some exogenous probability known to the defendant but not the plaintiffs. The outcome of the litigation depends on the number of plaintiffs in the litigation, in particular, we assume that there is a minimal number of plaintiffs required for the litigation to be successful. We suppose that there are two types of plaintiffs. A behavioral plaintiff always litigates, and a strategic plaintiff decides on whether to file the case, and then negotiates a settlement with the defendant.

We show that if the fraction of behavioral plaintiffs is low, the mere capability of the defendant to pay off future plaintiffs is enough to prevent any filing from strategic plaintiffs. However, if the fraction of behavioral plaintiffs is sufficiently high, the strategic plaintiffs will file the case. Moreover, pre-trial negotiations with strategic plaintiffs may fail, and the collective litigation can succeed. Additionally, we study the effects of private settlements in this context. We show that introducing a possibility of settling the case privately is equivalent in terms of payoffs to only secret settlements being present. When the case can be settled privately, some plaintiffs receive less information and it becomes more difficult for them to learn about the scope of the harm. In particular, the plaintiffs do not change their decision on whether to file a case based on the history of past settlements. Importantly, the defendant gains in the availability of private settlements when the plaintiffs hold a low prior about the arrival rate, but loses with it in the opposing scenario.

Several extensions are left for future research. First, it is relevant to verify the robustness of the model when there are more than three periods and the litigation payoff is strictly increasing in the amount of litigants. From our early results we conjecture that, in this setting, the negotiations are more likely to fail in the late periods of the game. However, in the early periods of the game only pooling equilibria exist and the settlement can always be reached. On one hand, it suggests that the collective litiga-

Table 3.1: Payoff changes after allowing for secret settlements

	Low-litigation equilibrium	**High-litigation equilibrium**
2nd period behavioral plaintiff	$-\Delta p_{1,0}\lambda_L(1-\eta)^2 w < 0$	0
2nd period strategic plaintiff	$-\mu\lambda_H(1-\eta)(\rho_H^2 w - f)$ $-(1-\mu)\lambda_L\Delta p_{1,0}(w-f)$ $+(1-\mu)\lambda_L(1-\eta)(1-\bar{p}_{1,0})(f-\rho_L^2 w) < 0$	$\mu(1-\lambda^H)(\rho_2^H w - f)$ $-(1-\mu)(1-\lambda_L)(f-\rho_2^L w) < 0$
3rd period behavioral plaintiff	$-\Big((\Delta p_{1,0}\lambda_L(1-\eta)(1-\lambda_L\eta)$ $+\big(\lambda_L(1-\eta)\big)^2(1-\bar{p}_{1,0})p_{2,0}\Big)w < 0$	$(1-\mu)(1-\lambda_L)\lambda_L p_{2,0} w > 0$
3rd period strategic plaintiff	$-\Big((\Delta p_{1,0}\lambda_L(1-\eta)(1-\lambda_L\eta)$ $+\big(\lambda_L(1-\eta)\big)^2(1-\bar{p}_{1,0})p_{2,0}\Big)(w-f) < 0$	$(1-\mu)(1-\lambda_L)\lambda_L(1-\eta)p_{2,0}(w-f) > 0$
defendant	$\mu\big(\lambda_H(1-\eta)\big)\rho_2^H w$ $+(1-\mu)\lambda_L(1-\eta)\Big(\Delta p_{1,0}(2\lambda_L(1+\eta)-(\lambda_L\eta)^2-\rho_1^L)$ $+(1-\bar{p}_{1,0})\lambda_L(1-\eta)\lambda_L(\eta+p_{2,0})\Big)w > 0$	$-\mu(1-\lambda_H)\lambda_H(1-\eta)\rho_2^H w$ $-(1-\mu)(1-\lambda_L)\lambda_L(1-\eta)(\rho_2^L w + p_{2,0}\lambda_L w) < 0$

tion is strongly driven by the behavior of the late plaintiffs. On the other hand, it implies that the effect of secret settlements is especially relevant in the early period, since the observed history influences both the decision on whether to file the case and the outcome of the negotiation. Second, in our analysis we ignore the role of attorneys. In fact, our model suggests that the attorneys may play a much more relevant role in collective litigation than in individual litigation. In particular, apart from providing their services and expertise, they may limit the ability of the defendant to exploit the plaintiffs through sequential settlements by joining the cases and handling the negotiation on behalf of multiple litigants.

Appendix A

Negotiations, Expertise and Strategic Misinformation

A.1 Existence proofs

A.1.1 Out-of-equilibrium beliefs

As mentioned in the body of the chapter, I disregard babbling equilibria if communication is possible. To impose that condition and simplify the notation I focus on equilibrium in which the attorney makes a recommendation $r = 1$ if he prefers the settlement and $r = 0$ if he prefers trial.[1]

Refinement A.

$$s_n y > (s_n + s_t)x - t^a + f_t \ \Rightarrow\ r(x, y) = 1 \tag{71}$$

$$s_n y < (s_n + s_t)x - t^a + f_t \ \Rightarrow\ r(x, y) = 0 \tag{72}$$

Additionally, in this subsection, I propose a simple rule in which the plaintiff could form her beliefs out-of-equilibrium path. If this rule is followed the defendant-preferred equilibrium are unique – however they exist also for other out-of-equilibrium beliefs.

Firstly, on an out-of-equilibrium path the plaintiff should realize that the attorney always makes the recommendation in accordance with his preferences, thus she can asses a positive probability only for the liability values for which the plaintiff would be willing to make the observed recommendation (r) given the observed offer (y).

[1] As in any cheap-talk game this convention can be reversed for all or some offers, as long as both agents agree on the meaning of the message.

Secondly, I assume that the beliefs of the plaintiff follow the intuitive criterion (Cho and Kreps, 1987). In other words, observing some unexpected offer, the plaintiff should believe that it would have never been made if there had existed a lower offer that would have been accepted, or the defendant would have been better off under the trial than under the settlement at the observed offer.

If the two conditions are satisfied and the plaintiff observes some out-of-equilibrium (y, r) then she assigns a positive probability only to the liability values that belong to the set $\mathbf{X}(\mathbf{y}, \mathbf{r})$ defined as follows:

$$\mathbf{X}(\mathbf{y}, \mathbf{r}) \equiv \{x \in [0, \overline{x}] \mid r(x, y) = r \text{ and } p\big(y', r(x, y')\big) = 0 \; \forall y' < y\}. \tag{73}$$

Finally, I suppose that the plaintiff makes use of the information that liability values are uniformly distributed and assigns an equal probability to each realization in $\mathbf{X}(\mathbf{y}, \mathbf{r})$.

This way of forming beliefs can be seen as a simple rule of thumb used by the plaintiff. She only needs to be capable of recognizing what is the best case and worst case scenario liability value and computing the average between these two scenarios.

The beliefs must also be specified for "impossible scenarios," i.e., $\mathbf{X}(\mathbf{y}, \mathbf{r}) = \emptyset$. This situation happens either when the offer is unreasonably high or when the recommendation is positive despite the offer being extremely low. The choice of beliefs of the plaintiff in these cases does not influence the equilibrium path and is purely a matter of convention. I simply suppose that the plaintiff believes that the defendant is behaving as if the information was complete.

These conditions are summarized in refinement B.

Refinement B. *Suppose the plaintiff faces some out-of-equilibrium pair (y, r) then her beliefs are:*

$$F^p(x; y, r) \text{ s.t. } x \sim U\big(\mathbf{X}(\mathbf{y}, \mathbf{r})\big) \qquad \text{if } \mathbf{X}(\mathbf{y}, \mathbf{r}) \neq \emptyset, \tag{74}$$

$$F^p(x; y, r) \text{ s.t. } P[\min\{\frac{(1-s_n)y + f_t}{1 - s_n - s_t}; \overline{x}\}|y, r] = 1 \qquad \text{if } \mathbf{X}(\mathbf{y}, \mathbf{r}) = \emptyset. \tag{75}$$

Refinement B uniquely specifies the plaintiff's out-of-equilibrium beliefs for any strategy profile.[2]

[2] With the exception of out-of-equilibrium beliefs for (y, r) s.t. $X(y, r) = \emptyset$ and $(1 - s_n)y + f_t = (1 - s_n - s_t) = 0$ where term (6) is not well defined. However, since this situation is based on the plaintiff being indifferent between any two offers, and the undefined beliefs are associated with "impossible scenarios" the choice of beliefs is irrelevant.

Existence of equilibrium described in Proposition 1.1
Existence of equilibrium described in Proposition 1.1 is proved in claims 1 – 3.

Claim 1. *There is no profitable deviation for the defendant, given the strategies of the attorney and the plaintiff.*

First, observe that making an offer higher than a candidate equilibrium offer $y(x)$ cannot be a profitable deviation for the defendant. It would necessarily be accepted and would yield a lower payoff.

Second, observe that making a lower offer than a candidate equilibrium offer $y(x)$ cannot be a profitable deviation. Such an offer would necessarily be rejected, leading to trial. Indeed, if the defendant makes an offer $y' < y(x)$, then $r(y', x) = 0$ (since $\sigma^a(C) = \sigma^p(C)$) and $p(y, r) = 0$, leading to the payoff of $-x - t^d < -y(x)$ to the defendant.

Claim 2. *At any pair (x, y) there is no profitable deviation for the attorney, given the strategy of the plaintiff.*

The proof is a consequence of the fact that the plaintiff always follows the attorney's recommendation and the attorney makes a recommendation in accordance with his own preferences, thus there cannot be any profitable deviation for the defendant.
Suppose (y, x) is s.t. $r(y, x) = 1$, but the attorney deviates and recommends $r' = 0$. Then, if $y < \overline{x} - t^d$, the plaintiff's response is $p(y, r') = 0$ and the payoff of the attorney is $s_n x + f_t + f_n - c - t^a \leq s_n y - c$. If, $y \geq \overline{x} - t^d$, then the plaintiff's response is $p(y, r) = 1$ and the payoff of the attorney is $s_n y - c = s_n y - c$.
Suppose (y, x) is s.t. $r(y, x) = 0$, but the attorney deviates $r' = 1$. Then $p(y, r') = 1$ and the payoff of the attorney is $s_n y - c \leq s_n x + f_t + f_n - c - t^a$. The plaintiff, following the Bayes' rule and refinement B, must have the following beliefs:

(i) If the plaintiff observes some $(y \leq \overline{x} - \sigma^p(C), r = 1)$, then using the Bayes' rule the plaintiff believes that $P(x = y - \sigma^p(C)|y, r] = 1$.

(ii) If the plaintiff observes some $(y > \overline{x} - \sigma^p(C), r = 1)$, then using refinement B the offer falls into "the impossible scenario case" $\mathbf{X}(y, r) = \emptyset$ and the beliefs of the plaintiff are such that $\mathbb{E}^p[x|y, r] \leq \overline{x} - \sigma^p(C)$.

(iii) If the plaintiff observes some $(y < \overline{x} - \sigma^p(C), r = 0)$ then using refinement B it is enough for the plaintiff to realize that for the attorney to make a negative recommendation $x = y - \sigma^p(C)$ in the best case scenario. So $F_p(x|y,r) = U([y - \sigma^p(C); \overline{x}])$ and the expectations of the plaintiff are such that $\mathbb{E}^p[x|y,r] > y - \sigma^p(C)$.

(iv) If the plaintiff observes $(y = \overline{x} - \sigma^p(C), r = 0)$, then the offer again falls into "the impossible scenario" $\mathbf{X}(y,x) = \emptyset$ and therefore by refinement B the beliefs of the plaintiff satisfy $\mathbb{E}^p[x|y,r] = y - \sigma^p(C)$.

Claim 3. *At any pair (x, y) there is no profitable deviation for the plaintiff, given her beliefs.*

It is always the best response for the plaintiff to accept the offer if she believes it at least compensates her payoff under the trial:

$$p^{BR}(y,r) = \begin{cases} 1 & \text{if } \mathbb{E}^p[x|y,r] \leq y - \sigma^p(C) \\ 0 & \text{if } \mathbb{E}^p[x|y,r] > y - \sigma^p(C). \end{cases} \tag{76}$$

Now, by substituting for $\mathbb{E}^p[x|y,r]$ from the beliefs of the plaintiff derived above:

$$p^{BR}(y,r) = \begin{cases} 1 & \text{if } y \geq \overline{x} - \sigma^p(C) \\ r & \text{if } y < \overline{x} - \sigma^p(C). \end{cases} \tag{77}$$

Thus, $p(y,r) = p^{BR}(y,r)$.

Existence of equilibrium described in Proposition 1.2

Existence of equilibrium described in Proposition 1.2 is proved using claims 4 – 6.

Claim 4. *There is no profitable deviation for the defendant, given the strategies of the attorney and the plaintiff.*

Note that making any offer greater than a candidate equilibrium offer cannot be a profitable deviation – such an offer would always be accepted and would thus yield a lower payoff.

(i) If $y' < \dot{y}$, then $r(x, y') = 1$, thus $p(y', r) = 1$ and the defendant's payoff is $-y' < -y(x)$.

(ii) If $y' \geq \dot{y}$, then $p(y', r) = 1$ despite the recommendation and the defendant's payoff is $-y' < -y(x)$.

Now, observe that also making any offer lower than a candidate equilibrium offer is not a profitable deviation. It would always be rejected, yielding a (weakly) smaller trial payoff. Suppose the defendant indeed makes

some deviation $y' < y(x)$.
Firstly, observe that then $y' < \dot{y}$.
Since $y' < y(x)$, then $r(x, y') = 0$ and since $y' < \dot{y}$, then $p(y', r) = 0$ thus the payoff of the defendant is: $-x - t^d \geq -y(x)$.

Claim 5. *At any (x, y) there is no profitable deviation for the attorney, given the strategy of the plaintiff.*

Analogously as in the proof of Proposition 1.1, the proof of this Claim is a direct consequence of the fact that the attorney always makes a recommendation in accordance with his own preferences. If the plaintiff follows the recommendation, there clearly cannot be a profitable deviation for the attorney. However, for offers $y \geq \dot{y}$, the attorney's recommendation is actually ignored. Yet, still there cannot be any profitable deviation for the defendant, since his recommendation is simply irrelevant.

Claim 6. *At any (y, r) there is no profitable deviation for the plaintiff given her beliefs.*

It is always the best response of the plaintiff to accept the offer if she believes it at least compensates her payoff under the trial:

$$p^{BR}(y, r) = \begin{cases} 1 & \text{if } \mathbb{E}^p[x|y, r] \leq y - \sigma^p(C) \\ 0 & \text{if } \mathbb{E}^p[x|y, r] > y - \sigma^p(C). \end{cases} \tag{78}$$

Now I analyze the beliefs of the plaintiff for any (y, r).

(i) If the plaintiff observes some $(y > doty, r = 0)$, then the case falls into " the impossible scenario" category, i.e., $\mathbf{X}(y, r) = \emptyset$ and so the beliefs of the plaintiff must satisfy $\mathbb{E}^p[x|y, r] \leq y - \sigma^p(C)$.

(ii) If the plaintiff observes $(y = \dot{y}, r = 0)$, then using the Bayes' rule the plaintiff recognizes that the offer is made for all liability values $x \in (\dot{y} + \sigma^a(C); \overline{x}]$ and so her expectation must satisfy $\mathbb{E}^p[x|y, r] = y - \sigma^p(C)$.

(iii) If the plaintiff observes $(y = \dot{y}, r = 1)$, then using the Bayes' rule the plaintiff correctly recognizes that there is only one liability value $\dot{y} - \sigma^a(C)$ for which such an offer and such a recommendation could be made. Thus, the expectations of the plaintiff must satisfy $\mathbb{E}^p[x|y, r] < y - \sigma^p(C)$.

(iv) If the plaintiff observes $(y < \dot{y}, r = 1)$, then using the Bayes' rule he correctly recognizes that the offer is made by a type $y + \sigma^a(C)$, therefor the beliefs of the plaintiff must satisfy: $\mathbb{E}^p[x|y,r] < y - \sigma^p(C)$.[3]

(v) If the plaintiff observes $(y < \overline{y}, r = 0)$. Then, by refinement B, the plaintiff must believe that in the best case scenario $x = y + \sigma^a(C)$ and in the worst case scenario $x = \overline{x}$. Now, since $y < \dot{y}$, it must be the case that the beliefs of the plaintiff satisfy $\mathbb{E}^p[x|y,r] > y - \sigma^p(C)$.

Substituting the beliefs of the plaintiff into p^{BR} it occurs that $p(y,r) = p^{BR}(y,r)$.

Existence of equilibrium described in Proposition 1.4
Existence of equilibrium described in Proposition 1.4 is proved in claims 7 – 9.

Claim 7. *There is no profitable deviation for the defendant given the strategy of the plaintiff and the attorney.*

Firstly, observe that the defendant cannot benefit from increasing its offer. If the higher offer happens to be accepted, his payoff will be lower than under the candidate equilibrium offer $y(x)$. If the offer is rejected, the defendant also obtains a trial payoff, which is also (weakly) smaller than the settlement payoff under a candidate equilibrium offer. Suppose the defendant indeed makes some deviation $y' > y(x)$.

(i) If $y' \in \mathbf{Y}^*$, then recommendation of the attorney is such that $r(y', x) = 1$, and the plaintiff follows the recommendation ($p(y', r) = 1$), thus the payoff of the defendant is $-y' < -y(x)$.

(ii) If $y' > y_K$ then independently from the attorney's recommendation plaintiff accepts the offer ($p(y', r) = 1$), thus the payoff of the defendant is $-y' < -y(x)$;

(iii) If $y' \notin \mathbf{Y}^*$ and $y' < y_K$ then independently from the attorney's recommendation the plaintiff rejects the offer ($p(y', r) = 0$) and the payoff of the defendant is $-x - t^d \leq -y(x)$.

[3] Note that if the offer is so low that the attorney should never have recommended it, yet the plaintiff observes a positive recommendation by refinement B, then $\mathbb{E}^p[x|y,r] = y - \sigma^p(C)$. Also, if the offer is 0 it may be the case that using Bayes' rule the plaintiff cannot exactly determine the type of the defendant, yet the condition on the on the expectations of the plaintiff $\mathbb{E}^p[x|y,r] < y - \sigma^p(C)$ still holds.

Also, making a lower offer than the candidate equilibrium offer cannot benefit the defendant, since it would necessarily lead to a trial. Either because of a negative recommendation of the attorney or because the offer is not an element of a standard offer sequence.

Suppose the defendant indeed makes some deviation $y' < y(x)$.

(i) If $y' \notin \mathbf{Y}^*$, then independently from the recommendation of the attorney the plaintiff rejects the offer ($p(y', r) = 0$), and the payoff of the defendant is $-x - t^d \leq -y(x)$.

(ii) If $y \in \mathbf{Y}^*$, then the recommendation of the attorney is necessarily negative ($r(y, x) = 0$) and the plaintiff follows the recommendation ($p(y', r) = 0$). Thus, the payoff of the defendant is $-x - t^d < y(x)$.

Claim 8. *At any (x, y) there is no profitable deviation for the attorney given the strategy of the plaintiff.*

Analogously to the proof of Proposition 1.2, the attorney cannot have a profitable deviation, since the plaintiff either follows or ignores his recommendation.

