Designing Remedies to Compensate Plaintiffs for Unobservable Harms

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Despite the vast sums transferred through the legal system, the foundations of the procedures used to compensate plaintiffs for unobservable losses remain unclear. Standard remedies can compensate plaintiffs for unknown harms, but it is expensive to do so. Damage awards will generally undercompensate or overcompensate a plaintiff whose true harm is unknown, while equitable remedies that provide more tailored compensation are generally wasteful. In this article I develop a novel remedy that compensates plaintiffs for unobservable private values at the lowest possible cost to the defendant. This remedy consists of offering the plaintiff the choice between intermediate damages and an inalienable injunction that restores the underlying harm at the conclusion of the trial. I show that this remedy is robust to errors by the court and potential post judgment renegotiation. Furthermore, I demonstrate that this remedy reduces litigants' incentives to lie during trial. Finally, I consider *ex ante* deterrence and show conditions under which the remedy improves social welfare relative to optimal damages. (*JEL:* K12, K13, K40, D82)

1. Introduction

At the conclusion of a trial, successful plaintiffs are awarded remedies that are meant to compensate them for the harms that they have suffered.

Because the court does not know the true amount of harm suffered by the plaintiff, it is difficult to structure the remedy. In particular, plaintiffs may be undercompensated or defendants may pay far too much. From harm to a cherished piece of property, to emotional damage, to pain and suffering, courts cannot directly observe a plaintiff's harm. At the conclusion of a trial uncertainty invariably remains, leaving the choice of remedy to be little more than educated guesswork. Despite the billions of dollars in compensatory remedies that are awarded annually,[1] the best means of compensating plaintiffs for unobservable losses remains unclear to this day.

This article considers the question: how can a court fully compensate plaintiffs for unobservable harms at the lowest possible cost to the defendant? I introduce a novel remedy that induces plaintiffs to truthfully reveal information about their unobservable harms. The remedy consists of offering the successful plaintiff the choice of monetary damages or an inalienable injunction that remediates the underlying harm at the conclusion of the trial. This choice induces plaintiffs to truthfully reveal information about their private valuations. Low-value plaintiffs will choose damages while high-value plaintiffs will choose the injunction. Plaintiffs are always compensated because they can choose the injunction if damages are undercompensatory. I call this the *optional injunction remedy*. The optional injunction remedy incorporates the strengths of both legal and equitable remedies, while minimizing their respective costs.

In most civil cases plaintiffs are awarded monetary damages, but the unobservability of plaintiffs' harms may hurt both plaintiffs and defendants. Many plaintiffs prevail at trial, yet are awarded damages that are not enough to compensate for the harms that they have suffered, violating norms of justice. In other cases, plaintiffs are compensated far more than necessary, leaving the defendant with exorbitant costs. This overpayment is not only unfair to the defendant, but may also lead to overdeterrence.

As an alternative to monetary damages, courts are often able to award equitable relief that undoes the underlying harm and fully compensates

1. Mello et al. (2010) estimate $3.15 billion in economic damages and $2.4 billion in noneconomic damages in the medical liability system alone. There are no widely agreed upon estimates of compensatory remedies more broadly. Tillinghast-Towers-Perrin (2003) estimates that courts awarded $51.3 billion in economic damages and $56 billion in noneconomic damages in the tort system in 2003.

plaintiffs. Instead of awarding damages to compensate for property damage, the court could enjoin the defendant to fix the property; instead of awarding damages for breach of contract, the court could enjoin the defendant to perform on the contract; instead of awarding damages for pain and suffering, the court could provide medical and counseling services. Throughout this article, I use the term *injunction* in a narrow sense to refer to relief that remediates the underlying harm caused by the defendant.[2] In contract cases, this generally consists of specific performance. In tort cases, the court should determine the underlying interest of the plaintiff that has been harmed, and an injunction should restore that interest. The great strength of an injunction is that, in many cases, injunctions can be structured to fully compensate plaintiffs for harms, even when the court does not know how much the plaintiff has been harmed. The drawback is that it may be wasteful if the cost to the defendant of providing the injunction is more than the value of the injunction to the plaintiff.