Claim 9. *At any (y, r) there is no profitable deviation for the plaintiff given her beliefs.*

The proof is analogous as in Proposition 1.2. It is always the best response for the plaintiff to accept the offer if she believes it at least compensates her payoff under the trial:

$$p^{BR}(y, r) = \begin{cases} 1 & \text{if } \mathbb{E}^p[x|y, r] \leq y - \sigma^p(C) \\ 0 & \text{if } \mathbb{E}^p[x|y, r] > y - \sigma^p(C). \end{cases} \tag{79}$$

Now I analyze the beliefs of the plaintiff for any (y, r).

(i) If the plaintiff observes $(y > y_K, r)$, it is an example of " the impossible scenario" $\mathbf{X}(y, r) = \emptyset$, and by refinement B the beliefs of the plaintiff must satisfy $\mathbb{E}^p[x|y, r] \leq y - \sigma^p(C)$.

(ii) If the plaintiff observes $(y \in \mathbf{Y}^*, r = 1)$, then using the Bayes' rule the plaintiff correctly identifies that $x \in (x_k; x_{k+1}]$, [4] and thus the beliefs of the plaintiff satisfy $\mathbb{E}^p[x|y, r] \leq y - \sigma^p(C)$.

[4] Or $x \in [0, x_0)$,

(iii) If the plaintiff observes $(y < y_K, r = 0)$, then using the refinement B, just from the fact that recommendation is negative the plaintiff must realize that $x > y + \sigma^p(C)$, and so her beliefs must be such that $\mathbb{E}^p[x|y, r] > y - \sigma^p(C)$.

(iv) If the plaintiff observes $(y \notin \mathbf{Y}^*$ and $y < y_K, r = 1)$, then using the refinement B, she should believe that at best the liability value is just above the one for which the defendant could make a lower standard offer x_l where $l = \max\{k|y_k \in \mathbf{Y}^*$ and $y_k < y'\}$.[5], and at worst the liability value satisfies $x = y' + \sigma^a(C)$. Thus the beliefs of the plaintiff must satisfy the following condition $\mathbb{E}^p[x|y, r] > y - \sigma^p(C)$.

So substituting the plaintiff beliefs into the expression for p^{BR} it can be concluded that $p(x, y) = p^{BR}(x, y)$.

Existence of equilibrium described in propositions 1.3 and 1.5
Existence of equilibrium described in propositions 3 and 5 is proved in claims 10 – 12.

Claim 10. *There is no profitable deviation for the defendant given the strategies of the plaintiff and the attorney.*

Suppose the defendant makes a deviation $y' > y(x)$.

(i) If $y' \geq \dot{y}$, then independently from the recommendation of the attorney the plaintiff accepts an offer $(p(y', r) = 1)$ and the payoff of the defendant is $-y'$ which is smaller than both $-x - t^d$ if $x < \overline{y} - t^d$ and $-\dot{y}$.

(ii) If $y' < \dot{y}$, independently from the recommendation of the attorney, the plaintiff rejects $p(y', r) = 0$ and the payoff of the defendant is $-x - t^d = -x - t^d$.

Suppose the defendant makes some deviation $y' < y(x)$. Then, the decision of the plaintiff independently from her attorney's recommendation is to reject the offer $(p(y, x) = 0)$ and the payoff of the defendant is $-x - t^d \leq -\dot{y}$.

Claim 11. *At any (x, y) there is no profitable deviation for the attorney given the strategy of the plaintiff.*

[5] If this set is empty $l = 0$.

Since the attorney's recommendation is always ignored, he cannot have a profitable deviation from any strategy.

Claim 12. *At an (y, r) there is no profitable deviation for the plaintiff, given her beliefs*

Any strategy of the plaintiff that satisfies the following conditions is her best response:

(a) $\mathbb{E}^p[x|y, r] > y - \sigma^p(C) \Rightarrow p = 0$,

(b) $\mathbb{E}^p[x|y, r] < y - \sigma^p(C) \Rightarrow p = 1$.

Now I analyze the plaintiff's beliefs under each possible pair (y, r).

(i) If the plaintiff observes some $(y > \dot{y}, r)$, then by refinement B her beliefs must satisfy $\mathbb{E}^p[x|y, r] \leq y - \sigma^p(C)$.

(ii) If the plaintiff observes some $(y = \dot{y}, r = 0)$, then by the Bayes' rule her expectations must satisfy: $\mathbb{E}^p[x|y, r] = y - \sigma^p(C)$.

(iii) If the plaintiff observes some $(y \in (0, \dot{y}), r = 0)$, then by refinement B her beliefs must be such that $\mathbb{E}^p[x|y, r] > y - \sigma^p(C)$.

(iv) If the plaintiff observes $(y = 0, r = 0)$[6] then by the Bayes' rule her expectations satisfy $\mathbb{E}^p[x|y, r] > \sigma^p(C)$.

(v) If the plaintiff observes $(y \leq \dot{y}, r = 1)$ then by refinement B her beliefs are such that $\mathbb{E}^p[x|y, r] = x - \sigma^p(C)$.

Thus $p(y, r)$ satisfies (a) and (b).

A.2 Defendant-preferred equilibria

In this section I show that the selected equilibria are indeed defendant-preferred.

For sake of keeping the proofs concise I ignore the restriction on the non-negativity of the offers, as well as the possibility of the equilibria being completely pooling.

In case of equilibria with positive s_t I study only the most complex case of the equilibrium exhibiting features of all the equlbria types – the proofs for other can be obtained by eliminating some steps of the given proof.

[6]The equilibrium is not supposed to be completely pooling, otherwise the point (iii) would apply.

Lemma 1. *If $\Phi(C) < 0$ and $\Phi(C) + \sigma^p(C) \geq -t^d$, then partially informative equilibrium is a defendant-preferred equilibrium.*

Proof. Firstly, I show that partially informative equilibrium is defendant-preferred among the equilibria that do not lead to trial.

There cannot exist a trial-free equilibrium in which the plaintiff does not recover her payoff under the trial on average; that is the expected transfer form the defendant to the plaintiff's side must be higher or equal than $\frac{1}{2}\overline{x} - \sigma^P(C)$. Observe that, the average transfer from the defendant to the plaintiff's side under partially informative equilibrium is equal to the lower bound on the transfer.

Secondly, for any liability value x the defendant is (weakly) better off under the settlement than under the trial. Thus partially informative equilibrium is defendant-preferred. ■

Lemma 2. *If $\Phi(C) = 0$, then perfectly informative equilibrium is a defendant-preferred equilibrium.*

The proof of Lemma 2 follows exactly the proof of Lemma 1, as perfectly informative equilibrium is a limit of partially informative equilibrium when the difference between consecutive terms of the pooling offer sequence converge to 0, and thus is omitted.

Lemma 3. *If $\Phi(C) > 0$ and $\sigma^a(C) \geq -t^d$ misinformative equilibrium is a defendant-preferred equilibrium.*

Proof. Firstly, I show that misinformative equilibrium is defendant-preferred among the equilibria that do not lead to trial.

To prove the statement above I define the concept of meaningfulness of a recommendation. A recommendation is called meaningful at an offer y if and only if $p(y,1) \neq p(y,0)$ and is called meaningless otherwise. I suppose, without loss of generality, that a recommendation "1" is always interpreted as "accept" and a recommendation "0" is always interpreted as "reject"; that is, at any y for which the recommendation is meaningful $p(y,0) = 0$ and $p(y,1) = 1$.

Observe that if the recommendation is meaningful then the attorney must behave in accordance with his preferences, that is, $r(x,y) = 1 \Rightarrow\ y \geq x - \sigma^a(C)$ and $r(x,y) = 0 \Leftarrow y < x - \sigma^a(C)$.

Note that if the equilibrium is supposed to be trial-free the defendant makes offers at which the recommendation is meaningful only if the liability value is s.t. the recommendation will be positive, and makes only one offer at which the recommendation is meaningless. Particularly, it must be the smallest offer which the plaintiff accepts despite the negative recommendation.

Denote by y^* the smallest offer which the plaintiff accepts despite the negative recommendation in any trial-free equilibrium if $\Phi(C) > 0$ and $\sigma^a(C) \geq -t^d$. Observe that this offer would be made for all the liability values s.t. $x - \sigma^a(C) \geq y^*$.

Denote the smallest liability value at which the offer y^* is made in this equilibrium by $x^* \equiv y^* + \sigma^a$. Then, by assumption that y^* is accepted by the plaintiff in equilibrium, it must be that it at least covers her expected payoff under the trial, thus $y^* = \frac{1}{2}(x^* + \bar{x} - \sigma^p(C)$. After verifying the conditions on $\dot{y}$ and $\dot{x}$ it occurs that the $y^* = \dot{y}$ and $x^* = \dot{x}$ and so in a misinformative equilibrium the offer that is accepted by the plaintiff despite the negative recommendation of the attorney is the smallest among all trial-free equilibria and is made for the widest range of liability values among all trial-free equilibria.

Now, observe also that the offers at which the recommendation is meaningful are made for such a liability values that the condition y $\geq x - \sigma^a(C)$ is always binding.[7]

Combining these two observations, implies that in the misinformative equilibrium, for any liability value the defendant makes the smallest possible offer that could have been accepted in any equilibrium. That is, the misinformative equilibrium is defendant-preferred among trial-free equilibria.

Secondly, since the defendant at any liability value (weakly) prefers the settlement to the trial, the misinformative equilibrium is the defendant-preferred equilibrium. ■

Lemma 4. *If $\Phi(C) > 0$ and $\sigma^a(C) < -t^d$, then uninformative equilibrium is defendant preferred equilibrium.*

Proof. I firstly derive the minimal offer made in any equilibrium i $\Phi(C) > 0$ and $\sigma^a(C) < -t^d$: y^*, at which the trial is avoided. For this offer to be made in some equilibrium and be accepted the following condition must hold:

$$\exists\, x \text{ s.t. } y^* + t^d \leq x \text{ and } p(y^*, r(y^*, x)) = 1. \tag{80}$$

The first part of the condition states that the defendant must prefer settling at y^* for some liability value x, and the second part state that the case is indeed settled at this liability value.

Observe that recommendation cannot be meaningful at the offer y^*. Since the defendant would make an offer for liability value $x \geq y^* + t^d$ and the plaintiff prefers the settlement to the trial only if $y^* + \sigma^p(C) \geq x \Rightarrow x < y^* + t^d$. Thus, if the recommendation was meaningful at the offer y^*, then the attorney would have a profitable deviation of changing the recommendation and ensuring trial.

Thus, y^* is a minimal offer that the plaintiff is willing to unconditionally accept. Any such an offer would be made on the equilibrium path for all liability values s.t. $x \geq y^* - t^d$. Thus, the plaintiff beliefs at y^* are $\mathbb{E}[x|y = y^*] = \frac{1}{2}[y^* - t^d + \bar{x}]$. She is willing to accept offer y^* only if $y^* - \sigma^P(C) \geq \frac{1}{2}(y^* - t^d + \bar{x})$. Since y^* is minimal the condition holds with an equality and $y^* = \dot{y}$.

[7]Unless the non-negativity constraint is relevant.

So in the uniformative equilibrium the pooling accepted settlement offer is the lowest possibly sustainable in an equilibrium, and what follows it is made for the widest range of liability values, thus the uniformative equilibrium is defendant-preferred. ■

Lemma 5. *If* $\Phi(C) < 0$ *and* $\Phi(C) + \sigma^p(C) < -t^d$ *the uninformative equilibrium is defendant-preferred.*

Proof. I show that if $\Phi(C) + \sigma^p(C) < -t^d$, then there cannot exist an offer lower than $\dot{y}$ that is ever accepted by the plaintiff.

Denote by y^* the lowest offer accepted by the plaintiff in any equilibrium satisfying the condition above. If the plaintiff's recommendation is meaningful at this offer, then the offer is made for all the liability values from $y^* - t^d$ to $\min\{y^* + \sigma^a, \bar{x}\}$.

Firstly, I analyze the case in which $y^* + \sigma^a < \bar{x}$. In this situation the plaintiff's expected payoff under rejecting y^* is $\mathbb{E}^p\, x|y^*, r(y^*) = 1] - \sigma^p = y^* + \frac{1}{2}(\sigma^a - t^d) - \sigma^p$. Rearranging the condition $\Phi(C) + \sigma^p(C) < -t^d$, one obtains $\sigma^p(C) < \frac{1}{2}(\sigma^a - t^d)$. Thus, at any potential offer y^* at which the recommendation is meaningful and $y^* + \sigma^a < \bar{x}$ the plaintiff is better-off under trial than under the settlement, so no such an offer can be accepted on the equilibrium path.

Secondly, I analyze the case in which $y^* + \sigma^a \geq \bar{x}$, or equivalently the attorney's recommendation is meaningless at y^*. Then the plaintiff's excerpted payoff under rejecting y^* is $\mathbb{E}[x|y^*] - \sigma^p(C) = \frac{1}{2}(y^* - t^d + \bar{x}) - \sigma^p(C)$. At a minimal ever accepted offer the plaintiff is exactly indifferent between the settlement and the trial, i.e $y^* = \bar{x} - t^d - 2\sigma^p(C) = \dot{y}$.

Thus uninformative equilibrium selects the lowest possible offer at which the trial is avoided, and what follows this offer is made for the widest range of liability values, and so is defendant-preferred. ■

Lemma 6. *If* $s_t > 0$ *then the equilibrium described in Appendix A.3, is the defendant-preferred equilibrium.*

Proof. For keeping the proof concise I focus on the most complex case in which there exists 5 regions of liability values for which the equilibrium behavior is different: from 0 to $\hat{x}$ the case is resolved by trial; from $\hat{x}$ to $\tilde{x}$ the equilibrium behaves as partially informative equilibrium; from $\tilde{x}$ to $\check{x}$ as misinformative equilibrium and from; form $\check{x}$ to $\dot{x}$ the case is resolved by trial and from $\dot{x}$ to $\bar{x}$ there is a pooling offer always accepted by the plaintiff.

Following the procedure from proofs of lemmas 1 – 5 observe that $\dot{y}$ is the minimal possible offer that is unconditionally accepted by the plaintiff, and as such it is also made for the widest range of liability values. This implies that a necessary condition for avoiding trial at any other offer is receiving a positive recommendation of the attorney.

For all the liability values in $(\check{x}, \dot{x})$ the defendant prefers trial to obtaining positive recommendation of the attorney/making an offer $\dot{y}$.

For all the liability values in $(\tilde{x}, \check{x})$ the defendant always makes a minimal offer recommended by the attorney.

Now, observe that there cannot exist an offer smaller than y_0 that is ever accepted by the plaintiff. Suppose it does, and denote smallest such an offer by y', and it is accepted by the plaintiff only after the positive recommendation of the attorney. Then such an offer would be made by all the liability values from $y' - t^d$ to $\frac{s_n y' + t^a - f_t}{s_n + s_t}$. For the offer to be accepted by the plaintiff, it must be that $\rho(y' - t^d, C) \leq y'$. But the smallest liability value x for which there exists $y \leq x + t^d$ s.t. $\rho(x, C) \leq y$ is by definition given by $\check{x}$ and the corresponding offer is given by y_0, which yields contradiction.

On the interval $[0, \check{x})$ the defendant prefers the trial to making an offer y_0. On the interval $[\check{x}; \tilde{x})$ the average offer compensates exactly the plaintiff's payoff under the trial, and thus there cannot exist any sequence of offers lower on average that would not lead to trail.

Thus, the equilibrium is defendant-preferred. ■

A.3 Negotiations phase under contracts with trial premium in the form of a share

As mentioned in Section 1.4, if $s_t > 0$ the willingness to settle is no longer constant over the liability value for both the attorney and the plaintiff.

$$\sigma^p(x, C) = \frac{f_t + s_t x}{1 - s_n} \text{ if } f_t + s_t x \neq 0 \text{ or } 1 - s_n \neq 0 \quad (81)$$

And can take any value otherwise.

$$\sigma^a(x, C) = \frac{t_a - f_t - s_t x}{s_n} \text{ if } t^a - f_t - s_t x \neq 0 \text{ or } s_n \neq 0 \quad (82)$$

And can take any value otherwise.

Consequently $\Phi(x; C)$ is no longer constant but decreases with x. So if $s_t > 0$ the equilibrium may contain up to four regions that exhibit the properties of different equilibria types, described in Section 1.4. Firstly, for low liability values $\Phi(x; C)$ is strongly negative and the equilibrium is uninformative (due to the aggressive plaintiff). As $\Phi(x; C)$ increases with the liability value, even though it is still negative, the equilibrium becomes partially informative. As the liability value increases even further

$\Phi(x;C)$ becomes positive, yielding misinformative equilibrium. Finally, for very high values of liability $\Phi(x;C)$ reaches the level under which the equilibrium becomes uninformative again. This regions are separated by three thresholds.

If indeed the equilibrium exhibits features of all the equilibria types mentioned in Section 1.4,[8] the liability value at which the attorney and defendant's willingness to settle intersect ($\sigma^a(\check{x},C)=t^d$) generates the upper threshold $\check{x}$, which is given by a following formula:

$$\check{x}=\tfrac{(1-s_n)t^d+t^a-f_t}{s_t}. \tag{83}$$

The intersection of the attorney and the plaintiff's willingness to settle ($\sigma^a(\tilde{x},C)=\sigma^p(\tilde{x},C)$) generates the middle threshold $\tilde{x}$, which is given by the formula below:

$$\tilde{x}=\tfrac{(1-s_n)t^a-f_t}{s_t} \tag{84}$$

To find the lowest threshold, a new object called *the pooling offer function* $\rho(x;C)$ must be defined. The function is linked to the way the plaintiff forms her beliefs. It answers a question: what is a minimal offer that would be acceptable for the plaintiff if she knew that the liability value was in between x and the liability at which the attorney would change his recommendation give an offer y.

Formally, the function $\rho(x;C)$ is the solution of the following minimization problem:

$$\begin{aligned}&\min y \\ &\text{s.t.} \\ &y\geq x^e-\sigma^p(x^e) \\ &x^e=\tfrac{1}{2}\left(x+\tfrac{s_ny+t^a-f_t}{s_t+s_n}\right).\end{aligned} \tag{85}$$

And the exact solution is given by:

$$\begin{aligned}\rho(x,C)=&\tfrac{(s_n+s_t)(1-s_n)-(s_n+s_t)s_t}{(s_n+s_t)(1-s_n)+s_t}x+\\ &\tfrac{1-s_n-s_t}{(s_n+s_t)(1-s_n)+s_t}t^a-\tfrac{1+s_n+s_t}{(s_n+s_t)(1-s_n)+s_t}f_t.\end{aligned} \tag{86}$$

The lowest threshold $\hat{x}$ is given by the intersection of the defendant's willingness to settle and the pooling offer function ($\rho(\hat{x};C)=\hat{x}+t^d$), and it is given by a formula below:

$$\hat{x}=\tfrac{1-s_n-s_t}{(1+s_n+s_t)s_t}t^a-\tfrac{(1-s_n)(s_n+s_t)+s_t}{(1+s_n+s_t)s_t}t^d-\tfrac{f_t}{s_t} \tag{87}$$

[8] It does not have to be the case, the thresholds can take values below 0 and above $\overline{x}$, then properties of some equilibrium type are not exhibited.

For all the liability values below $\hat{x}$ the equilibrium is *uniformative* – since the attorney is recommending settlement for such a wide range of liability values that the defendant is not even capable of pooling around some offer acceptable by the plaintiff.

If the liability value lies in between $\hat{x}$ and $\tilde{x}$ the equilibrium is *partially informative* – even though the attorney is still more willing to settle than the plaintiff, the plaintiff is ready to follow her attorney's advice at some offers.

For liability values in-between $\tilde{x}$ and $\breve{x}$ the equilibrium is *misinformative*. The attorney is more willing to go to trial than the plaintiff, but the defendant may still be willing to make an offer high enough to ensure a positive recommendation.

Finally, if the liability value lies above $\breve{x}$ the equilibrium is *uninformative* - attorney's preference for resolving the case by trial is so strong that the defendant is no longer willing to convince the attorney.

Compared to the scenario described in Section 1.4 the y_k and x_k sequences derivations change, since they must now take into account that plaintiff and attorney's incentives are becoming more and more aligned as the liability value increases.

Particularities of each standard offer cannot be described in terms of congruence coefficient at a liability value ($\Phi(x, C)$), since the liability value is not observed by the plaintiff. Instead, they can be expressed by the congruence coefficient of their incentives at a given offer y ($\phi(y, C)$). It measures the alignment of the incentives as a difference between the liability value at which the plaintiff and the defendant would be willing to accept the given settlement offer y.

$$\phi(y, C) \equiv \tfrac{s_t y + f_t - (1 - s_n - s_t)t^a}{(1 - s_n - s_t)(s_n + s_t)}. \tag{88}$$

The lowest and highest liability value realizations for which the defendant makes the same standard offer are described by each two consecutive terms of a sequence x_k. Firstly, I derive the lower bound of the first sub-interval (x_0):

$$x_0 = \begin{cases} \breve{x} & \text{if } \rho(\breve{x}) \geq 0 \\ \frac{f_t - t^a}{s_n + s_t} & \text{if } \rho(\breve{x}) < 0 \end{cases}. \tag{89}$$

Then I observe that the size of the sub-intervals is decreasing in the liability value in a following way:

$$x_{k+1} = x_k + 2\phi\big(\rho(x_k)\big). \tag{90}$$

Finally, I observe that standardized offer is such that it compensates the plaintiff's expected payoff under the trial:

$$y_k = \tfrac{1}{2}(x_k + x_{k-1}) - \sigma^p\big(\tfrac{1}{2}(x_k + x_{k-1}), C\big). \tag{91}$$

Additionally, I define the x_K being the smallest element of the sequence s.t $x_{K+1} \geq \overline{x}$. Note that x_K does not have to be well defined, when $K \to \infty$.[9]

Finally, the minimal unrejectable offer, i.e., the offer the plaintiff is willing to accept ignoring the recommendation of the plaintiff, must be found. Since the equilibrium may exhibit properties of all the equilibrium types described in Section 1.4, before finding an actual value of $\dot{y}$, the minimal unrejectable offer for each possible scenario must be found: $\dot{y}^M$ for misinformative; $\dot{y}^U$ for uninformative; and y_K for partially informative.

Firstly, note that$\dot{y}^M$ must be an element of the solution to the following system of equations:

$$\dot{y}^M = \tfrac{(\dot{x}+\overline{x})}{2} - \sigma^p\left(\tfrac{(\dot{x}^M+\overline{x})}{2}, C\right) \tag{92}$$

$$\dot{y}^M = \dot{x}^M - \sigma^a(\dot{x}, C). \tag{93}$$

The first equation ensures that the plaintiff is exactly compensated for his payoff under trial, and the second equation ensures that the cut-off type ($\dot{x}$) is indifferent between making an offer that would be recommended by the attorney and making a minimal unrejectable offer. Which leads to an explicit formula for $\dot{y}^M$:

$$\dot{y}^M = \frac{(1-s_n-s_t)\Big((s_n+s_t)(\overline{x}-\frac{f_t}{1-s_n-s_t})-(f_t-t^a)\Big)}{(1-s_n)(s_n+s_t)+s_t}. \tag{94}$$

Analogously $\dot{y}^U$ must be an element of the solution to the following system of equations:

$$\dot{y}^U = \tfrac{(\dot{x}+\overline{x})}{2} - \sigma^p\left(\tfrac{(\dot{x}^U+\overline{x})}{2}, C\right) \tag{95}$$

$$\dot{y}^U = \dot{x}^U + t^d. \tag{96}$$

The first equation ensures that the plaintiff is exactly compensated for his payoff under the trial; and the second equation ensures that the cut-off

[9] It happens if $\tilde{x} < \overline{x}$ i.e., for high values of x the equilibrium behaves in an uninformative or partially informative manner. Then the difference between the consecutive elements of pooling step and standard offer sequences are getting smaller and smaller, tending to 0, so that the type $\tilde{x}$ can be seen as constituting a separate group x_K.

type ($\dot{x}$) is indifferent between the trial and accepting the minimal unrejectable offer.

$$\dot{y}^U = \tfrac{(1-s_n-s_t)\overline{x}-t^d-2f_t}{1-s_n+s_t} \tag{97}$$

Finally, x_K is well defined[10] y_K behaves analogously as in the case described in Section 1.4:

$$y_K = \tfrac{1}{2}(x_K + \overline{x}) - \sigma^p\big(\tfrac{1}{2}(x_K + \overline{x}), C\big). \tag{98}$$

While computing $\dot{y}$ the possibility of completely pooling equilibrium (with 0 or with a positive offer) must be taken into account. Since the actual $\dot{y}$ corresponds to an equilibrium behavior for very high liability values, it must be the highest from candidate minimal unrejectable offers:

$$\dot{y} = \max\{0, \tfrac{1}{2}\overline{x} - \sigma^p(\tfrac{1}{2}\overline{x}, C), \dot{y}^M, \dot{y}^U, y_K\}. \tag{99}$$

Additionally, I define $\underline{y}$ which is the smallest offer the plaintiff would ever be willing to accept:

$$\underline{y} = \begin{cases} y_0 & \text{if } \tilde{x} > 0 \\ 0 & \text{if } \tilde{x} \leq 0. \end{cases} \tag{100}$$

For simplicity, the set of offers that are made by the defendant in the equilibrium is denoted by $\mathbf{Y^E}$. The proposition does not describe equilibrium behavior on the thresholds, since they are of measure 0 and do not influence the expected payoff.[11]

Proposition A.1. *For any contract C s.t. $s_t > 0$ there exists a defendant-preferred PBE in which:*

(i) The defendant's offer is $\min\{y(x), \dot{y}\}$ *where* $y(x)$ *is s.t.*

(a) For $x \in (\check{x}, \tilde{x})$

$$y(x) = \begin{cases} 0 & \textit{if } x < x_0 \\ y_k & \textit{if } x \in (x_{k-1}; x_k) \end{cases} \tag{101}$$

[10] Otherwise y_K cannot ever be $\dot{y}$, and thus its derivation can be ignored.

[11] The actual behavior on the thresholds can be determined, and depends on the relation of each of the thresholds with 0 and $\overline{x}$.

(b) *For* $x \in (\tilde{x}, \hat{x})$

$$y(x) = x - \sigma^a(x; C) \tag{102}$$

(c) *For* $x < \check{x}$ *or* $x > \hat{x}$

$$y(x) = \begin{cases} \dot{y} & \text{if } x \geq \dot{y} - t^d \\ 0 & \text{if } x < \dot{y} - t^d \end{cases} \tag{103}$$

(ii) *The attorney's recommendation is:*

$$r(x, y) = r^a(x, y) \tag{104}$$

(iii) *The plaintiff's decision is:*

$$p(y, r) = \begin{cases} 1 & \text{if } y \geq \dot{y} \\ r & \text{if } y \in \mathbf{Y^E} \text{ and } y \geq \underline{y} \text{ and } y < \dot{y} \\ 0 & \text{otherwise} \end{cases} \tag{105}$$

The proof is analogous to the proofs of Propositions 1.2 – 1.5 and is stated in claims 13 to 15.

Claim 13. *There is no profitable deviation for the defendant given the strategies of the plaintiff and the attorney*

Firstly, observe that any deviation $y' > y(x)$ cannot be a profitable deviation for the attorney. Since if the plaintiff decides to reject it ($p(y', r) = 0$) the payoff of the attorney is: $-x - t^d$, which is smaller than the payoff when the equilibrium offer was accepted ($-y(x)$), and equal to the payoff when the equilibrium offer was rejected ($-x - t^d$). If the plaintiff decides to accept an offer ($p(y', r) = 1$) the payoff of the attorney is $-y'$, which is smaller than the equilibrium offer if it was accepted, but must be also smaller than the trial payoff if the equilibrium offer was rejected.
Secondly, observe that for any deviation $y' < y(x)$ necessarily implies $p(y', r) = 0$ leading to a payoff $-x - t^d$, which is smaller than the equilibrium payoff if the equilibrium offer was accepted ($-y(x)$), and is equal to the equilibrium payoff if the equilibrium offer was rejected.

Claim 14. *At any* (x, y) *there is no profitable deviation for the attorney given the strategy of the plaintiff.*

Analogously to Proposition 1.1, the proof of this claim is a consequence of the fact that the attorney is giving his advice in accordance with his own preferences. Since the plaintiff either follows or ignores the recommendation of the attorney, there cannot be a profitable deviation for the attorney.

Claim 15. *At any (y, r) there is no profitable deviation for the plaintiff given that her beliefs follow the Bayes' rule on the equilibrium path and refinement B out of the equilibrium path.*

Note that any strategy of the plaintiff satisfying the following conditions must be her best response:

(A) $\mathbb{E}^p[x|y,r] > y - \sigma^p(\mathbb{E}[x^p|y,r], C) \;\Rightarrow\; p(y,r) = 0$,

(B) $\mathbb{E}^p[x|y,r] < y - \sigma^p(\mathbb{E}[x|y,r], C) \;\Rightarrow\; p(y,r) = 1$.

Now, I analyze what the beliefs of the plaintiff are at any (y, r), given that they follow the Bayes' rule on and the refinement B out of the equilibrium.

(i) If the plaintiff observes some $(y > \dot{y}, r)$, then using refinement B her beliefs must satisfy $\mathbb{E}^p[x|y,r] \leq y - \sigma^p(\mathbb{E}^p[x|y,r], C)$.

(ii) If the plaintiff observes $(\dot{y}, r = 0)$, then her beliefs satisfy: $\mathbb{E}^p[x|y,r] = y - \sigma^p(\mathbb{E}^p[x|y,r], C)$, and it happens:

   (a) by Bayes' rule if $\dot{x} \geq \tilde{x}$,

   (b) by refinement B if $\dot{x} < \tilde{x}$.

(iii) If the plaintiff observes $(\dot{y}, r = 1)$, then her beliefs depend on the structure of the equilibrium.

   (a) If $\dot{x} \in [\check{x}; \tilde{x}]$, then the beliefs of the plaintiff must satisfy $\mathbb{E}^p[x|y,r] = y - \sigma^p(\mathbb{E}^p[x|y,r]; C)$ by the Bayes' rule.

   (b) If $\dot{x} \in (\tilde{x}, \hat{x}]$, then the beliefs of the plaintiff must satisfy $\mathbb{E}^p[x|y,r] \leq y - \sigma^p(\mathbb{E}^p[x|y,r]; C)$ by the Bayes' rule.

   (c) If $\dot{x} < \check{x}$, then the beliefs of the plaintiff must satisfy $\mathbb{E}^p[x|y,r] = y - \sigma^p(\mathbb{E}^p[x|y,r], C)$ by the Bayes' rule.

   (d) If $\dot{x} > \hat{x}$, them then beliefs of the plaintiff must satisfy $\mathbb{E}^p[x|y,r] = y - \sigma^p(\mathbb{E}^p[x|y,r]; C)$ by refinement B.

(iv) If the plaintiff observes some $\big(y \in [\tilde{x} - \sigma^a(\tilde{x}; C); \hat{x} - \sigma(\hat{x}; C]; r = 1\big)$ and $y < \dot{y}$, then by the Bayes' rule her beliefs must be such that $\mathbb{E}^p[x|y,r] < y - \sigma^p(\mathbb{E}^p[x|y,r]; C)$.

(v) If the plaintiff observes some $\big(y \in [\tilde{x} - \sigma^a(\tilde{x}; C); \hat{x} - \sigma(\hat{x}; C]; r = 0\big)$ and $y < \dot{y}$, then by refinement B her beliefs must satisfy $\mathbb{E}^p[x|y,r] \geq y - \sigma^p(\mathbb{E}^p[x|y,r]; C)$.

(vi) If the plaintiff observes some $\big(y \in [\underline{y}; \tilde{x} - \sigma^a(\tilde{x}; C)); r = 1\big)$ and $y \in \mathbf{Y^E}$, then by the Bayes' rule her beliefs are as follows $\mathbb{E}^p[x|y,r] = y - \sigma^p(\mathbb{E}[x|y,r]; C)$.

(vii) If the plaintiff observes some $\big(y \in [\underline{y}; \tilde{x} - \sigma^a(\tilde{x}; C)); r = 0\big)$ and $y \in \mathbf{Y^E}$. then by refinement B her expectation must satisfy the following condition $\mathbb{E}^p[x|y,r] > y - \sigma^p(\mathbb{E}^p[x|y,r]; C)$.

(vii) If the plaintiff observes some $\big(y \in [\underline{y}; \tilde{x} - \sigma^a(\tilde{x}; C)); r = 0\big)$ and $y \in \mathbf{Y^E}$. then by refinement B her expectation must behave as follows $\mathbb{E}^p[x|y,r] > y - \sigma^p(\mathbb{E}^p[x|y,r]; C)$.

(viii) If the plaintiff observes some $\big(y \in [\underline{y}; \tilde{x} - \sigma^a(\tilde{x}; C)); r\big)$ and $y \neq \mathbf{Y^E}$, then by refinement B it must be the case that $\mathbb{E}^p[x|y,r] > y - \sigma^p(\mathbb{E}^p[x|y,r]; C)$

(ix) If the plaintiff observe some $(y < \underline{y}, r)$, then it is necessarily the case that $\mathbb{E}^p[x|y,r] > y - \sigma^p(\mathbb{E}^p[x|y,r]; C)$, and

  (a) if $\breve{x} > 0$ it follows from the Bayes' rule;

  (a) if $\breve{x} = 0$ it follows from refinement B.

Substituting for the beliefs of the plaintiff in each case it can be concluded that $p(y,r)$ satisfies (A) and (B).

A.4 Optimal contracts

Proposition 1.6 is proved in lemmas 7 – 15.

Lemma 7. *Any two contracts $C = (f_n, s_n, f_t, s_t)$ and $C' = (f'_n, s_n, f_t, s_t)$ that are accepted by the attorney, lead to the same total profit for the plaintiff's side.*

Lemma 7 is a consequence of the fact that f_n does not influence the agents' incentives once the contract have been sighed, but rather serves as a pure utility transfer.
Lemma 7 has two main implications. Firstly, it states that the analysis of the optimal contract can be simplified to finding a s_n, f_t and s_t of the contract that maximizes the total expected profit of the plaintiff's side and

determine f_n at a level that allows the plaintiff to capture the whole bargaining surplus.
Secondly, it states that, up to f_n the structure of the optimal contract is independent from the bargaining power of the plaintiff and the attorney. That is, the agent offering a contract can be changed without impacting the results of the model.

Lemma 8. *For any contract $C = (f_n, s_n, f_t, s_t > 0)$, there exists a contract $C' = (f_n, s'_n, f'_t, 0)$ s.t $\Pi(C) \leq \Pi(C')$*

In the proof I show that by rotating $\sigma^p(x, C)$ and $\sigma^a(x, C)$ around an appropriately chosen point, so that they become flat lines ($s_t = 0$) one can always improve the total expected profits of the plaintiff and the attorney.

Particularly, one can find x^* under which the plaintiff's side recovers the biggest part of the bargaining surplus and by appropriately adjusting f_t and s_n, construct a contract C' under which the $\sigma^p(x, C')$ and $\sigma^a(x; C')$ are constant and always take the value of $\sigma^p(x^*, C)$ and $\sigma^a(x^*, C)$ respectively. I show the way of constructing this contract below.

To simplify the analysis, I smooth the actual profit of the plaintiff part at any given x, by replacing the actual payoff under any pooling part of the equilibrium by the $x - \sigma^p(x, C)$ and ignoring the fact that negative offers are not allowed in the model.

$$\tilde{\Pi}(x, C) = \begin{cases} x - \sigma^p(x, C) & \text{if } x \in (\check{x}, \tilde{x}) \text{ or } x > \dot{x} \\ x - \sigma^a(x, C) & \text{otherwise .} \end{cases} \tag{106}$$

Secondly, I define the (approximated) plaintiff's side surplus at point x, denoted by $B(x, C)$:

$$B(x, C) = \tilde{\Pi}(x, C) - x + t^a. \tag{107}$$

Call x^* the point at which the bargaining surplus of the plaintiff's side is maximized:[12]

$$x^* = \arg\max_x B(x; C). \tag{108}$$

For any contract $C = (f_n, s_n, f_t, s_t > 0)$, take a contract $C' = (f_n, s_n, f_t + s_t x^*, 0)$.
Contract C' always sets $\sigma^p(C') = \sigma^p(x^*, C)$ and $\sigma^a(C') = \sigma^a(x^*, C)$.

After constructing a contract C' I show that it yields a (weakly) higher payoff that a contract C. I show that it weakly improves the payoff in any region of the liability value.

[12] In case $\arg\max_x B(x; C)$ is not a singleton, I take the minimal value of x maximizing the expression as the solution. The choice is purely a matter of convention.

(a) Firstly, consider the region of liability values for which the defendant does not offer a minimal unrejectable offer under the new contract ($\dot{y}'$, that is$x \leq \dot{x}'$. For all these liability values, it must be the case that the bargaining surplus under the new contract, must be equal to the highest value of the plaintiff's side surplus under the old contract ($B(x, C') = B(x^*, C)$).
It directly follows from the fact that $\sigma^p(x, C') = \sigma^p(x^*, C)$ $\forall x$ and $\sigma^a(x, C') = \sigma^a(x^*, C)$ $\forall x$. In other words under a new contract the incentives of the agents are fixed at the level they had in the best case scenario under the old contract.

(b) Secondly, observe that it must be the case that region at which minimal unrejectable offer is made under the new contract is smaller than under the original contract, that is $\dot{x}' \geq \dot{x}$.
It follows from the fact that $\sigma^p(x, C)$ is increasing in x and $\sigma^a(x, C)$ decreasing in x. Thus, $\sigma^p(x, C') < \sigma^p(x, C)$ $\forall x > x^*$ and $\sigma^a(x, C') > \sigma^a(x, C)$ $\forall x > x^*$ and $x^* \leq \dot{x}$

(c) Finally, consider the region of liability values for which the defendant makes a minimal unrejectable offer under the new contract ($x > \dot{x}$). Then it must be the case that the plaintiff's side surplus weakly increased ($B(x, C') \geq B(x, C)$
It follows from the fact that at the minimal unrejectable offer the surplus of the plaintiff's side depends only on the plaintiff's willingness to settle. Moreover it is decreasing in the plaintiff's willingness to settle, which, in the relevant region, is lower under the new contract, as shown in point (b).