By offering the plaintiff the choice between intermediate damages and an inalienable injunction, the optional injunction remedy guarantees full compensation, but at a lower cost than standard remedies. The application of the remedy hinges upon two things. First, the court must be able to structure the injunction in a manner that compensates plaintiffs for their unobservable harms. Second, the court must choose a level of damages that is enough to induce low-value plaintiffs to prefer damages to the injunction. The application is particularly clear in the case of damage to real property.

In *Corbello v. Iowa Production*,[3] an oil company was found liable for causing extensive damage to plaintiff's 320 acres of rural land. At issue was the correct remedy. Despite a property value of only $108,000, it would have cost a full $33 million to restore the land to its original condition. The Supreme Court of Louisiana upheld a verdict of $33 million, yet plaintiffs had no legal duty to use the award to restore the property.

The $33 million verdict adequately compensated the plaintiffs almost surely. But, the court may have been able to fully compensate at a much lower cost. Instead of a damage award, the court could have awarded the optional injunction remedy. The plaintiffs would then have had the choice

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2. This is obviously a small subset of the possible injunctions. In the terminology of Calabresi and Melamed (1972), this is an entitlement to the plaintiff to be free of harm from the defendant, protected by a property rule.

3. 850 So. 2d 686 (La. 2003).

between an inalienable injunction that would restore their property or an intermediate level of damages (e.g., $3 million). Given this choice, the plaintiffs would have chosen whichever option would be better for them. If plaintiffs valued the restored land at more than $3 million, they could have chosen the injunction which would have restored them to the position they were in before the defendant's actions (the defendant would have been enjoined to physically restore the land). But if plaintiffs valued the restored land at less than $3 million, they could have chosen damages, and would have been in a better position than if they had chosen the injunction. By giving the plaintiffs this choice, they are guaranteed to be fully compensated. The defendant is no worse off if the plaintiffs choose the injunction (they pay the same $33 million). But if plaintiffs choose damages, the defendant saves $30 million. This example illustrates the simple mechanics and the potential cost savings of the optional injunction remedy.

The remainder of the article is structured as follows. After reviewing the related law and literature in the next section, I develop a formal model of unobservable harms in Section 2. In Section 3, I develop the optional injunction remedy and prove that it is the least expensive means of compensating plaintiffs for unobserved private harms. While a precise mathematical formulation is given, I show that the remedy dominates standard remedies even if the court makes large errors of implementation. Furthermore, I demonstrate that the optional injunction remedy reduces the litigants' incentives to lie during the trial. This section also shows how the optional injunction remedy can be used by courts with goals other than minimizing the cost to the defendant.

The optional injunction remedy minimizes costs by offering a choice that separates plaintiffs into two groups, and cost savings are achieved by compensating these two groups differentially. In Section 4, I consider the question of whether it could be advantageous to offer plaintiffs a broader set of options, and thereby separate plaintiffs into more groups based on type. I show that while it is possible to offer choices that more finely separate plaintiffs, doing so increases the cost of the remedy.

In Section 5, I consider a key component of the optional injunction remedy: inalienability. The optional injunction remedy gives the plaintiff the choice between damages and an *inalienable* injunction. The inalienability of the injunction ensures that plaintiffs only choose injunctive relief if damages

are undercompensatory. Otherwise, plaintiffs may choose the injunction in order to secure a favorable bargaining position in post judgment negotiations. I discuss the court's powers to limit the scope of renegotiation, and I show that the cost savings of the optional injunction remedy persist so long as there is even a small chance that renegotiation will not occur.

Up through Section 6, I consider the *ex post* question of providing a remedy to a plaintiff who has been wronged. In Section 6, I embed the optional injunction remedy into a model of social welfare where would-be injurers choose whether or not to take an action that will harm others. I show that when victims are sufficiently risk averse, the optional injunction remedy results in higher social welfare than standard damage awards. Finally, Section 7 considers the application of the remedy to some real-world cases and Section 8 concludes. Formal proofs are given in Appendix A.