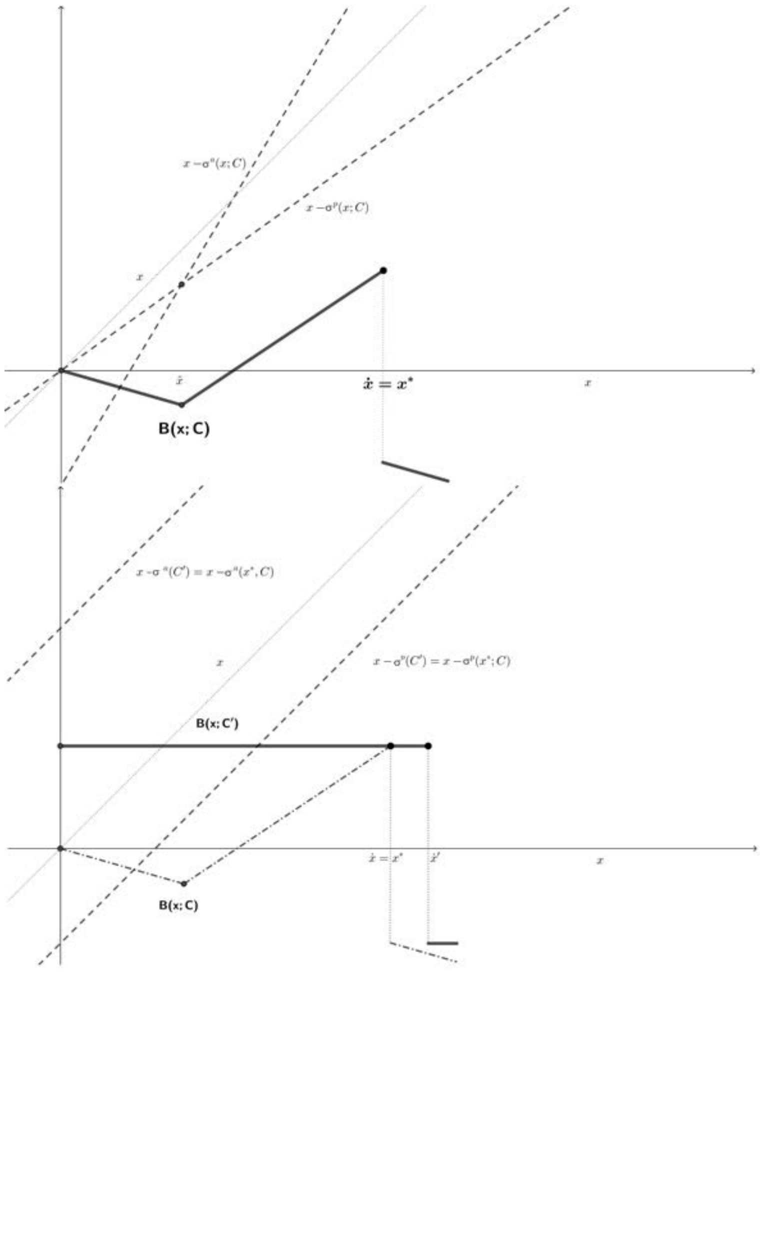
Since the plaintiff's side surplus has (weakly) increased at all the liability values, the expected profits must (weakly) increase as well. The idea behind the proof is also depicted in the example in figures A.1.

Lemma 8 has the following consequence: if there exists any optimal contract, there exists an optimal contract under which $s_t = 0$, i.e., contract that leads to an equilibrium of only one type. Thus, I restrict my attention to these contracts.

Lemma 9. *No contract other than C^M can be an optimal contract among contracts leading to a misinformative equilibrium.*

Proof. Take some contract C that yields a misinformative equilibrium, s.t. $f_t = t^a + \varepsilon$, for ε which can be negative, and $s_n > 0$. Then $\sigma^a(C) = \frac{-\varepsilon}{s_n}$, and $\sigma^p(C) = \frac{t^a+\varepsilon}{1-s_n}$. Observe that, if this contract yields a misinformative equilibrium, it must

Figure A.1: Lemma 8 - contracts C and C’



be the case that $s_n t^a \leq -\varepsilon$, since otherwise $\sigma^a(C) > t^a$ and $\sigma^p(C) < t^a$ and $\Phi(C) < 0$.
Now, take another contract C' such that $f'_t = t^a + \frac{1}{2}\varepsilon$ and $s'_n = \frac{1}{2}s_n$. Observe that then $\sigma^a(C) = \sigma^a(C')$ and $\sigma^p(C) > \sigma^p(C')$. Since the plaintiff's side profits decrease in σ^p, contract C' yields higher profits.

Thus, for any contract including $f_t \neq t^a$ and $s_n \neq 0$ there exist a profitable deviation of signing a contract with f'_t closer to t^a and s_n closer to 0. ■

Lemma 10. *If C^M is to be an equilibrium contract $\sigma^a(C)$ must be the most profitable for the plaintiff.*

Proof. It is a consequence of the fact that under C^M, the expression $\frac{t^a - f_t}{s_n}$ is undefined and the attorney is always indifferent between the trial and the settlement. However, in the equilibrium $\sigma^a(C)$ can be actually pin down to the level that is the most profitable for the plaintiff, since otherwise she would have a profitable deviation of proposing a perturbed contract which would ensure strict preferences of the attorney.

Particularly, she could reverse the procedure used in the proof of Lemma 9, and propose a contract which induces any desired σ^a, but yields a marginally lower σ^p. ■

A consequence of lemmas 9 and 10 is that C^M must be an optimal contract among those leading to a misinformative equilibrium.

Lemma 11. $\sigma^a(C^M) = \max\{-t^d; -(\frac{\overline{x}}{4} - t^a); \min\{-(\frac{\overline{x}}{3} - \frac{4}{3}t^a); t^a\}\}$

Proof. Following, lemmas 9 and 10 to determine $\sigma^a(C^M)$ it is enough to solve a profit-maximization problem give $\sigma^p(C^M) = t^a$.
Firstly, note that if $\sigma^a(C^M) < t^a - \frac{\overline{x}}{2}$ the equilibrium becomes completely pooling, leading to total expected profits of the plaintiff's side of $\frac{\overline{x}}{2} - t^a$ despite the actual choice of $\sigma^a(C^M)$.
Now, I analyze the case for which the constraint restricting the settlement offers to be non-negative is not relevant, i.e. $\sigma^a(C^M) < 0$. Then the maximization problem is the following:

$$\max_{\sigma^a(C^M)} \frac{\overline{x}}{2} - \sigma^a(C^M) - \frac{2}{\overline{x}}\big(t^a - \sigma^p(C^M)\big)^2. \tag{109}$$

Subject to:

$$\sigma^a(C^M) \leq 0$$
$$\sigma^a(C^M) \geq -t^d.$$

For which the solution is $\sigma^a(C^M) = \max\{-t^d, -(\frac{\overline{x}}{4} - t^a)\}$.
Now, the situation under which the constraint on negative offers is relevant must be taken into account. Then the maximization problem is the following:

$$\max_{\sigma^a(C^M)} \frac{\overline{x}}{2} - \sigma^a(C^M) - \frac{2}{\overline{x}}\big(t^a - \sigma^p(C^M)\big)^2 + \frac{1}{2}\sigma^a(C^M)^2. \tag{110}$$

Subject to:

$$\sigma^a(C^M) \geq 0$$
$$\sigma^a(C^M) < t^a.$$

For which the solution is $\min\{-(\frac{\overline{x}}{3} - \frac{4}{3}t^a); t^a\}$.

■

Note that, since the contract C^M makes the attorney always indifferent there exist also equilibria in which $\sigma^a(x, C^M)$ is not constant and decreases for high liability values, which would improve the position of the plaintiff even further. However, these equilibria would no longer be defendant-preferred.

Lemma 12. *Contract C^S is an optimal contract among the contracts leading to a partially informative equilibrium.*

Proof. Firstly, observe that C^S makes the plaintiff always indifferent between any outcome of the negotiation. Moreover, $\sigma(C^S)$ must always take a value that is profit maximizing for the plaintiff's side, since otherwise the defendant would have a profitable deviation of not accepting a contract.[13] In turn, the plaintiff would have a profitable deviation of offering a perturbed contract, which marginally increases σ^p, but ensures strict preferences.

Secondly, observe that $\sigma^a(C^S) = t^a$ and it is minimal among contracts leading to a partially informative equilibrium, since if $\sigma^a(C^S) < t^a$ then $\Phi(C) \geq 0$.

Now, observe that $\sigma^a(C^S)$ does not influence the payoff under partially informative equilibrium, but enters only the existence condition, which can be stated as $\sigma^p(C) \geq \frac{\sigma^a(C)+t^d}{2}$. Thus, it must be the case that C^S is optimal (although not necessarily unique) among the contracts leading to a partially informative equilibrium. It yields the minimal possible $\sigma^a(C)$, that is makes the existence condition the easiest to satisfy. Moreover, it always selects the optimal $\sigma^p(C)$. ■

Lemma 13. $\sigma^p(C^S) = \frac{1}{2}\max\{0, t^a - t^d\}$.

[13]As long as $\sigma(C^S)$ is constant and non-negative. Although, other scenarios still can be sustained as equilibria, they are no longer defendant-preferred.

Proof. The Lemma is a consequence of the fact that the total excepted profits of the plaintiff's side are decreasing in $\sigma^p(C^S)$. So either the non-negativity constraint or the constraint on the incentives of the agents must be binding.

Note that, if the non-negativity constraint is binding C^S is not a unique optimal contract. ■

Lemma 14. *Any contract that leads to an Uniformative Equilibrium that is not completely pooling cannot be optimal.*

Proof. Firstly, I find an optimal contract among those not leading to a completely pooling equilibrium.[14]

$$\max_{\sigma^p(C)} \tfrac{\overline{x}}{2} - \tfrac{\overline{x}-2\sigma^p(C)-2t^d}{\overline{x}} t^a - \tfrac{2\sigma^p(C)+2t^d}{\overline{x}} \sigma^p(C). \tag{111}$$

Subject to:

$$\sigma^p(C) \geq 0$$
$$\sigma^p(C) \leq \tfrac{\overline{x}}{2} - t^d.$$

Observe that if $\frac{\overline{x}}{2} < t^d$ the problem does not have a solution, i.e., any uninformative equilibrium would necessarily be completely pooling.
Otherwise the solution of the problem is given by:$\sigma^p(C) = \max\{0; \min\{\frac{t^a-t^d}{2}; \frac{\overline{x}}{2} - t^d\}\}$.

If $\sigma^p(C) = \frac{\overline{x}}{2} - t^d$ the equilibrium becomes completely pooling. If $\sigma^p(C) = \frac{t^a-t^d}{2}$ the profits are:

$$\Pi(C) = \tfrac{\overline{x}}{2} - \tfrac{\overline{x}-t^a-t^d}{\overline{x}} t^a - \tfrac{t^a+t^d}{\overline{x}} \tfrac{t^a-t^d}{2}. \tag{112}$$

Since $\sigma^p(C) = \frac{t^a-t^d}{2}$ only if $t^a \geq t^d$ then $\Pi(C) < \Pi(C^S) = \frac{\overline{x}}{2} - \frac{t^a-t^d}{2}$. If $\sigma^p(C) = 0$ the profits are:

$$\Pi(C) = \tfrac{\overline{x}}{2} - \tfrac{\overline{x}-2t^d}{\overline{x}}. \tag{113}$$

Since $\sigma^p(C) = 0$ only if $t^a \leq t^d$; $\Pi(C) < \Pi(C^S) = \frac{\overline{x}}{2}$. ■

Lemma 15. *Contract C^P s.t. $f_t = \max\{0; \frac{\overline{x}}{2} - t^d\}$ and $s_n = 1$ is an optimal contract leading to a completely pooling uninformative equilibrium*

[14] Note that since profits are independent from $\sigma^a(C)$, the optimization problem can be conducted with respect to $\sigma^p(C)$ rather than s_n and f_t. Having determined $\sigma^p(C)$ one can always construct a contract leading to $\sigma^a(C)$ being sufficiently high (or low).

Proof. The optimal contract must solve:

$$\max_{\sigma^p(C)} \frac{x}{2} - \sigma^p(C). \tag{114}$$

Subject to:

$$\sigma^p(C) \geq 0$$
$$\sigma^p(C) \geq \frac{\overline{x}}{2} - t^d.$$

The solution of the problem is $\sigma^p(C) = \max\{0; \frac{\overline{x}}{2} - t^d\}$, which coincides with $\sigma^p(C^P)$. Moreover $\sigma^a(C^P)$ is always sufficiently different from $\sigma^p(C^P)$ to yield an uninformative equilibrium. ∎

The proof of the remaining part of the proposition directly follows the comparison of the profits under each of the contracts.

Appendix B

Cherry-picking and Career Concerns

B.1 Proofs

The results are proven for any continuous distribution of task difficulties $F()$ with a full support on $[0, 1]$, satisfying three assumptions.
Denote by $e(\theta) \equiv \mathbb{E}[\tilde{\theta}|\tilde{\theta} \geq \theta]$, that is, $e(\theta)$ is an expectation of $F()$ truncated at θ.

Assumption 1. *For all* $\theta,\ \theta' \in (0, 1)$*, such that* $\theta' < \theta$*:*

$$\frac{\theta'}{\theta} \leq \frac{e(\theta')}{e(\theta)}. \tag{115}$$

Assumption 1 provides a sufficient condition for the existence of threshold equilibrium.

Assumption 2. *For all* $\theta,\ \theta' \in (0, 1)$*, such that* $\theta' < \theta$*:*

$$\frac{\theta'}{\theta} \leq \frac{F(\theta')/f(\theta')}{F(\theta)/f(\theta)}. \tag{116}$$

Denote by $P_F(\theta) \equiv (1 - F(\theta))(1 - e(\theta))$, that is, $P_F(\theta)$ is the probability of the high type failing a task, given a cut-off difficulty θ.

Assumption 3. *For all* $\theta,\ \theta' \in (0, 1)$*, such that* $\theta' < \theta$*:*

$$\frac{\theta'}{\theta} \leq \frac{P_F(\theta')/P'_F(\theta')}{P_F(\theta)/P'_F(\theta)}. \tag{117}$$

Assumptions 2 and 3 provide a sufficient condition for the uniqueness of the threshold equilibrium.

Simple inspection shows that a standard uniform distribution satisfies Assumption 1 – 3. [1]

Proof of Proposition 2.1.
It is done through lemmas 16 - 19

Lemma 16. *An equilibrium in which no tasks are performed exists if and only if* $\gamma - c \leq \beta\mu$.

Proof. Take out-of-equilibrium beliefs s.t. $\mu(S) = \mu(F) = 0$. Then, if $\gamma - c \leq \beta\mu$, for any task and any agent it is the case $\theta p_i \gamma - c \leq \mu$, and thus not performing any task is always a best response.

For the reverse implication note that if $\gamma - c > \beta\mu$, even at beliefs $\mu(S) = \mu(F) = 0$, the high type has a profitable deviation of performing the simplest task $\theta = 1$. Thus, the equilibrium does not exist. Since the equilibrium does not exist for the lowest possible beliefs under performing the task, it cannot exist for any other beliefs. ■

Lemma 17. *If* β *is sufficiently large, there exists an equilibrium in which both types of agents are always indifferent between performing and not performing any given task.*

Proof. Observe that for an agent to be always indifferent, it must be the case that the reputation always offsets the monetary incentives. That is, $\gamma + \beta\mu(S) = \beta\mu(F) = \beta\mu(\emptyset) + c$.

Observe that, if β is sufficiently large, there always exists a way of assigning tasks to the agents in such a way that this condition is satisfied, and the beliefs of the market follow Bayes' rule.

For example, pick some tasks θ_H^A,θ_L^A solving the following system of equations:

$$\begin{cases} \frac{c}{\beta} = \frac{\mu(1-\theta_H^A)}{\mu(1-\theta_H^A)+(1-\mu)(1-\theta_L^A p_L)} - \mu \\ \frac{\gamma-c}{\beta} = \mu - \frac{\mu\theta_H^A}{\mu\theta_H^A+(1-\mu)p_L\theta_L^A}. \end{cases} \tag{118}$$

[1] Any distribution with CDF of a form x^α for $\alpha > 0$ or $(1-x)^\beta$ for $\beta > 0$ satisfies assumptions 1 – 3. Hence, I conjecture that they are satisfied for any β distribution, the verification of this statement is left for future research. The triangular distribution is an example of a distribution for which assumption 1 holds, but assumption 2 may be violated. That is, although the equilibrium for the triangular distribution exists, it is not necessarily unique.

Solving (118) the following is obtained:

$$\begin{cases} \theta_H^A = \frac{\mu - \frac{\gamma - c}{\beta}}{\mu}\left(\frac{c}{\gamma}\right) \\ \theta_L^A = \frac{1-\mu+\frac{\gamma-c}{\beta}}{1-\mu}\left(\frac{c}{p_L\gamma}\right) \end{cases} \tag{119}$$

Note that if β is sufficiently large then θ_H^A, $\theta_L^A \in (0,1)$. Suppose that the high-skilled agent performs only tasks $\theta \in [\theta_H^A - \varepsilon, \theta_H^A + \varepsilon]$, and the low-skilled agent only tasks $\theta \in [\theta_L^A - \varepsilon, \theta_L^A + \varepsilon]$, for some ε s.t. $\theta_H^A - \varepsilon \geq 0$ and $\theta_L^A + \varepsilon \leq 1$. Then, $\mu(\emptyset) = \mu$, since the high- and low-skilled agent perform the same measure of tasks. Moreover, (118) implies that $\gamma + \beta\mu(S) = \beta\mu(F) = \beta\mu(\emptyset) + c$. Hence, the equilibrium in which the agent is always indifferent exists.

However, if β is sufficiently small, this equilibrium ceases to exist. Particularly, if $\gamma > \beta$, the equilibrium can no longer exist since each type will then strictly prefer to be successful than to fail, independently of the beliefs held by the market.

■

Lemma 18. *If Assumption 1 is satisfied, then there always exists a threshold equilibrium.*

Proof. Firstly, observe that in any threshold equilibrium, $\theta_H = \theta_L p_L$. Denote by $\mu(\omega, \theta_L)$ the posterior beliefs after observing event ω conditional on the market believing that the selection levels are θ_L and $\theta_H = \theta_L p_L$.
Denote by $\tilde{\theta}_L(\theta_L)$ the best response difficulty cut-off for the low types, given the market beliefs that his actual selection level is θ_L:

$$\tilde{\theta}_L(\theta_L) = \max\{\min\{1, \frac{1}{p_L}\frac{\beta(\mu(\emptyset,\theta_L) - \mu(F,\theta_L)) + c}{\beta(\mu(S,\theta_L) - \mu(F,\theta_L) + \gamma}\}, 0\}. \tag{120}$$

Under Assumption 1, $\mu(S,\theta_L) \geq \mu(F,\theta_L)\ \forall \theta_L$. Hence, $\tilde{\theta}_L(\theta_L)$ is a continuous mapping from $[0,1]$ to $[0,1]$ and the Brouwer fixed point theorem applies, that is, a fixed point exists.
Simple inspection shows that the fixed point is never equal to 0 or 1. Hence, the fixed point of $\tilde{\theta}_L(\theta_L)$ and the corresponding market beliefs are a solution to equations (40) – (43) and an equilibrium of the game. ■

Lemma 19. *No other equilibrium exists.*

Proof. To prove the lemma, it is enough to show that if the agent has strict preferences, that is, there are some tasks which he strictly prefers to perform rather than not (or the opposite), then they must fall into the categories described in Proposition 2.1.

For the agent to have strict preferences over performing the task it must be the case that $\exists \alpha \in [0,1]$ such that $\beta\mu(\emptyset) + c \neq \alpha(\beta\mu(S) + \gamma) + (1-\alpha)\beta\mu(F)$. This implies that the agent must have a strict preference over not performing the task and at least one of other outcomes.

Firstly, suppose that the agent strictly prefers not to perform the task to any other outcome. Then, no task is performed in equilibrium, which has been already included in Proposition 2.1.

Secondly, suppose that the agent strictly prefers any outcome to not performing the task. Then, it must be the case that all the tasks are performed. But then the beliefs of the market must satisfy $\mu(F) < \mu(\emptyset) = \mu$. Thus, the agent has a profitable deviation of not performing a task of the highest difficulty $\theta = 0$.

Thirdly, suppose that the agent strictly prefers succeeding to not performing the task, but prefers not to perform the task to failing. Then the equilibrium is a threshold equilibrium.

Finally, suppose that the agent strictly prefers failing in the task to not performing the task, but he prefers not to perform it to succeeding in it. For that to be true it must be the case that $\mu(F) > \mu(S)$. Then, there must exist some task θ performed by the high type, such that the low type only performs tasks $\theta' > \theta$. Thus, the low type has a profitable deviation of performing θ. Contradiction. ■

Proof of Proposition 2.2.
The existence and structure of a threshold equilibrium are provided by the proof of Lemma 18. To prove Proposition 2.2 it is enough to show the uniqueness of the threshold equilibrium, which is shown in Lemma 20.

Lemma 20. *If assumptions 2 and 3 hold then the threshold equilibrium is unique.*

Proof. (By contradiction) Suppose there exist multiple threshold equilibria, and pick any two of them. Denote by $\underline{\theta}_i$ the cut-off difficulties in the equilibrium with lower cut-off difficulties and by $\overline{\theta}_i$ the cut-off difficulties and the equilibrium beliefs in the equilibrium with higher cut-off difficulties (that is, $\underline{\theta}_i < \overline{\theta}_i$).

Recall the functions $\mu(\omega, \theta_L)$ for $\omega \in \{S, F, \emptyset\}$. They are the functions that provide the posterior beliefs of the market after observing an event ω conditional on the market believing that the selection levels are θ_L and $\theta_H = \theta_L p_L$.

Following the proof of Lemma 18, it must be the case that:

$$\underline{\theta}_L p_L \mu(S, \underline{\theta}_L) + (1 - \underline{\theta}_L p_L)(\mu(F), \underline{\theta}_L) = \mu(\emptyset, \underline{\theta}_L) - \frac{\gamma \underline{\theta}_L p_L - c}{\beta}; \tag{121}$$

$$\overline{\theta}_L p_L \mu(S, \overline{\theta}_L) + (1 - \overline{\theta}_L p_L)\mu(F, \overline{\theta}_L) = \mu(\emptyset, \overline{\theta}_L) - \frac{\gamma \overline{\theta}_L p_L - c}{\beta}. \tag{122}$$

That is, the agent is indifferent between accepting and rejecting the cut-off task in any equilibrium. Below I show that if (121) is true, and assumptions 2 and 3 hold, (122) cannot be true. In particular, the agent strictly prefers accepting $\overline{\theta}_L$, that is, there exist some $\theta < \overline{\theta}_L$ which the agent would accept if the beliefs are $\mu(\omega, \overline{\theta}_L)$. Hence, the equilibrium with a higher cut-off would not exist.

Firstly, note that, by Assumption 2, $\mu(\emptyset, \overline{\theta}_L) < \mu(\emptyset, \underline{\theta}_L)$, at any candidate equilibrium such that $\theta_H = \theta_L p_L$.
In particular, recall that $\mu(\emptyset, \theta_L) = \frac{\mu(1-\lambda+\lambda F(\theta_L p_L))}{\mu(1-\lambda+\lambda F(\theta_L p_L))+(1-\mu)(1-\lambda+\lambda F(\theta_L))}$. Hence, the sign of $\dfrac{d\mu(\emptyset, \theta_L)}{d\theta_L}$ corresponds to the sign of:

$$f(\theta_L p_L)p_L\big(\lambda F(\theta_L) + (1-\lambda)\big) - f(\theta_L)\lambda\big(F(\theta_L p_L) + (1-\lambda)\big). \tag{123}$$

Therefore, $\dfrac{d\mu(\emptyset, \theta_L)}{d\theta_L} \leq 0$ if and only if:

$$p_L \frac{\lambda F(\theta_L) + (1-\lambda)}{f(\theta_L)} \leq \frac{\lambda F(\theta_L p_L) + (1-\lambda)}{f(\theta_L p_L)}. \tag{124}$$

The condition in the Assumption 2 can be restated in the following way for all $\alpha \in (0, 1)$ and $\theta \in (0, 1)$ it must be the case that:

$$\alpha \frac{F(\theta)}{f(\theta)} \leq \frac{F(\alpha\theta)}{f(\alpha\theta)}. \tag{125}$$

Simple inspection shows that (125) implies (124). Hence, $\mu(\emptyset, \theta_L)$ decreases in θ_L.

It follows that the RHS of (121) is strictly lower than the RHS of (122).

Secondly, note that, by Assumption 3, $\mu(F, \overline{\theta}_L) \geq \mu(F, \underline{\theta}_L)$. To be precise, recall that $\mu(F, \theta_L) = \frac{\mu(1-F(\theta_L p_L))(1-e(\theta_L p_L))}{\mu(1-F(\theta_L p_L))(1-e(\theta_L p_L))+(1-\mu)(1-F(\theta_L))(1-e(\theta_L)p_L)}$. Hence, the sign of $\dfrac{d\mu(F, \theta_L)}{d\theta_L}$ corresponds to the sign of,

$$\begin{aligned}&(1-F(p_L\theta_L))(1-e(p_L\theta_L))\big((1-F(\theta_L))p_L e'(\theta_L) + (1-p_L e(\theta_L))f(\theta_L)\big) \\ &- p_L(1-F(\theta_L))(1-p_L e(\theta_L))\big((1-F(p_L\theta_L))e'(p_L\theta_L) + (1-e(p_L\theta_L))f(p_L\theta_L)\big).\end{aligned} \tag{126}$$

where $e'(\theta)$ denotes the first derivative of $e()$ with respect to θ_L around θ. Hence, $\dfrac{d\mu(F, \theta_L)}{d\theta_L} > 0$ if and only if:

$$-\frac{P_F(\theta_L p_L)}{P'_F(\theta_L p_L}) > \frac{(1-p_L e(\theta_L))(1-F(\theta_L))}{(1-F(\theta_L))p_L e'(\theta_L) + (1-p_L e(\theta_L))f(\theta_L)}. \tag{127}$$

Observe that the RHS of (127) is always greater than $-p_L \frac{P_F(\theta_L)}{P_F'(\theta_L)}$. Knowing that $P_F' < 0$ one can restate assumption 3 in the following way: for all $\alpha \in (0,1)$, $\theta \in (0,1)$ it is the case that:

$$-\frac{P_F(\alpha\theta)}{P_F'(\alpha\theta)} \geq -\alpha\frac{P_F(\theta)}{P_F'(\theta)}. \tag{128}$$

(128) implies (127). Hence, $\mu(F, \theta_L)$ is increasing in θ_L.

Suppose it is also the case that $\mu(S, \overline{\theta}_L) \geq \mu(S, \underline{\theta}_L)$. Then, the LHS of (121) is smaller than or equal to the LHS of (122). Thus, if (121) holds then $\overline{\theta}_L p_L \mu(S, \overline{\theta}_L p_L) + (1 - \overline{\theta}_L p_L)(\mu(F, \overline{\theta}_L p_L)) > \mu(\emptyset, \overline{\theta}_L p_L) - \frac{\gamma\overline{\theta}_L p_L - c}{\beta}$ and (122) does not hold. In other words, a higher cut-off could not be an equilibrium cut-off since the agent would have a profitable deviation of performing some tasks below it.

Finally, suppose that $\mu(S, \overline{\theta}_L) < \mu(S, \underline{\theta}_L)$. Denote by $\underline{P}(\omega)$ ($\overline{P}(\omega)$) the unconditional probabilities of an event ω at the low (high) cut-off equilibrium. It must be the case that $\underline{P}(\emptyset) < \overline{P}(\emptyset)$, and moreover it was shown that $\mu(\emptyset, \overline{\theta}_L) < \mu(\emptyset, \underline{\theta}_L)$. Then, by the law of total probability:

$$\overline{P}(S)\mu(S, \overline{\theta}_L) + \overline{P}(F)\mu(F, \overline{\theta}_L) > \underline{P}(S)\mu(S, \underline{\theta}_L) + \underline{P}(F)\mu(F, \underline{\theta}_L). \tag{129}$$

Denote by $\alpha \equiv \frac{\overline{P}(S)}{\overline{P}(S)+\overline{P}(F)}$ the frequency of successes among the tasks performed in the higher cut-off equilibrium. Since $\overline{P}(S) < \underline{P}(S)$ and $\overline{P}(F) < \underline{P}(F)$, it must be that:

$$\alpha\mu(S, \overline{\theta}_L) + (1-\alpha)\mu(F, \overline{\theta}_L) > \alpha\mu(S, \underline{\theta}_L) + (1-\alpha)\mu(F, \underline{\theta}_L). \tag{130}$$

Observe that $\alpha > \overline{\theta}_L p_L$. Then, since $\mu(S, \overline{\theta}_L) < \mu(S, \underline{\theta}_L)$ and $\mu(F, \overline{\theta}_L) \geq \mu(F, \underline{\theta}_L)$:

$$\overline{\theta}_L p_L \mu(S, \overline{\theta}_L) + (1 - \overline{\theta}_L p_L)\mu(F, \overline{\theta}_L) > \overline{\theta}_L p_L \mu(S, \underline{\theta}_L) + (1 - \overline{\theta}_L p_L)\mu(F, \underline{\theta}_L). \tag{131}$$

Following the proof of Lemma 18, $\mu(S) > \mu(F)$. Since $\overline{\theta}_L p_L > \underline{\theta}_L p_L$, it must be the case that:

$$\overline{\theta}_L p_L \mu(S, \overline{\theta}_L) + (1 - \overline{\theta}_L p_L)\mu(F, \overline{\theta}_L) > \underline{\theta}_L p_L \mu(S, \underline{\theta}_L) + (1 - \underline{\theta}_L p_L)\mu(F, \underline{\theta}_L). \tag{132}$$

Thus, LHS of (121) must be strictly smaller than the LHS of (122). Therefore, if (121) holds, then (122) cannot hold. In particular, the higher cut-off equilibrium could not be an equilibrium, since the agent would have a profitable deviation of performing some tasks below the cut-off difficulty. ■

Proof of Proposition 2.3.

Proof. Consider an equilibrium in which the agent is only concerned with the reputation (that is, $\beta \to \infty$). I denote the cut-off levels in this PBE by θ_i^R, and the beliefs by $\mu^R(\omega)$. Observe that the proof of Lemma 18 applies, that is, the equilibrium always exists. Moreover, Lemma 20 also applies, and the equilibrium is unique.

Now, consider the case where the agent is also concerned about the monetary payoff (that is, β is finite). First, suppose that $\frac{c}{\gamma} = \theta_H^R$. In this situation, the equilibrium cut-offs θ_i satisfy $\theta_i = \theta_i^M = \theta_i^R$, since $\frac{c+\beta(\mu(\emptyset)-\mu(F)))}{c+\beta(\mu(S)-\mu(F))} = \frac{\mu(\emptyset)-\mu(F)}{\mu(S)-\mu(F)}$, for any $\mu(\omega)$ such that $\frac{\mu(\emptyset)-\mu(F)}{\mu(S)-\mu(F)} = \frac{c}{\gamma}$. That is, if $\theta_i^R = \theta_i^M$, then $\theta_i = \theta_i^M$.

Second, suppose $\frac{c}{\gamma} < \theta_H^R$. It must be the case that:

$$\theta_i^R p_i(\gamma + \beta(\mu^R(S)) + (1-\theta_i^R)(\beta\mu^R(F)) - c > \beta\mu^R(\emptyset) \tag{133}$$

Recall the $\tilde{\theta}_L(\theta_L)$ function from proof of Lemma 18, which gives the cut-off difficulty level for the low type, conditional on the market believing that the cut-off is θ_L (and $\theta_H = p_L\theta_L$). Then, (133) implies that:

$$\tilde{\theta}_L(\theta_L^R) < \theta_L^R. \tag{134}$$

By Lemma 20, it must be the case that $\tilde{\theta}_L(\theta_L)$ crosses the 45^o line only once (that is, it has a unique fixed point). Moreover (using the fact that neither 0 nor 1 can be fixed points), it crosses it from above. Thus, (134) implies that $\theta_i < \theta_i^R$.

What is more, it must also be the case that the junior agent is more selective than the agent that is senior. Suppose it is not true, then $\frac{c}{\gamma p_L} \geq \theta_L$, which implies $\frac{c}{\gamma} \geq \frac{\mu(\emptyset)-\mu(F)}{\mu(S)-\mu(F)}$. Therefore:

$$p_L\theta_L(\mu(S)) + (1-p_L\theta_L)\mu(F) > \mu(\emptyset) \tag{135}$$

That is, absent monetary payoffs the agent must strictly prefer performing the cut-off task.

Denote by $\tilde{\theta}_L^R()$, the $\tilde{\theta}_L()$ function for an agent who is not concerned about monetary payoffs. Then, (135) implies that:

$$\tilde{\theta}^R(\theta_L) < \theta_L. \tag{136}$$

What follows is that $\theta_L^R < \theta_L$. But θ_L was assumed to be smaller or equal to $\frac{c}{\gamma p_L}$, and $\frac{c}{\gamma p_L}$ was assumed to be strictly smaller than θ_L^R. Thus, it must be the case that $\theta_L > \frac{c}{\gamma p_L}$. To sum up, if $\theta_i^M < \theta_M^R$, then $\theta_i \in (\theta_i^M, \theta_i^R)$.

The proof for the case of $\theta_i^M > \theta_i^R$ follows the same steps, and thus it is omitted. ■

Proof of Proposition 2.4.
It is proven in lemmas 21 – 24. The case when $g < c$ and $p_L\gamma > c$ follows directly from the proofs of propositions 2.1 and 2.2 and it is omitted.

Lemma 21. *Performing all tasks is an equilibrium if and only if* $c - g \leq -\beta\frac{\mu(1-\mu)(1-p_L)}{1+(1-\mu)(1-p_L)}$.

Proof. For the equilibrium to exist it must be the case that the agent prefers failing to not performing a task, if the market believes that all the tasks are always performed.
Substituting $\theta_H = \theta_L = 0$ into the formulas for posterior beliefs, one obtains $\mu(\emptyset) = \mu$ and $\mu(F) = \frac{\frac{1}{2}\mu}{\frac{1}{2}\mu+(1-\mu)(1-\frac{1}{2}p_L)}$.
Therefore, the agent indeed performs all if and only if: $\beta\mu(F) - c + g \geq \beta\mu(\emptyset)$.
After substituting for the beliefs and rearranging, the condition from the lemma is obtained. ■

Lemma 22. *An equilibrium in which the low type does not perform any task, but the high type has a threshold strategy exists if and only if* $c - g - p_L\gamma \geq \beta\frac{1-\mu}{\mu(1-\lambda+\lambda p_L)+(1-\mu)}$ *and* $c - g - \gamma \leq \beta(1-\mu)$.

Proof. Firstly, observe that if the market believes that only the high type will perform any task then $\mu(S) = \mu(F) = 1$. The beliefs under $\emptyset$ are given by the following formula:

$$\mu(\emptyset) = \frac{\mu(1-\lambda+\lambda\theta_H)}{\mu(1-\lambda+\lambda\theta_H)+(1-\mu)}. \tag{137}$$

The high type threshold is then given by:

$$\theta_H = \frac{\beta(\mu(\emptyset)-1)+c-g}{\gamma}. \tag{138}$$

Observe that the technique used in the proof of Lemma 18 applies, and there always exist a real solution for the system of equations given by (137) and (138). The technique used in the proof of Lemma 20 shows that it is unique.

To obtain the condition for existence, note that for this equilibrium to exist $\theta_H \in [p_L, 1]$. $\theta_H > 1$ leads to a contradiction. However, also $\theta_H < p_L$ cannot be an element of the equilibrium, since it would imply that the low type has a profitable deviation of performing the task of the lowest difficulty $\theta = 1$. Observe that the cut-off increases in $c - g$. For $c - g = \beta\frac{1-\mu}{\mu(1-\lambda+\lambda p_L)+(1-\mu)} + p_L\gamma$, it must be that $\theta_H = p_L$. For $c - g = \beta(1-\mu) + \gamma$, it is the case that $\theta_H = 1$. ■

Lemma 23. *An equilibrium in which no task is performed exists if and only if* $c - g - \gamma \geq 0$.

Proof. Observe that if $c-p-\gamma \geq 0$ then there exist a continuum of market beliefs $\mu(S)$ for which the high type would not accept performing even the simplest tasks: $\mu(S) \in [\mu, \mu\frac{c-g-\gamma}{\beta}]$. Additionally, it must be ensured that the agent would rather not perform the task than fail in it, that is, $\mu(F) < \mu + \frac{c-g}{\beta}$. ■

Lemma 24. *No equilibrium different from those highlighted in lemmas 21 to 23 exist.*

Proof. Firstly, observe that the types of equilibrium described in point (i)-(iii) can be seen as special cases of a threshold equilibria, and Lemma 20 applies. The rest of the proof precisely follow the proof of Lemma 21. ■

Proof of Proposition 2.6.
It is proved in lemmas 25 and 26.

Lemma 25. *If the principal holds the whole bargaining power, no contract including $\gamma > 0$ would be ever proposed.*

Proof. Denote by $s \equiv \theta p_i$ the probability of the success of an agent of type i facing a task with difficulty θ, that is, the "effective type" of the agent from the principal's perspective.

Take some equilibrium in which a menu of contracts is proposed [2] and there exists an agent type which accepts a contract including $\gamma > 0$. Denote by $\underline{s}$ the smallest type for which it is true.[3] Denote by ($\underline{\gamma}$, $\underline{g}$), the contract that this agent accepts.

Firstly, suppose that $\underline{s}$ is the marginal type, that is, all $s < \underline{s}$ reject all the contracts in the menu. Then, I claim that the principal has a profitable deviation of proposing a menu consisting only of the contract $(\gamma = 0, g = \underline{\gamma}\underline{s} + \underline{g})$.

Note that if an agent of type s accepts some contract, then any agent of type $s' > s$ finds it profitable to accept this contract rather than not performing a task. Moreover, recall that it is assumed the contract is not observed by the market, that is, the principal and the agent take the beliefs of the market as given.