1.1. Related Law and Literature

A remedy is anything that the court can do for a plaintiff who has been wronged (Laycock, 2012). The most basic goal of remedies is to compensate plaintiffs for harms: the Restatement (Second) of Torts lists the first goal of tort damages as "to give compensation, indemnity or restitution for harms," while the Restatement (Second) of Contracts states that damages are intended to "put [the plaintiff] in as good a position as he would have been in had the contract been performed."[4]

This article adopts compensation as the driving goal of the court. This is not to say that all courts in all situations will focus primarily on compensation. In some cases, it may be impossible to award a remedy that is even approximately compensatory. In other cases, some other goal may take precedence over compensation. But while it is not always the paramount goal, compensation is the driving factor in many cases, and therefore deserves careful study.

If compensation were the court's only goal, remedies would be simple. Courts could set damage awards arbitrarily high, thereby maximizing the probability that plaintiffs are compensated. But courts have multifaceted

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4. The Restatement (Second) of Torts §901(a); Restatement (Second) of Contracts §347 comment (a).

incentives. In addition to compensating plaintiffs, courts have other goals when structuring remedies—ranging from punishing wrongdoers to avoiding economic waste to deterring future wrongful conduct.[5] Of the many secondary goals that the court could pursue, this article examines a court that minimizes the cost borne by the defendant. The Restatement (Second) of Torts explains that "[i]t is desirable, also, that there be definiteness of proof of the amount of damage as far as is reasonably possible," while the Restatement (Second) of Contracts explains that damages can be limited due to uncertainty, but "[d]oubts are generally resolved against the party in breach."[6] Therefore the objective of the court considered in this article is to minimize the burden borne by the defendant while ensuring adequate compensation for the plaintiff.[7]

The utility function utilized in this article differs from standard social welfare functions used in the economic analysis of the law. Economic theories generally design legal rules to induce socially desirable behavior (Polinsky and Shavell, 2007). In particular, Kaplow and Shavell (2001) show that any non-welfarist method of policy analysis violates the Pareto principle. They show that social welfare will be lower when fairness is taken into account, and therefore argue that welfare considerations, and not fairness, should guide policy decisions. The authors acknowledge the tautology of their argument, yet still argue against fairness considerations due to the potentially large welfare losses.[8] While Kaplow and Shavell argue

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5. In addition to socially minded goals, some argue that courts maximize a more selfish utility function. For example, Cooter (1983) suggests that judges seek prestige when making judgments, while Posner (1993) argues that leisure is a fundamental driver of judicial decision making.

6. The Restatement (Second) of Torts §912(a); Restatement (Second) of Contracts §352.

7. This objective function relates to the principle of corrective justice, "which (in its most influential form) says that an individual has a duty to repair the wrongful losses that his conduct causes" (Coleman et al., 2015).

8. Coleman (2002), Dorff (2001), Chang (2000), and others have criticized Kaplow and Shavell's conclusions from a number of perspectives. And while, Kaplow and Shavell defend the Pareto principle when it conflicts with fairness, Sen (1970) questioned the appeal of the Pareto principle when he discovered that it conflicts with liberalism. Finally, while Kaplow and Shavell make a strong argument for consequentialist reasoning, their view is a minority view among professional philosophers. Bourget and Chalmers (2014) surveyed nearly half of all philosophy professors at the ninety-nine top-ranked philosophy departments, and found that only 23.6% identified as consequentialists. So

that welfare should be the ultimate guide in making policy decisions, they do acknowledge that fairness may have an instrumental role in evaluating policy under a welfarist approach. One reason is that fairness may proxy welfarist principles when a direct assessment of policies cannot be undertaken. In Section 6, I consider a model of social welfare and show that the remedy developed in this article, while based on principles of fairness, can increase social welfare by acting as a proxy for risk-reduction when an individual's type cannot be directly observed. A second reason for incorporating fairness recognized by Kaplow and Shavell is that if individuals have tastes for fairness, then those tastes should be incorporated into a welfare analysis. Regardless of what principles are advocated by scholars, the ultimate objective function should be the pragmatic one—that of the ruling judge. As Judge Richard Posner said, "[a] case is just a dispute. The first thing you do is ask yourself—forget about the law—what is a sensible resolution of this dispute?"(Liptak, 2017). This purpose of this article is not to tell the judge what objective function she should maximize, but if the "sensible resolution" includes compensating plaintiff while limiting the cost to the defendant, this article gives the judge an effective mechanism do so.