Indeed, since the payoffs of the agents under any given contract is increasing in s, the set of the types which accept the contract $(\gamma = 0, g = \underline{\gamma}\underline{s} + \underline{g})$ is the same as the set of the types which accepted some contract from the original menu. Under the original menu each agent characterized by $s > \underline{s}$ chooses a contract yielding a weakly better pay-off than a contract ($\underline{\gamma}$, $\underline{g}$). Hence, for any $s > \underline{s}$ the profit of the principal is bounded from above by $s(v - \underline{\gamma}) - \underline{g} - d$. If only the contract $(\gamma = 0, g = \underline{\gamma}\underline{s} + \underline{g})$ is proposed, then for an $s > \underline{s}$ the principal earns a

[2] A menu of contracts can be constituted by a single contract.

[3] If $\underline{s} = 1$ then the equilibrium indeed exists. It is ignored, since the probability of the principal meeting an agent of the high type holding a task of the smallest difficulty is 0.

profit of $sv - \gamma\underline{s} - \underline{g} > s(v - \underline{\gamma}) - \underline{g} - d > s(v - \underline{\gamma}) - \underline{g} - d$. Therefore, proposing only a contract $(\gamma = 0, g = \underline{\gamma s} + \underline{g})$ is a profitable deviation for the defendant.

Secondly, suppose that $\underline{s}$ is not the marginal type, that is, there exist some $s < \underline{s}$, such that the agent accepts a purely fixed-fee contract from the original menu. Then the principal has a profitable deviation of proposing only the fixed-fee contract accepted by the marginal type. The steps of the proof exactly follow the case of $\underline{s}$ being a marginal type. ■

Lemma 26. *If the principal holds the whole bargaining power then there exists an equilibrium in which the agent plays a threshold strategy. Moreover, in any such equilibrium the principal proposes a contract s.t. $\gamma = 0$, $g < c$ to a junior agent, and the junior agent performs more tasks in the equilibrium than the senior agent does.*

Proof. I solve the game by backwards induction. Firstly, observe that in an equilibrium where the agent plays a threshold strategy for any contract $(\tilde{\gamma}, \tilde{g})$, an agent of type i accepts any task $\theta > \theta_i(\tilde{\gamma}, \tilde{g})$, where:

$$\theta_i(\tilde{\gamma}, \tilde{g}) \equiv \frac{1}{p_i} \frac{\beta\big(\mu(F) - \mu(\emptyset)\big) + c - \tilde{g}}{\beta\big(\mu(S) - \mu(F)\big) + \tilde{\gamma}}. \tag{139}$$

Secondly, I consider the decision of the principal. Lemma 25 shows that it is always optimal for the principal to use only contracts where $\gamma = 0$. Hence, the decision of the principal simplifies to selecting a price maximizing her profits, that is:

$$\begin{aligned} g = \arg\max_{\tilde{g}} \Big(&\mu[(1 - F(\theta_H(0, \tilde{g}))(e(\theta_H(0, \tilde{g})v - d - \tilde{g})] \qquad (140)\\ &+ (1 - \mu)[(1 - F(\theta_L(0, \tilde{g}))(e(\theta_L(0, \tilde{g})v - d - \tilde{g})]\Big). \end{aligned}$$

Since the contract is not observable for the market the principal treats the beliefs of the market as given.
Finally, in equilibrium the market correctly conjectures g and $\theta_i(g)$ values, and forms its beliefs using Bayes' rule.

Observe that for the uniform distribution the program in (140) is convex in $\tilde{g}$, hence a unique maximize exists. Solving (140) the following is obtained:

$$g = v\theta_H(0, g) - d + \beta[\mu(S) - \mu(F)](\frac{p_L}{\kappa} - \theta_H(0, g)), \tag{141}$$

for $\kappa \equiv \mu p_L + (1 - \mu)$.
Substituting (141) into (139) the following is obtained:

$$\theta_i(0, g) = \frac{1}{p_i} \frac{c + d + \beta(\mu(\emptyset) - \mu(F)) - \beta(\mu(S) - \mu(F))\frac{p_L}{\kappa}}{v}. \tag{142}$$

Take (142) and equations (41) – (43) from Section 2.3 representing the beliefs of the market given $\theta_i(0, g)$. Observe that (analogously to the proof of Lemma 18)the Brouwer fixed point theorem applies, hence a solution for the system of equations exists. Substituting the obtained $\theta_H(0, g)$ into (141) one obtains the equilibrium price. Hence, the equilibrium exists.

Moreover, since $\mu(\emptyset) < \mu(F)$ (following the proof of Proposition B.1 in Appendix C) and $\mu(S) > \mu(F)$ (by Assumption 1), (142) implies that a junior agent performs more tasks than a senior agent (as $\theta_i(0, g) < \frac{1}{p_i}\frac{c+d}{v}$).

Finally, substituting $\theta_H(0, g)$, from (142) into (141) shows that $g < c$. ■

Proof of Proposition 2.7

Proposition 2.7 is proved in lemmas 27 to 29.

Lemma 27. *When the agent holds a bargaining power there exists an equilibrium satisfying the following properties:*

(i) the participation constraint of the principal is binding,

(ii) no contract including $g > 0$ is proposed by the agent and accepted by the principal,

(iii) there are some tasks performed on the equilibrium path.

Proof. Take some candidate equilibrium satisfying (ii). Observe that in any candidate equilibrium satisfying (ii) there exists at most one contract which is proposed by the agent of some type and accepted by a principal. Suppose otherwise, and pick any two such contracts. Then the agent would have a profitable deviation of proposing only a contract characterized by higher γ. Additionally, if the candidate equilibrium satisfies also (iii), then there exists a contract which is proposed by some agent and accepted by the principal.Denote by γ^* the contingent fee used in the candidate equilibrium contract, which is proposed by the agent and accepted by a principal.

Since in any any candidate equilibrium (ii) and (iii), there exists a unique fully contingent contract proposed by some agent and accepted by the principal the analysis from Section 2.3 applies. In particular it is the case that in any candidate equilibrium satisfying $\mu(S) \geq \mu$ there exists a threshold difficulty for the agent of type i ($\theta_i(\gamma^*)$), such that the agent proposes the contract $(\gamma^*, 0)$ if and only if $\theta \geq \theta_i(\gamma^*)$ and proposes some contract rejected by the principal otherwise, for:

$$\theta_i(\gamma^*) = \frac{1}{p_i}\frac{\beta(\mu(\emptyset) - \mu(F)) + c}{\beta(\mu(S) - \mu(F)) + \gamma^*}. \tag{143}$$

Where the beliefs of the market ($\mu(\omega)$) are provided by (41) – (43) in Section 2.3.

Moreover, observe that any γ^* can be supported as a part of some equilibrium as long as:

$$
\begin{aligned}
&(\mu(1-\theta_H(\gamma^*))+ \\
&(1-\mu)(1-\theta_L(\gamma^*))(v-\gamma^*)\frac{1}{2}(\mu(1+\theta_H(\gamma^*))+(1-\mu)(1+\theta_L(\gamma^*))p_L) \geq \\
&d(\mu(1-\theta_H(\gamma^*))+(1-\mu)(1-\theta_L(\gamma^*)),
\end{aligned} \tag{144}
$$

that is, the participation constraint of the principal is satisfied. To be precise the equilibrium can be constructed in the following way. Firstly, the principal beliefs that the probability of success is 0 if she is proposed any contract $(\gamma, g) \neq (\gamma^*, 0)$ s.t. $\gamma + g \leq v - d$. Secondly, the principal rejects any contract $(\gamma, g) \neq (\gamma^*, 0)$. Finally, the agent of type i proposes a contract $(\gamma^*, 0)$ if and only if $\theta \geq \theta_i(\gamma^*)$, and proposes some contract s.t. $\gamma + g > v - d$ otherwise.

What remains to be show that there exists an equilibrium satisfying not only (ii) and (iii), but also (i). In such an equilibrium (144) must hold with equality. Rearranging it, and substituting $\theta_H p_L$ for θ_L I obtain:

$$\theta_L(\gamma^*) = \frac{1}{p_L}\Big(\frac{2d}{v-\gamma^*} - \eta\Big), \tag{145}$$

for $\eta \equiv \mu + (1-\mu)p_L$. Note that, $\theta_L(\gamma^*)$ in (145) is continuous in γ^* for $\gamma^* \in [0, v-d]$, $\theta_L(v-d) > 1$, and $\theta_H(0) < 0$ (using the assumption that $\frac{1}{2}v\eta > d+c$).

Recall, the functions $\mu(\omega, \theta_L)$ that give the beliefs of the market conditional on the cut-off levels θ_L, and $\theta_H = p_L\theta_L$. Then (143) and (41) – (43), can be restated as:

$$\theta_L(\gamma^*) = \frac{1}{p_L}\frac{\beta(\mu(\emptyset, \theta_L(\gamma^*)) - \mu(F, \theta_L(\gamma^*))) + c}{\beta(\mu(S, \theta_L(\gamma^*)) - \mu(F, \theta_L(\gamma^*))) + \gamma^*}. \tag{146}$$

Following the fact that the selection cut-off of the game analyzed in Section 2.3 is continuously decreasing in γ, it must be that $\theta_L(\gamma^*)$ in (146) is also continuously decreasing γ. Moreover, (by assumption that $\beta > c$) it must be that $\theta_L(0) > 1$, and (by assumption that $\frac{1}{2}v\eta > d+c$) $\theta_L(v-d) < 1$.

Hence, it follows from the Intermediate Value Theorem that $\theta_L(\gamma^*)$ provided by (145) and (146) intersect for some $\gamma^* \in (0, v-d)$. Moreover that the value of $\theta_H(\gamma^*)$ at the intersection point must be below 1. Suppose otherwise, then for $\theta_H(\gamma^*) > 1$ to satisfy (145) it must be that $\gamma^* > c$ (by assumption that $\frac{1}{2}v\eta > d+c$). However, for $\theta_H(\gamma^*) > 1$ to satisfy (146) it must be that $\gamma^* < c$ (following the proof of Proposition 2.2).

Observe that (145) gives the cut-off difficulty for which the participation constraint of the principal is binding given γ^*. And (146) gives the equilibrium cut-off difficulty if the payment is fixed at γ^*. Hence, if (145) and (146) intersect for $\theta_H(\gamma^*) < 1$ then equilibrium satisfying (i)-(iii) exists. ■

Lemma 28. *In the equilibrium, described in Lemma 27 there are always some tasks performed which yield a negative expected payoff to the principal. Moreover, a career-concerned agent performs more tasks and charges a smaller γ than an agent concerned only with monetary payoff.*

Proof. Firstly, observe that $\gamma < v - d$. Clearly, $\gamma \leq v - d$, otherwise the principal would necessarily be at a loss. However, suppose $\gamma = v - d$. Then, there exists a probability of success smaller than 1, for which the agent would perform the task (since $v - d > c$, and $\mu(S) > \mu(F) > \mu(\emptyset)$ in any candidate equilibrium), and the principal would be at a loss.

Thus, there exists a continuum of success probabilities under which the principal does achieve a positive expected payoff. Since the overall expected payoff is 0, there must be some tasks which yield an expected monetary loss to the principal.

Now, recall equations (145) and (146). Observe that $\theta_L(\gamma^*)$ given by (145) is increasing for $\gamma^* \in (0, v - d)$, and $\theta_L(\gamma^*)$ is decreasing for $\gamma^* \in (0, v - d)$. Hence, there exists a unique γ^* that can be supported in the equilibrium described in Lemma 27.

Setting $\beta = 0$ in (146) makes θ_i higher for any γ^* (since following the proof of Lemma B.1 it must be that $\mu(S, \theta_L(\gamma^*)) > \mu(F, \theta_L(\gamma^*)) > \mu(\emptyset, \theta_L(\gamma^*))$) and does not influence (145). Thus, they intersect at a higher θ_L, that is a senior agent performs fewer tasks.

Since the senior agent performs fewer tasks, from (145), he charges higher γ. ■

Lemma 29. *The equilibrium described in Lemma 27 is the one where there are the least unprofitable tasks performed out of the class of equilibria in which:*

(i) the participation constraint of the principal is binding,

(ii) there exists some task performed on the equilibrium path,

Proof. (By contradiction)
Following Lemma 28, note that, in the equilibrium described in Lemma 27 there are some unprofitable tasks being performed. Hence, if there exists an equilibrium in which there are less unprofitable tasks performed, it must be the case that in this equilibrium the cut-off difficulty level above which the agent of some type performs a task on the equilibrium path is higher than in the equilibrium described in Lemma 27. Following Proposition 2.4, in any threshold equilibrium with interior selection thresholds, $\theta_H = p_L \theta_L$. Therefore, if the cut-off difficulty is higher for the agent of one type, it is also higher for the agent of the other type.

Take some alternative equilibrium in which the principal makes 0 expected profits and the cut-off levels, denoted by θ_i', are higher. Denote by $\mu'(\omega)$ the beliefs of the market under the new equilibrium. Following the proof of Lemma 18, since $\theta_H < \theta'_H$, it must be that:

$$\theta_H \mu(S) + (1-\theta_H)\mu(F) - \mu(\emptyset) < \theta_H \mu'(S) + (1-\theta_H)\mu'(F) - \mu'(\emptyset). \quad (147)$$

That is, the high type expects a larger reputation gain in the alternative equilibrium if he is faced with a task θ_H.

Denote by (γ',g') the contract offered by the agent who is sure to succeed in the new equilibrium and note that by (ii) the principal always accepts the contract proposed by this agent. Compared to the original equilibrium there is necessarily fewer agents who mimic this agent (since $\theta'_H > \theta_H$) by proposing a contract (γ',g'). Hence, in order for the principal to make zero profit $g' + \gamma' > \gamma$. Using (147) it must be the case that the high-type agent holding a task with a difficulty θ_H has a profitable deviation of proposing a contract (g', γ'), which is accepted by the principal. Contradiction. ■

B.2 Derivation of comparative statics

To follow the derivation of comparative statics, recall the functions $\mu(\omega, \theta_L)$ which give the market posterior beliefs after observing an event ω, given that the market believes that the cut-off difficulties are θ_L for the low type and $\theta_L p_L$ for the high type. The function $\tilde{\theta}_L(\theta_L)$ which gives the cut-off difficulty for the low type, given that the market believes the cut-off difficulties are θ_L for the low type and $\theta_L p_L$ for the high type.

Firstly, I show the comparative statics with respect to λ. Observe that if λ decreases, $\mu(\emptyset, \theta_L)$ must increase at any candidate equilibrium, and no other beliefs are affected. What follows is that both θ_i and θ_i^R decrease in λ.

Secondly, I present the comparative statics with respect to μ. Differentiating:

$$\frac{1}{p_i}\frac{\beta(\mu(\emptyset) - \mu(F)) + c}{\beta(\mu(S) - \mu(F)) + \gamma} \quad (148)$$

at a fixed θ_i it is obtained that the sign of the derivative corresponds to the sign of the following expression:

$$\mu(\emptyset)(1-\mu(\emptyset) - \theta_i p_i \mu(S)(1-\mu(S)) - (1-\theta_i p_i)\mu(F)(1-\mu(F)). \quad (149)$$

In other words, the derivative is positive whenever the expected variance of the posterior at a cut-off task is higher under not performing the task than under performing the task. Observe that a positive derivative of (148) corresponds to increasing $\tilde{\theta_L}(\theta_L)$, and thus increasing θ_L and θ_H.

Moreover, in case of an agent concerned only with the reputation, one can substitute for θ_i^R in (149) by $\frac{1}{p_i}\frac{\mu^R(\emptyset)-\mu^R(F)}{\mu^R(S)-\mu^R(F)}$. After rearranging (149), I obtain that the cut-off increases in μ if and only if:

$$\mu^R(\emptyset)^2 < \theta_i^R p_i \mu^R(S)^2 + (1-\theta_i^R p_i)\mu^R(F)^2 \tag{150}$$

Since $\mu^R(\emptyset) \in (\mu^R(F), \mu^R(S))$, this condition is always satisfied.

B.3 Noiseless empty signal

Additionally, I consider a market in which $\lambda = 1$, that is, the empty signal is fully observed due to the decision of the agent.

Proposition B.1.

(i) If $\lambda = 1$, for any choice of γ, c, p_L and μ there exists β^E such that for any $\beta \geq \beta^E$ there exists an equilibrium satisfying $\mu(S) \geq \mu(F)$ in which all the tasks are performed. Moreover, there exists $\beta^U > \beta^E$ such that an equilibrium in which all the tasks are performed is a unique one satisfying $\mu(S) \geq \mu(F)$.

(ii) For any $\beta < \beta^U$ there exists a threshold equilibrium described in Proposition 2.2, and for $\beta < \beta^E$ it is a unique one satisfying $\mu(S) \geq \mu(F)$.

(iii) In any equilibrium satisfying $\mu(S) \geq \mu(F)$ a career-concerned agent performs more tasks than an agent who is only concerned about monetary payoff, that is, $\theta^R = 0$.

Proof. The proposition is a direct consequence of the fact that in any candidate equilibrium $\mu(\emptyset) < \mu(F)$.

Clearly, in any equilibrium in which all the tasks are performed $\mu(\emptyset) < \mu(F)$. Otherwise, the task characterized by $\theta = 0$ would not be performed. To show that $\mu(\emptyset) < \mu(F)$, in any candidate equilibrium with $\theta_i > 0$, observe that in any such equilibrium it must be the case that: $\mu(\emptyset) = \frac{\mu p_L}{\mu p_L + (1-\mu)}$ and $\mu(F) = \frac{\mu(1-\theta_L p_L)^2}{\mu(1-\theta_L p_L)^2 + (1-\mu)(1-\theta_L)^2 + (1-\mu)(1-\theta_L)^2(1-p_L)}$, since $\theta_H = p_L\theta_L$. Suppose that $\mu(F) \geq \mu(\emptyset)$. This implies that $(1-\theta_L)^2 p_L(2-p_L) \geq (1-\theta_L p_L)^2$. Rearranging the terms: $\theta_L p_L(\theta_L - 1) \geq \frac{1-p_L}{2}$. Since $p_L < 1$ RHS must be strictly positive. Since $\theta_L \in [0,1]$ LHS must be weakly negative. Contradiction.

Since $\mu(\emptyset) < \mu(F)$, that is, not performing the task harms the reputation more than failing in performing one. What follows, if the agent values its reputation strongly he may choose to perform a task that he is sure to fail in.

Finally, the multiplicity of equilibria follows from the fact,that if the market does not expect some tasks to be performed then $\mu(\emptyset) = \frac{\mu p_L}{\mu p_L + (1-\mu)}$. However if the market does not expect any task to remain unperformed then $\mu(\emptyset)$ is an out-of-equilibrium belief which can be arbitrarily low.

Consequently, there exists β, such that if $\mu(\emptyset) = 0$, the agent decides to perform all the tasks, but if $\mu(\emptyset) = \frac{\mu p_L}{\mu p_L + (1-\mu)}$, some tasks remain unperformed. ■

Appendix C

Dynamics of Collective Litigation

Proof of **Proposition 3.1**.