The court's goals can be implemented in two primary ways: legal or equitable relief. Legal relief, consisting of damages, is the presumptive form of relief in most cases. Courts award damages that are meant to compensate the plaintiff for the harm that she has suffered. But because harm can be measured in a variety of ways, damages can be classified based on what harm the damages are meant to compensate for. *Market value* damages are meant to compensate the plaintiff for the observable portion of the plaintiff's harm. Market value damages compensate for objective harms, but fail to compensate plaintiffs for unobservable idiosyncratic harms. At the opposite extreme, *cost of performance* damages represent the cost of undoing the harm that has been done. Cost of performance damages provide enough money to undo the harm and are therefore fully compensatory for both objective and subjective harms. Finally, courts award *intermediate damages*, which are greater than market value damages and less than cost

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while consequentialism is an important school of normative ethics, other views deserve consideration.

of performance damages. Intermediate damages fully compensate some plaintiffs, but fail to fully compensate others.

As an alternative to legal relief, more flexible equitable relief is generally available,[9] which allows courts to award relief that is restitutionary, in money, or coercive (Dobbs, 1993). In particular, courts can structure equitable relief to provide remediation of the underlying harm. Because it undoes the harm that was done, equitable relief can be structured to perfectly compensate all plaintiffs.

The debate over whether legal or equitable relief should be generally applied has been prominent in contract law, but the arguments carry over to other areas of private law. Eisenberg (2005) explains how damages may be generally undercompensatory, and often fail to make the plaintiff indifferent between performance or breach. Many scholars have therefore argued for widely available equitable relief in order to better compensate plaintiffs (Schwartz, 1979). But there are two important criticisms to implementing equitable relief. First, equitable relief may lead to economic waste if the value to the plaintiff is less than the cost of providing the equitable relief. While parties could avoid this inefficiency by having the defendant buy back the duty of providing equitable relief, transaction costs will limit the scope of efficient trades. Second, equitable relief may suffer from opportunism because plaintiffs may seek equitable relief in order to secure a favorable bargaining position (Ayres and Madison, 1999, 2000).[10]

In order to counter this threat of opportunism, courts can tailor the alienability of equitable relief. Courts may condition relief on actions of the

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9. Historically law and equity were broken into two separate court systems. Today, courts of law and equity have largely been merged, and the irreparable injury rule that limited the scope of equitable relief is no longer constraining on courts (Laycock, 1990).

10. The authors argue that this could be countered by giving the defendant the option of making any equitable relief inalienable. The authors assert that this would lead to fewer plaintiffs electing injunctions. But due to the lack of a formal model, the implementability of their proposal is unclear. In particular the authors do not identify the court's preferences or action sets. In their setup, plaintiffs elect for the type of remedy before the trial, yet the court is assumed to award a fixed amount of expectation damages. But in equilibrium a rational court that awards expectation damages will know that plaintiffs who elect for damages are of relatively low type, and will therefore update expectation damages downwards. Anticipating this, fewer plaintiffs will elect for expectation damages. This process would continue until expectation damages converge to 0, yielding a pooling equilibrium on equitable relief.

plaintiff, and compliance can be enforced through contempt proceedings, fines, further injunctions, or even imprisonment (Bray, 2016). While court orders of inalienability would likely deter most post-judgment renegotiation between the parties, it may not be necessary. Arbel (2015) and Farnsworth (1999) empirically show that litigants rarely engage in post-judgment renegotiation after being awarded equitable relief, even when they are free to do so. The court's powers of contempt coupled with this empirical regularity should suffice to prevent most post-judgment renegotiation.

The optional injunction remedy works by separating plaintiffs into two groups, which can then be compensated differentially. A wide variety of research has considered how institutions, rules, and markets can be designed to best utilize individuals' private information. Stole (1992) shows how liquidated damage clauses can reveal information about an individual's type. In a paper closely related to this one, Avraham and Liu (2006) show that contracting parties may agree to let the non-breaching party choose the form of the remedy after the breach in order to leverage new information. A similar sorting mechanism has been independently developed in a conceptual paper by Ben-Shahar and Porat (2017), which well illustrates how a sorting mechanism can be applied to cases of emotional harm. The mathematical form of the optional injunction remedy relates closely to the optimal pricing mechanism for a buyer who buys an indivisible good from a seller with unknown production costs (McAfee and McMillan, 1988). For a general overview of the literature on screening, see Bolton and Dewatripont (2004).