In the final period there is no uncertainty, and the negotiation, whenever the plaintiff files the case, is a simple ultimatum bargaining game. That is, if $k = 0$ an offer $s_3 = 0$ is made and accepted by a strategic plaintiff. If $k > 0$ an offer $s_3 = w$ is made and accepted by a strategic plaintiff. Since $0 < f < w$, the case is filed if and only if $k > 0$.
Using backwards induction, if $k_2 = 0$, the plaintiff in the second period expects a payoff of $\lambda\eta w$ from litigation. Hence, if the case is filed, in equilibrium the defendant makes an offer $\lambda\eta w$ and a strategic plaintiff accepts it. What follows is that the strategic plaintiff files the case if and only if $\eta \geq \frac{f}{\lambda w}$, that is $\rho_2 \geq \frac{f}{w}$.
Analogous reasoning applies in period 1. ■

Proof of **Proposition 3.2**
Proposition 3.2 is proved by backward induction in lemmas 30 – 33.

Lemma 30. *In period 3 a strategic plaintiff files the case if and only if $k_3 > 0$. If he files the case, it is always settled for w.*

Since the game in the final period is a simple ultimatum bargaining game the proof is omitted.

Lemma 31. *In period 2, if $k_2 = 1$ a strategic plaintiff always files the case and settles it for w.*

Lemma 2 is the direct consequence of a fact that if there are two participants of the litigation the litigation is necessarily successful and yields a known payoff of w to the plaintiff.

Lemma 32. *In period 2, if $k_2 = 0$ in any PBE satisfying D1 criterion:*

(i) the defendant of type i makes an offer $s^i_{2,0} = \lambda_i \eta w$,

(ii) the plaintiff's beliefs satisfy $\mu(s^L_{2,0}) = 0$, and $\mu(s) = 1$ for any $s \in (s^L_{2,0}, s^H_{2,0}]$.

(iii) the plaintiff accepts any offer $s \geq s^H_{2,0}$, rejects any offer $s \in (-\infty, s^H_{2,0}) - \{s^L_{2,0}\}$, and rejects an offer $s^L_{2,0}$ with probability $p_{2,0} = \frac{\Delta\rho_2}{\Delta\rho_2 + \lambda_H}$.

Lemma 32 is proved in claims 16– 18.

Claim 16. *The described equilibrium is a PBE satisfying the D1 criterion.*

Proof. Simple inspection shows that the equilibrium is indeed a PBE: the plaintiff's beliefs are consistent, and the plaintiff is best responding to his beliefs. Given the response of the plaintiff, there is no profitable deviation for the defendant.
In order to show that the equilibrium satisfies the D1 criterion it is enough to prove that the high type is not deleted for any strategy $s \in (s^L_{2,0}, s^H_{2,0})$. That is, a plaintiff can assign a positive probability for the scope of harm being high if an offer $s \in (s^L_{2,0}, s^H_{2,0})$ is observed.
Take any such offer s, then the high type is weakly better off making it if it is rejected with probability at most $p^H(s) \equiv \frac{p_{2,0}(w\lambda_H(1+\eta) - s^L_{2,0}) - (s - s^L_{2,0})}{w(1+\lambda_H)(1+\eta) - s}$. The low type is strictly better off making this offer if it is rejected with probability at most $p^L(s) \equiv \frac{p_{2,0}(w\lambda_L(1+\eta) - s^L_{2,0}) - (s - s^L_{2,0})}{w(1+\lambda_L)(1+\eta) - s}$. Since $p^H(s) \geq p^L(S)$ the equilibrium satisfies the D1 criterion. ■

Claim 17. *There is no PBE satisfying the D1 criterion in which the high-type defendant makes an offer $s < s^H_{2,0}$ with positive probability.*

Proof. Take some PBE in which some offer $s < s^H_{2,0}$ is made with a positive probability by the high-type defendant. Then, it must be the case that this offer is accepted with some positive probability $1 - p(s)$. Since it is always the best-response of the plaintiff to accept any offer $s > s^H_{2,0}$, otherwise the high-type defendant would have a profitable deviation of offering $s^H_{2,0} + \varepsilon$ and ensuring settlement. Since $p(s) < 1$ it must be the case that the plaintiff assigns a positive probability to s being made by the low-type defendant. Hence, in equilibrium, the offer s has to indeed be made with a positive probability also by the low-type defendant.
Observe that there can exist only one such offer. Suppose there are more, and denote any two of them by s_1 and s_2. Then it must be the case that both the high type and the low type must be indifferent between making the offers, that is:

$$(1 - p(s_1,))s_{1,0} + p(s_1)w(1+\eta)\lambda_i = (1 - p(s_2))s_2 + p(s_2)w(1+\eta)\lambda_i \quad (151)$$

for $i = H, L$,

which yields a contradiction.
Take some offer $s' = s^L_{2,0} + \varepsilon$ which is not made on the equilibrium path. Then the high-type defendant is better off making the offer s' than under her equilibrium payoff if and only if it is rejected with probability at most $p^H(s') \equiv \frac{(1-p(s))s+p(s)(\lambda_H(1+\eta)w)-s'}{\lambda_H(1+\eta)w-s'}$. The low type is better off making the offer s' than under her equilibrium payoff if and only if it is rejected with probability at most $p^L(s') \equiv \frac{(1-p(s))s+p(s)(\lambda_L(1+\eta)w)-s'}{\lambda_L(1+\eta)w-s'}$. Since $p^L(s') < p^H(s')$, if the equilibrium satisfies the D1 criterion, then $\mu_{2,h_2}(s') = 0$. But then the offer s' is accepted by the plaintiff with probability 1 and the defendant has a profitable deviation. ■

Claim 18. *The described equilibrium is the unique PBE satisfying the D1 criterion.*

Proof. A consequence of Claim 17 is that the high type always makes an offer $s^H_{2,0}$ in any PBE satisfying D1. Moreover, since the unique best response of a plaintiff is to always accept any offer $s > s^H_{2,0}$, the offer $s^H_{2,0}$ must also always be accepted on the equilibrium path. Otherwise the defendant of a high type would have a profitable deviation of making an offer $s^H_{2,0} + \varepsilon$.
Observe that the low type cannot make any offer $s \in (s^L_{2,0}, s^H_{2,0})$ on the equilibrium path. Otherwise, the equilibrium beliefs of the plaintiff would be $\mu_{2,h_2}(s) = 0$ and it would always be accepted. Hence the high-type defendant would have a profitable deviation of making an offer s. Any offer $s > s^H_{2,0}$ cannot be an element of the equilibrium path, since the defendant would have a profitable deviation of making an $s - \varepsilon > s^H_{2,0}$. An equilibrium in which the low-type defendant makes an offer $s^H_{2,0}$ cannot satisfy the D1 criterion. The proof exactly follows the proof of Claim 17 and is omitted.
Take some separating equilibrium in which the high-type defendant makes an offer $s^H_{2,0}$ and the low type makes an offer $s^L_{2,0}$. Observe that there cannot exist an equilibrium in which the offer $s^L_{2,0}$ is rejected with a probability smaller than $p_{2,0}$, since the high-type defendant would have a profitable deviation of making the offer $s^L_{2,0}$. Hence, take some equilibrium in which the offer $s^L_{2,0}$ is rejected with some probability $p > p_{2,0}$, and consider some offer $s = s^L_{2,0} + \varepsilon$. The defendant of the low type is better off making an offer s than under her equilibrium payoff if it is rejected with probability at most $p^L(s) \equiv \frac{p\lambda_L(1+\eta)w+(1-p)s^L_{2,0}-s}{\lambda_L(1+\eta)w-s}$. The defendant of the high type is better off making an offer s than under her equilibrium payoff if it is rejected with probability at most $p^H(s) \equiv \frac{s^H_{2,0}-s}{\lambda_H(1+\eta)w-s} = \frac{p_{2,0}\lambda_L(1+\eta)w+(1-p_{2,0})s^L_{2,0}-s}{\lambda_H(1+\eta)w-s}$. Hence, $\lim_{s\to s^L_{2,0}} p^H(s) = p_{2,0}$ and $\lim_{s\to s^L_{2,0}} p^L(s) = p$. Thus, there exists s small enough such that $p^L(s) < p^H(s)$. Therefore $\mu_{2,h_2}(s) = 0$ and the offer s is always accepted by the plaintiff. Hence, the defendant has a profitable deviation of making the offer s.

Note that the proof also applies for any equilibrium in which the low-type defendant makes an offer $s < s^L_{2,0}$. ■

Lemma 33. *In period 1 in any equilibrium satisfying the D1 criterion:*

(i) the defendant of type i makes an offer $s^i_{1,0} = \rho^i_1 w$,

(ii) the plaintiff's beliefs satisfy $\mu(s^L_{1,0}) = 0$, and $\mu(s) = 1$ for any $s \in (s^L_{2,0}, s^H_{2,0}]$,

(iii) the plaintiff accepts any offer $s \geq s^H$, rejects any offer $s \in (-\infty, s^H_{2,0}) - \{s^L_{2,0}\}$, and rejects an offer $s^L_{2,0}$ with probability $p_{1,0} = \frac{\Delta\rho_1}{\Delta\rho_1 + 2\lambda_H(1-\lambda_H\eta)}$, if $\mu \geq \underline{l}$, and $p_{1,0} = \frac{\Delta\rho_1}{\Delta\rho_1 + 2\lambda_H(1-\lambda_H\eta) - \lambda_H^2\eta(1-\eta)}$ otherwise.

We establish the existence of the equilibrium in claims 19 and 20. Observe that in the described equilibrium the defendant of each type makes an offer exactly compensating the expected payoff of a first-period plaintiff conditional on the realized state of the world, and the high type is exactly indifferent between making an offer $s^H_{1,0}$ and $s^L_{1,0}$. Hence, the proof that the described equilibrium is the unique equilibrium satisfying the D1 criterion exactly follows claims 17 and 18. Therefore, it is omitted.

Claim 19. *The continuation value of the game for the defendant of type i, given that there is $k \in \{0, 1\}$ plaintiffs litigating by the end of period 1 and a plaintiff in period 1 filed the case is given by $-\kappa^i_k(\mu)$ such that:*

$$\kappa^i_k(\mu) \equiv \begin{cases} [2(1+\eta) - \lambda_i\eta^2]\,\lambda_i w & \textit{if } k = 1 \\ \lambda_i^2\eta(1+\eta)w & \textit{if } k = 0 \textit{ and } \mu < \underline{l} \\ \lambda_i^2\eta w\left[2 + \frac{\Delta\lambda(1-\eta)}{\Delta\lambda\eta+\lambda_H}\mathbb{1}_{\lambda_i=\lambda_L}\right] & \textit{if } k = 0 \textit{ and } \mu > \underline{l} \end{cases} \tag{152}$$

Proof. Following lemmas 30 and 31, observe that if $k_1 = 1$ then a strategic plaintiff files the case in periods 2 and 3 and settles it at w and a behavioral plaintiff always litigates the case. Hence, the continuation value of the game for the defendant is given by: $-[2(1+\eta) - \lambda_i\eta^2]\,\lambda_i w$.
If $k = 0$ there are two cases. Either the plaintiff in the second period files the case, or he does not. If he does not file the case the litigation is fully driven by the behavioral plaintiff. Hence, the continuation value of the game is given by: $-\lambda_i^2\eta(1+\eta)w$.
If the plaintiff in the second period files the case then, following Lemma 32, conditional on the arrival of the plaintiff, in the second period the defendant makes an offer exactly compensating the expected payoff of the plaintiff conditional on the scope of the harm. Moreover, the offer made by the low-type defendant is rejected with positive probability $p_{2,0}$. Hence, the continuation value of the game is given

by: $-\lambda_i^2 \eta w \left[2 + \frac{\Delta\lambda(1-\eta)}{\Delta\lambda\eta+\lambda_H}\mathbb{1}_{\lambda_i=\lambda_L}\right]$.
To finish the proof recall that a strategic plaintiff in the second period files the case conditional on $k_2 = 0$ if and only if $l_{2,h_2} \geq \check{l}_2$. The beliefs of the plaintiff in period 2 if $h_2 = (0,1)$ are given by $l_{2,h_2} = l\frac{\lambda_H^2}{\lambda_L^2}$. Hence $l_{2,h_2=(0,1)} \geq \check{l}_2$ if and only if $l \geq \underline{l}$. ■

Claim 20. *The described equilibrium is a PBE satisfying D1 criterion.*

Proof. We start by analyzing the case when $\mu < \frac{\frac{f}{w}-\rho_2^L}{\Delta\rho_2}$. We firstly show that the proposed strategy profile can indeed be sustained as a PBE.
Set the following interim belief profile $\mu_{1,h_1}(s) = \mathbb{1}_{s\neq s_{1,0}^L}$.

A strategic plaintiff accepts an offer $s_{1,0}^i$ from type i if

$$s_{1,0}^i \geq \left[\lambda_i\eta + (1-\lambda_i)\lambda_i\eta\right] w = (2-\lambda_i)\,\lambda_i\eta w$$

Thus, the unique best response for the plaintiff is to reject the offer whenever $s_{1,0} \in (s_{1,0}^L, s_{1,0}^H)$. Also note that for $s_{1,0} \in \{s_{1,0}^L, s_{1,0}^H\}$ the plaintiff is indifferent between accepting or rejecting the offer. Hence, the plaintiff has no profitable deviation.

Note that $p_{1,0}$ is such that the high-type defendant is indifferent between offering $s_{1,0}^L$ or $s_{1,0}^H$:

$$\begin{aligned} &p_{1,0}\left[\left[2(1+\eta)-\lambda_H\eta^2\right]\lambda_H w\right] + (1-p_{1,0})\left[s_{1,0}^L + \lambda_H^2\eta(1+\eta)w\right] = \\ &= s_{1,0}^H + \lambda_H^2\eta(1+\eta)w \end{aligned} \tag{153}$$

$$\iff p_{1,0}\left[2(1+\eta)\lambda_H w - \lambda_H^2\eta^2 w - s_{1,0}^L - \lambda_H^2\eta(1+\eta)w\right] = s_{1,0}^H - s_{1,0}^L$$

Using $s_{1,0}^i = (2-\lambda_i)\lambda_i\eta w$ we get:

$$\begin{aligned} &p_{1,0}\left[2(1+\eta)\lambda_H w - \lambda_H^2\eta^2 w - (2-\lambda_L)\lambda_L\eta w - \lambda_H^2\eta(1+\eta)w\right] = \\ &= (2-\lambda_H-\lambda_L)\Delta\lambda\eta w \end{aligned} \tag{154}$$

$$\iff p_{1,0} = \frac{(2-\lambda_H-\lambda_L)\Delta\lambda\eta}{2\lambda_H\left(1-\eta^2\lambda_H\right) + (2-\lambda_H-\lambda_L)\Delta\lambda\eta} \in (0,1)$$

Any other offer is either rejected or is higher than the equilibrium offer. Hence, she does not have a profitable deviation.

Finally, we show that the low-type defendant does not have a profitable deviation either.

We have that in the proposed equilibrium the payoff for the low-type defendant is equal to:

$$-p_{1,0}\left[\left[2(1+\eta)-\lambda_L\eta^2\right]\lambda_L w\right] - (1-p_{1,0})\left[(2-\lambda_L)\lambda_L\eta w + \lambda_L^2\eta(1+\eta)w\right]$$

$$= -2p_{1,0}w\lambda_L(1-\lambda_L\eta^2) - w\lambda_L\eta(2+\lambda_L\eta)$$

.

A deviation to any $s_{1,0} \in (s_{1,0}^L, s_{1,0}^H)$ delivers expected payoffs equal to $-\left[2(1+\eta)-\lambda_L\eta^2\right]\lambda_L w$. Note that

$$-2p_{1,0}w\lambda_L(1-\lambda_L\eta^2) - w\lambda_L\eta(2+\lambda_L\eta) > -\left[2(1+\eta)-\lambda_L\eta^2\right]\lambda_L w$$

$$\iff p_{1,0} < \frac{1-\lambda_L\eta^2}{1-\lambda_L\eta^2} = 1$$

which always holds.

Let $g(\lambda_i)$ be the expected gain for type λ_i from offering $s_{1,0}^H$ instead of $s_{1,0}^L$, taking $(s_{1,0}^L, s_{1,0}^H, p_{1,0})$ as given:

$$\begin{aligned} g(\lambda_i) = &- s_{1,0}^H - \lambda_i^2\eta(1+\eta)w + p_{1,0}\left[2(1+\eta)-\lambda_i\eta^2\right]\lambda_i w + \\ &(1-p_{1,0})\left[s_{1,0}^L + \lambda_i^2\eta(1+\eta)w\right] \end{aligned} \tag{155}$$

We already argued that $g(\lambda_H) = 0$, hence $g(\lambda_L) = g(\lambda_L) - g(\lambda_H)$. As a result

$$\begin{aligned} g(\lambda_L) = &- s_{1,0}^H - \lambda_L^2\eta(1+\eta)w + \\ &p_{1,0}\left[2(1+\eta)-\lambda_L\eta^2\right]\lambda_L w + (1-p_{1,0})\left[s_{1,0}^L + \lambda_L^2\eta(1+\eta)w\right] \\ &+ s_{1,0}^H + \lambda_H^2\eta(1+\eta)w - p_{1,0}\left[2(1+\eta)-\lambda_H\eta^2\right]\lambda_H w - \\ &(1-p_{1,0})\left[s_{1,0}^L + \lambda_H^2\eta(1+\eta)w\right] \\ &= wp_{1,0}\Delta\lambda\left[\eta(\lambda_H+\lambda_L)(2\eta+1) - 2(1+\eta)\right] \end{aligned} \tag{156}$$

Therefore, $g(\lambda_L) \leq 0$ if and only if $(\lambda_L+\lambda_H)/2 \leq (1+\eta)/(2\eta^2+\eta)$, which is implied by $1-\lambda_L > \lambda_H$ for any choice of η.

Then, we show that if $\mu \geq \frac{\frac{f}{w}-\rho_2^L}{\Delta\rho_2}$ the described strategy profile is an element of a PBE.

Set the belief profile to $\mu_1(s) = \mathbb{1}_{s\neq s_{1,0}^L}$. The plaintiff is indifferent between accepting or rejecting equilibrium offers. For any offer $s_{1,0} \in (s_{1,0}^L, s_{1,0}^H)$ the plaintiff strictly prefers to reject. Hence, there is no profitable deviation for the plaintiff.

We choose $p_{1,0}$ such that the high-type defendant is indifferent between offering $s_{1,0}^H$ and $s_{1,0}^L$:

$$p_{1,0}\left[2(1+\eta)-\lambda_H\eta^2\right]\lambda_H w + (1-p_{1,0})\left[s_{1,0}^L + 2\lambda_H^2\eta w\right] = s_1^H + 2\lambda_H^2\eta w$$

$$\iff p_{1,0}\left[\left[2+(2-\lambda_H)\eta - \lambda_H\eta(1+\eta)\right]\lambda_H w - s_{1,0}^L\right] = s_1^H - s_{1,0}^L.$$

Using $s^i_{1,0} = (2-\lambda_i)\lambda_i \eta w$ we get:

$$p_{1,0} = \frac{s^H_1 - s^L_{1,0}}{[2-\lambda_H\eta(1+\eta)]\,\lambda_H w + s^H_{1,0} - s^L_{1,0}} = \\ = \frac{(2-\lambda_H-\lambda_L)\Delta\lambda\eta}{\lambda_H\,[2-\eta\lambda_H(1+\eta)] + (2-\lambda_H-\lambda_L)\Delta\lambda\eta}. \tag{157}$$

Finally, we check that the low-type defendant has no incentive to deviate. As in the previous part of the proof let $g(\lambda_i)$ be the expected gain for type λ_i of offering $s^H_{1,0}$ instead of $s^L_{1,0}$, taking $(s^L_{1,0}, s^H_{1,0}, p_{1,0})$ as given.

$$\begin{aligned} g(\lambda_i) = &-s^H_{1,0} - \lambda_i^2\eta w\left[2 + \frac{\Delta\lambda(1-\eta)}{\Delta\lambda\eta+\lambda_H}\mathbb{1}_{\lambda_i=\lambda_L}\right] \\ &+ p_{1,0}\left[2(1+\eta) - \lambda_i\eta^2\right]\lambda_i w \\ &+ (1-p_{1,0})\left[s^L_{1,0} + \lambda_i^2\eta w\left[2 + \frac{\Delta\lambda(1-\eta)}{\Delta\lambda\eta+\lambda_H}\mathbb{1}_{\lambda_i=\lambda_L}\right]\right]. \end{aligned} \tag{158}$$

Since $g(\lambda_H) = 0$, we can write $g(\lambda_L) = g(\lambda_L) - g(\lambda_H)$ to get the following expression:

$$\begin{aligned} g(\lambda_L) = &-s^H_{1,0} - \lambda_L^2\eta w\left[2 + \frac{\Delta\lambda(1-\eta)}{\Delta\lambda\eta+\lambda_H}\right] \\ &+ p_{1,0}\left[2(1+\eta) - \lambda_L\eta^2\right]\lambda_L w \\ &+ (1-p_{1,0})\left[s^L_{1,0} + \lambda_L^2\eta w\left[2 + \frac{\Delta\lambda(1-\eta)}{\Delta\lambda\eta+\lambda_H}\right]\right] \\ &+ s^H_{1,0} + 2\lambda_H^2\eta w - p_{1,0}\left[2(1+\eta) - \lambda_H\eta^2\right]\lambda_H w - \\ &(1-p_{1,0})\left[s^L_{1,0} + 2\lambda_H^2\eta w\right] \\ &= p_{1,0} w\Delta\lambda\left[-2(1+\eta) - \lambda_L^2\eta\frac{1-\eta}{\Delta\lambda\eta+\lambda_H} + (\lambda_H+\lambda_L)(2\eta+\eta^2)\right]. \end{aligned} \tag{159}$$

Therefore, $g(\lambda_L) \leq 0$ if and only if

$$\frac{\lambda_H+\lambda_L}{2} \leq \frac{1+\eta}{2\eta+\eta^2} + \frac{\lambda_L^2(1-\eta)}{2(2+\eta)(\Delta\lambda\eta+\lambda_H)}, \tag{160}$$

which is implied by $1-\lambda_L > \lambda_H$ for any choice of η.

To finish the proof, we show that the proposed equilibrium satisfies the D1 criterion. To prove it, it is enough to show that the high-type defendant is not eliminated for any strategy $s \in (s^L_{1,0}, s^H_{2,0})$ under the D1 criterion.

Take any such offer. Then the defendant of type i is better off making the offer s rather than under her equilibrium payoff if and only if the offer s is rejected at most with probability $p^i(s) \equiv p_{1,0} - \frac{s - s^L_{1,0}}{\kappa^i_1 - \kappa^i_0 - s_L}$.

Recall that the low type never has a profitable deviation of proposing $s^H_{1,0}$, and the high type never has a profitable deviation of proposing $s^L_{2,0}$. Hence, it is always the case that $\kappa^H_1 - \kappa^H_0 > \kappa^L_1 - \kappa^L_0$. Hence $p^H(s) > p^L(s)$ and the defendant of the high type is not eliminated for strategies $s \in (s^L_{1,0}, s^H_{2,0})$. ■

Proof of Proposition 3.3 Proposition 3.3 is proved in lemmas 34 – 36. The proof includes only the analysis of the negotiation in period 1 and the decision on filing the case in period 3, as other subgames exactly follow the proof of Proposition 3.2.

Lemma 34. *In any equilibrium satisfying the D1 criterion during the negotiation in the first period:*

(i) the defendant makes an offer including a transfer $s^i_{1,0} = \rho^i_1 w$.

(ii) A pair of probabilities (q^H, q^L) with which the i-type defendant makes a public settlement offer can be supported as a part of some equilibrium if and only if the decision of the second-period plaintiff is independent from observing a public settlement.

(ii) The plaintiff always accepts the offer with a transfer $s^H_{1,0}$, and rejects the offer with a transfer $s^L_{1,0}$ with some positive probability.

Lemma 34 is proved in claims 21 – 25.

Claim 21. *In any PBE satisfying the D1 criterion during the first-period negotiation the defendant of a high type makes an offer $s^H_{1,0}$.*

Proof. Firstly, observe that a strategic plaintiff always accepts any offer including a transfer $s > s^H_{1,0}$ independently of the secrecy regime proposed. Hence, no offer $s > s^H_{1,0}$ can be made in the equilibrium.

Take some candidate equilibrium in which the high type makes the offer $S = (s, \zeta)$ where $s < s^H_{1,0}$. Then, it must be the case that this offer is not rejected with probability 1, but only with some probability p. Hence, the low type must make an offer S with positive probability. Following the proof of Claim 17, recall that, for a given ζ, there exists at most one such offer.

Then, take some offer $S' = (s', \zeta)$, which is not made on the equilibrium path, with $s' = s^L_{1,0} + \varepsilon$ and ζ that is used in the offer S. Recall from Claim 19 the values of the continuation game for the defendant κ^i_k. Observe that if the second-period plaintiff files the case after observing history $h_2 = (0, \zeta)$, then

$\kappa_0^i = \lambda_i^2 \eta w \left[2 + \frac{\Delta\lambda(1-\eta)}{\Delta\lambda\eta + \lambda_H} \mathbb{1}_{\lambda_i = \lambda_L}\right]$, and otherwise $\kappa_0^i = \lambda_i^2 \eta (1+\eta) w$. Moreover, κ_1^i remains unchanged.

Hence, the i-type defendant is better off making an offer S' if it is rejected with probability at most $p^i(S') \equiv \frac{p(\kappa_1^i - \kappa_0^i - s) - s' + s)}{\kappa_1^i - \kappa_0^i - s'}$. Recall from the proof of Claim 20 that $\kappa_1^H - \kappa_0^H > \kappa_1^L - \kappa_0^L$. Hence, $p^H(S') < p^L(S')$, and if the equilibrium satisfies the D1 criterion $\mu_{1,h_1}(S') = 0$. Therefore, the offer S' is always accepted by the plaintiff, and the defendant has a profitable deviation of making the offer S'. ■

Claim 22. *In any PBE satisfying the D1 criterion during the first-period negotiation the defendant of a low type makes an offer* $s_{1,0}^L$.

Proof. Claim 21 implies that there does not exist an equilibrium in which the low-type defendant makes an offer with a transfer $s > s_{1,0}^L$. If $s \in (s_{1,0}^L, s_{1,0}^H)$ in a candidate equilibrium, then the offer made by the low type is always accepted and the high type has a profitable deviation of making an offer s. If $s \geq s_{1,0}^H$ then the proof of Claim 21 applies, and there exists some offer S' with a transfer $s' = s_{1,0}^L + \varepsilon$, which is always accepted by the plaintiff. Thus, the defendant has a profitable deviation of making the offer S'.
Suppose there exists an equilibrium, in which some offer $s < s_{1,0}^L$ is made by the defendant of the low type. Then, it is always rejected by the plaintiff. Consider some offer S' with a transfer $s' = s_{1,0}^L + \varepsilon$. Then, the plaintiff of the low type is better off making this offer than under her equilibrium payoff if it is accepted with any positive probability. The plaintiff of the high type is better off making the offer S' only if it is accepted with a probability higher than some threshold. Hence, if the equilibrium satisfies the D1 criterion, $\mu_{1,h_1}(S') = 0$, and the offer S' is always accepted. Therefore, the defendant has a profitable deviation of making an offer S'. ■

Claim 23. *There does not exist a PBE satisfying the D1 criterion, in which the second-period plaintiff files the case upon observing* $h_2 = (0,0)$ *but not upon observing* $h_2 = (0,1)$.

Proof. Take any such candidate equilibrium. Then, it must that the high-type defendant settles the case secretly with some positive probability. Hence, the high-type defendant has a profitable deviation of proposing a public settlement with probability 1. ■

Claim 24. *There does not exist a PBE satisfying the D1 criterion, in which the case is settled publicly with some positive probability and the second-period plaintiff files the case upon observing* $h_2 = (0,1)$*, but not upon observing* $h_2 = (0,0)$.

Proof. Take any such equilibrium. Then, it must be that the high type proposes a public settlement with some positive probability. Hence, she has a profitable deviation of proposing a secret settlement with probability 1. ■

Claim 25. *There does not exist a PBE satisfying the D1 criterion, in which the second-period plaintiff files the case upon observing $h_2 = (0,1)$, but not $h_2 = (0,0)$.*

Proof. Claim 24 proves the case when the case is settled publicly with some positive probability.
Suppose there exists an equilibrium in which the case is always settled secretly in the first period, and the second-period strategic plaintiff files the case if he observes $h_2 = (0,1)$, but not $h_2 = (0,0)$.
Observe that in any such equilibrium, the low offer during the first-period negotiation must be rejected with some probability $p \geq \underline{p}_{1,0} = \frac{\Delta\rho_1}{\Delta\rho_1 + 2\lambda_H(1-\lambda_H\eta) - \lambda_H\eta(1-\eta)}$.
Denote by $-\kappa_0^i(\zeta)$ the value of the continuation game for the defendant of type i, if the case in period 1 is settled at a privacy regime ζ. Following the proof of Claim 19 $\kappa_0^i(0) = \lambda_i^2\eta(1+\eta)w$, and $\kappa_0^i(1) = \lambda_i^2\eta w \left[2 + \frac{\Delta\lambda(1-\eta)}{\Delta\lambda\eta + \lambda_H}\mathbb{1}_{\lambda_i = \lambda_L}\right]$.

Consider an offer $S' = (s' = s_{1,0}^L + \varepsilon, \zeta = 1)$. Then, the high-type defendant is better off making the offer S' than under her equilibrium pay-off if it is rejected with probability at most $p^H \equiv \frac{s_{1,0}^H - s' - (\kappa_0^H(1) - \kappa_0^H(1))}{\kappa_1^H - \kappa_0^H(1) - s'}$. And the low-type defendant is better off making the offer S' than under her equilibrium if it is rejected with probability at most $p^L \equiv \frac{p(\kappa_1^L - \kappa_0^L(0) - s_{1,0}^L) - (\kappa_0^L(1) + s' - \kappa_0^L(0) - s_{2,0}^L)}{\kappa_L^1 - \kappa_0^1(1) - s'}$.

We claim that for ε small enough it must be the case that $p^H < p^L$ and $p^L > 0$. Observe that p^L is increasing in p, hence take the smallest possible $p = \underline{p}_{1,0}$. Knowing that if $p = \underline{p}_{1,0}$, the defendant of a high type is indifferent between making an offer $S = (s_{1,0}^H, 0)$ and $S = (s_{1,0}^L, 0)$, we can restate the expression for p^i where $i = H, L$ in the following way:

$$\begin{aligned} &\underline{p}_{1,0}\kappa_1^i + (1-\underline{p}_{1,0})(\kappa_0^i(0) + s_{1,0}^L) = \\ &= p^i\kappa_1^i + (1-p^i)(s' + \kappa_0^i(0)) + (1-p^i)(\kappa_0^i(1) - \kappa_0^i(0)). \end{aligned} \tag{161}$$

Hence, if $\kappa_0^H(1) - \kappa_0^H(0) > \kappa_0^L(1) - \kappa_0^L(0)$, there exists an offer s' sufficiently close to $s_{1,0}^L$ for which p^L is indeed strictly smaller than p^H. Substituting for κ_k^i's and simplifying we obtain:

$$\lambda_H^2\eta > \lambda_L^2\eta + \lambda_L^2 p_{2,0}. \tag{162}$$

Observe that $p_{2,0}$ is bounded from above by $\frac{\Delta\lambda}{\Delta\lambda + \lambda_H}$. Therefore, a sufficient condition for (162) is given by:

$$\Delta\lambda[\lambda_L + \lambda_H]\eta + \lambda_H[\lambda_L + \lambda_H]\eta > \lambda_L^2. \tag{163}$$

Using the assumption that $\lambda_L < \frac{f}{w}$ and $\lambda_H\eta > \frac{f}{w}$, and therefore $\lambda_L < \lambda_H\eta$, it must be the case that $\kappa_0^H(1) - \kappa_0^H(0) > \kappa_0^L(1) - \kappa_0^L(0)$.

Observe that the RHS of (161) is continuously increasing in p^i and s'. Hence, to show that $p^L > 0$ for some s' sufficiently close to $s^L_{1,0}$, it is enough to prove that if $s' = s^L_{1,0}$ and $p^L = 0$, then the RHS of (161) is strictly larger than the LHS of (161). In other words:

$$\Delta\rho_1\lambda_L[2(1-\lambda_l\eta) - \lambda_l\eta(1-\eta)(\eta + p_{2,0})] >$$
$$\lambda_H(2(1-\lambda_H\eta) - \lambda_H\eta(1-\eta))(\kappa^L_0(1) - \kappa^L_0(0)). \tag{164}$$

Note that: $2(1-\lambda_L\eta)-\lambda_L\eta(1-\eta)(\eta+p_{2,0}) > 2(1-\lambda_H\eta)-\lambda_H\eta(1-\eta)$. Hence, it is enough to prove that:

$$\Delta\rho_1 > \lambda_H\lambda_L(1-\eta)(\eta + p_{2,0}). \tag{165}$$

Using the assumption that $(1 - \lambda_L > \lambda_H)$, we can show that $\Delta\rho$ is bound from below by $\eta\Delta\lambda(2-\eta)$. Moreover, since $\lambda_L < \lambda_H\eta$, it must be the case that $\Delta\lambda > (1-\eta)\lambda_H$ and $\eta > \frac{\lambda_L}{\lambda_H}$. Naturally, $p_{2,0} < 1$. Hence, a sufficient condition for $p^L > 0$ is given by:

$$2 - \eta \geq \lambda_H(1 + \eta), \tag{166}$$

which is always satisfied.

Thus, if the equilibrium satisfies the D1 criterion, there exists an offer $S' = (s' > s^L_{2,0}, \zeta = 1)$ such that $\mu(S') = 0$. This offer is always accepted by the plaintiff and (by the fact that $p^L > 0$) the defendant of a low type has a profitable deviation of making the offer S'. ■

Lemma 35. *If the probability of the rejection of the offer $s^L_{1,0}$ during the first-period negotiation is given by p, then in any PBE equilibrium satisfying the D1 criterion in which the decision on filing the case is taken in pure strategies, the second-period strategic plaintiff files the case upon observing $k_2 = 0$ if and only if $l \geq \tilde{l}(p) \equiv \check{l}_2\frac{\lambda_L(1-\eta\lambda_L-p\lambda_L(1-\eta))}{\lambda_H(1-\eta\lambda_H)}$. Otherwise, there exists an equilibrium in which the second-period plaintiff always files the case.*

Proof. Following Lemma 34 it must be that a decision of a second-period plaintiff is independent from the realization of n_2.

Denote by q^i the probability with which the defendant of type i proposes a public settlement in period 1. Then, if an equilibrium in which the second-period plaintiff never starts the litigation exists, there must exist a pair $(q^H, q^L) \in [0,1]^2$ satisfying the following two conditions:

$$\check{l}_2 \leq l\frac{\lambda_H\Big(\lambda_H(1-\eta)(1-q^H) + 1 - \lambda_H)\Big)}{\lambda_L\Big((1-\eta)(1-p)(1-q^L) + 1 - \lambda_L\Big)}, \tag{167}$$

$$\check{l}_2 \leq l \frac{\lambda_H \lambda_H (1-\eta) q^H}{\lambda_L \lambda_L (1-\eta)(1-p) q^L}. \tag{168}$$

Condition (167) ensures that a second-period strategic plaintiff does not file the case if he observes $h_2 = (0,0)$, condition (168) ensures that a second-period strategic plaintiff does not file the case if he observes $h_2 = (0,1)$.
Rearranging the conditions we obtain:

$$q^L \geq \frac{1}{1-p}\Big(\frac{l}{\check{l}_2}\frac{\lambda_H^2}{\lambda_L^2} q^H - \frac{l\lambda_H}{\check{l}_2 \lambda_L}\frac{(1-\eta\lambda_H)}{\lambda_L(1-\eta)} + \frac{1-\big((1-\eta)p+\eta\big)\lambda_L}{\lambda_L(1-\eta)}\Big), \tag{169}$$

$$q^L \leq \frac{1}{1-p}\frac{l}{\check{l}_2}\frac{\lambda_H^2}{\lambda_L^2} q^H. \tag{170}$$

From (169) and (170) we get that the set of $(q^H, q^L) \in [0,1]^2$ satisfying (167) and (168) is non-empty if and only if:

$$\frac{1-\big((1-\eta)p+\eta\big)\lambda_L}{\lambda_L(1-\eta)} \leq \frac{l\lambda_H}{\check{l}_2 \lambda_L}\frac{(1-\eta\lambda_H)}{\lambda_L(1-\eta)}. \tag{171}$$

Solving (171) for l the following condition is obtained:

$$l \leq \check{l}_2 \frac{\lambda_L\big(1-\lambda_L\eta - p\lambda_L(1-\eta)\big)}{\lambda_H(1-\lambda_H\eta)} = \tilde{l}(p). \tag{172}$$

Hence, the equilibrium, in which a second-period strategic plaintiff never starts the litigation exists if and only if $l \leq \tilde{l}(p)$.
The proof that the equilibrium in which a second-period plaintiff always files the case exists if and only if $l > \tilde{l}(p)$ follows the exact same steps, and only requires reversing the direction of inequalities. ∎

Lemma 36. *If $l \leq \tilde{l}(\underline{p}_{1,0})$ then there exists a PBE satisfying the D1 criterion, in which the second-period strategic plaintiff never starts the litigation, and the probability of rejecting the offer $s^L_{1,0}$ during the first-period negotiation is given by $\underline{p}_{1,0}$.*
If $l \geq \tilde{l}(\bar{p}_{1,0})$ then there exists a PBE satisfying the D1 criterion, in which the second-period plaintiff always files the case, and the probability of rejecting the offer $s^L_{1,0}$ during the first-period negotiation is given by $\bar{p}_{1,0}$.
No other PBE satisfying the D1 criterion, in which the decision on filing the case is taken in pure strategies exists.

Proof. Observe that $\bar{p}_{1,0}$ is the probability of rejecting the low offer during the first-period negotiation which makes the high-type defendant exactly indifferent between making the offer $s^L_{1,0}$ and $s^H_{1,0}$, conditional on the second-period plaintiff always filing the case.

The proof that if a second-period plaintiff always files the case, then in any PBE satisfying the D1 criterion during the first-period negotiation the low offer is rejected with probability $\bar{p}_{1,0}$ follows the proof of Proposition 3.2. Hence, the existence condition is a corollary of Lemma 35.

Analogous reasoning applies for the equilibrium in which a second-period strategic plaintiff never starts the litigation. ■

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