2. A Model of Unobservable Harms

Setup. A defendant has harmed a plaintiff and the ensuing trial has concluded in favor of the plaintiff. The court knows that the plaintiff has suffered unobservable harm $\theta \in [0, 1]$, but the court does not know precisely how much the plaintiff has suffered. The court has two tools at its disposal. First, the court can award monetary damages $M \in [0, 1]$. Second, the court can choose whether or not to provide an injunction $I \in \{0, 1\}$. A remedy is represented by the pair (M, I). After the trial, the court offers the plaintiff a set of remedies: $\mathbb{S} = \{(M_1, I_1), (M_2, I_2), \ldots, (M_n, I_n)\}$, where the court is

able to structure and commit to the terms of the remedy.[11] The plaintiff then selects a remedy from among this set. Overall, the sequence of actions is as follows:

(1)   Nature determines the harm suffered by plaintiff, θ.
(2)   The court observes the posterior distribution of plaintiff types, $f(\theta)$.
(3)   The court offers the plaintiff a (possibly singular) set of remedies, $\mathbb{S}$.
(4)   The plaintiff chooses a remedy from the set provided by the court $(M, I) \in \mathbb{S}$.

Actors and Information.   The plaintiff's preferences are represented by the utility function:[12]

$$u(\theta, M, I) = \begin{cases} -\theta & \text{if no remedy is awarded} \\ M - \theta & \text{if damages } M \text{ are awarded} \\ 0 & \text{if injunction is awarded.} \end{cases}$$

Given a set of remedies, the plaintiff chooses the remedy that maximizes her utility.[13]

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11.   For the purpose of the analysis in Section 3, it is sufficient to limit attention to giving the plaintiff the choice between intermediate damages or an injunction at the conclusion of the trial, $\{(m, 0), (0, 1)\}$. Section 4 extends the model to consider remedy choices that are awarded probabilistically and allows the court to offer a continuum of choices rather than only a discrete number of choices.

12.   While this formulation of the plaintiff's utility function indicates risk-neutrality, no assumptions about the plaintiff's tolerance for risk are necessary for the baseline analysis in Section 3. Because the plaintiff is fully compensated, she does not bear any downside risk (the incidence of upside risk is discussed in Section 6). If the plaintiff were risk-averse, M could be interpreted as the utility benefit from a given level of damages rather than the amount of the damages. When a partial injunction is possible, risk aversion may affect the form of the remedy. This is discussed in footnote 50 of Appendix B.

13.   Implicit in this formulation is that no other parties take actions that affect the plaintiff's decision. It is possible that a third party may have preferences over the injunction and may be willing to offer a side payment to the plaintiff. The result of this behavior is ambiguous. A third party who would like the injunction could pay the plaintiff to induce her to choose the injunction, thereby increasing the cost of the remedy. However, the third party could also pay the plaintiff to elect for damages, which would reduce the cost of the remedy.

The defendant pays for the remedy that is awarded to the plaintiff. The defendant's costs are given by:

$$C(M,I) = \begin{cases} 0 & \text{if no remedy is awarded} \\ M & \text{if damages } M \text{ are awarded} \\ 1 & \text{if injunction is awarded,} \end{cases}$$

where it is assumed that the cost of providing the injunction is 1. Because $\theta \leq 1$ for all θ, this guarantees that awarding the injunction is inefficient. While not necessary, this assumption will make it clear that it is optimal to award injunctive relief even in cases of "efficient" breach.[14]

The goal of the court is to fully compensate the plaintiff at the lowest possible cost to the defendant. The court's preferences are represented by:

$$W(\theta,M,I) = \begin{cases} -\infty & \text{if plaintiff is undercompensated} \\ -C & \text{if the plaintiff is fully compensated.} \end{cases}$$

The term $-\infty$ in the court's utility representation reflects the fact that the court is unwilling to allow the plaintiff to be undercompensated. The defendant's costs are of secondary concern and only matter to the court when the plaintiff has been fully compensated. The goal of the court is therefore to select the set of remedies that minimizes the cost to the defendant subject to the plaintiff being fully compensated. The court's problem can be written:

$$\min_{\mathbb{S}} \ C(M,I)$$

$$\text{subject to}: \ u(\theta,M,I) \geq 0.$$

In making the choice of what set of remedies to offer the plaintiff, the court does not observe how much the plaintiff has been harmed. The value θ is private information of the plaintiff. The court only knows the posterior

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14.   The cost of 1 is without loss of generality. If the cost of providing the injunction is less than 1, the optional injunction remedy is still optimal but damages will be adjusted downward. If the cost of providing the injunction is greater than 1, the level of damages will be adjusted upward. In the next section, I discuss the implications if there is uncertainty about the cost of providing the injunction.

distribution of the valuation: $\theta \sim f[0, 1]$, which incorporates the information that the court has learned through the trial. Assume that the posterior distribution is continuous, has full support on this interval, and that $\frac{F(\theta)}{f(\theta)}$ is nondecreasing in θ.[15]

3. Analysis

To begin with, suppose that the court is perfectly informed about the plaintiff's type. The court can then treat each type of plaintiff separately and offer a type-specific remedy. In this case, the court awards damages equal to the plaintiff's type: $(M, I) = (\theta, 0)$. The court will never award the injunction, because it is more expensive for all plaintiffs except the highest type.

In the absence of perfect information, the court could ask the plaintiff how much harm she suffered, with the aim of providing differential compensation. But telling the truth would not be in the plaintiff's best interest, and all types would find it advantageous to claim that they are of type $\theta = 1$, thereby inducing the court to award damages of 1. The court would recognize the plaintiff's incentives and would not believe her declaration.

Perhaps because of the plaintiff's incentives to lie, courts do not offer remedies that vary in the plaintiff's declared type. Instead, courts offer the four types of compensatory remedies discussed in the previous section. Formally, these four remedies can be represented as follows: market value damages, $(M, I) = (0, 0)$; intermediate damages, $(M, I) = (m, 0)$, for $m \in (0, 1)$; cost of performance damages, $(M, I) = (1, 0)$; and an injunction, $(M, I) = (0, 1)$.[16] The plaintiff's utility from each of these remedies is given by:

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15.   While not necessary, this condition is sufficient to ensure that there is a unique solution. This constraint on the distribution of plaintiff types is similar to the common requirement in mechanism design problems that the hazard rate, $\frac{f(\theta)}{1-F(\theta)}$, is nondecreasing in θ.

16.   If the plaintiff has suffered an objective and observable harm, the court can easily award damages sufficient to compensate the plaintiff. Damages here should be interpreted as damages for the unobservable portion of the plaintiff's harm, which is why market value damages are given by $(M, I) = (0, 0)$.

$$u(\theta, M, I) = \begin{cases} -\theta & \text{if } (M, I) = (0, 0), & \text{Market value damages.} \\ m - \theta & \text{if } (M, I) = (m, 0), & \text{Intermediate damages.} \\ 1 - \theta & \text{if } (M, I) = (1, 0), & \text{Cost of performance damages.} \\ 0 & \text{if } (M, I) = (0, 1), & \text{Injunction.} \end{cases}$$

Given that the plaintiff has suffered harm between 0 and 1, market value damages leave all plaintiffs undercompensated, while intermediate damages leave a proportion of plaintiffs—those with harm greater than damages—undercompensated. Both cost of performance damages and the injunction fully compensate all plaintiffs, and both do so at the same cost to the defendant.

With the baseline remedies established I turn my attention toward finding the optimal solution to the court's problem. In order to achieve cost savings, it must be the case that the court can compensate some plaintiffs at a cost of less than 1. The court can improve upon the traditional remedies by offering the plaintiff the *ex post* choice of remedy. As discussed above, the court cannot assume that the plaintiff will truthfully declare her type. But it is possible to structure the choice of remedies in a manner that induces the plaintiff to reveal her private information:

PROPOSITION 1 (OPTIONAL INJUNCTION REMEDY) The remedy that guarantees full compensation at the lowest cost is to give the plaintiff the choice between an inalienable injunction or damages $m = \theta_D$, where damages are uniquely defined by the θ_D that solves: $\theta_D = 1 - \frac{F(\theta_D)}{f(\theta_D)}$.

The optional injunction remedy works by giving plaintiffs a choice that separates them into two groups based on their true valuations. Adequate compensation is guaranteed because all plaintiffs have the option of choosing the injunction. At the same time, some plaintiffs will choose damages. Plaintiffs with high valuations (those with values $\theta > \theta_D$) will find damages of θ_D undercompensatory and will therefore choose the injunction. While plaintiffs with low valuations (those with values $\theta \leq \theta_D$) would be perfectly compensated through the injunction, they can do better by choosing damages. By opting for damages, low types are overcompensated by an amount $\theta_D - \theta$. And because providing intermediate damages is less

expensive than providing the injunction, the optional injunction remedy is able to adequately compensate all plaintiffs at a lower cost to the defendant than traditional remedies. The following example illustrates the mechanics of the remedy:

Numerical Example 1. Suppose that plaintiffs are uniformly distributed: $f(\theta) = 1$ and $F(\theta) = \theta$. The optimal level of damages is therefore given by the θ_D that solves: $\theta_D = 1 - \frac{\theta_D}{1}$. Which is solved at $\theta_D = \frac{1}{2}$. Half of the plaintiffs will therefore choose damages, while half will choose the injunction, yielding an expected cost of $C = (\frac{1}{2})(\frac{1}{2}) + (\frac{1}{2})(1) = \frac{3}{4}$. Graphically, Figure 1 shows the cost to the defendant of the optional injunction remedy as a function of the damage offer. The horizontal axis represents the damage offer, θ_D, and the vertical axis
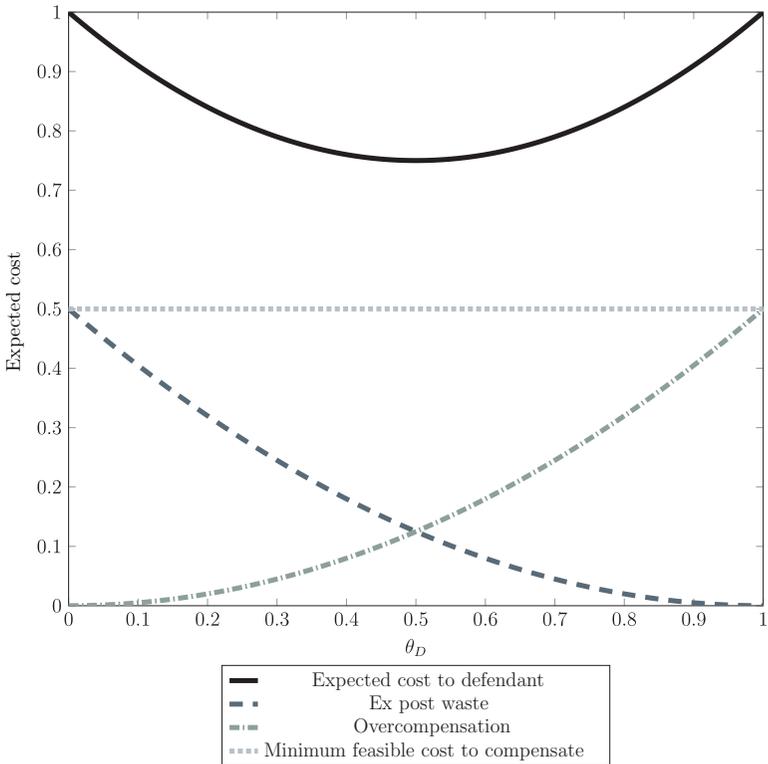

Figure 1. Expected Cost as a Function of the Damage Offer (uniform distribution of plaintiff values).

represents the expected cost. The uppermost curve indicates the expected cost to the defendant from offering a given level of damages. With a uniform distribution of plaintiff types, the cost to the defendant is minimized when damages are set at $\frac{1}{2}$. The other three curves decompose the cost of the remedy into constituent components. The decreasing curve is *ex post* waste, which is the difference between the cost of the injunction and the expected valuation of plaintiffs that choose the injunction. *Ex post* waste is decreasing in the offer of damages, because fewer plaintiffs will choose the injunction when a large damage award is available. The increasing curve shows that overcompensation increases in the offer of damages. Finally, the horizontal line at $\frac{1}{2}$ represents the minimum expected cost of compensation under full information.

More generally, the expected cost of the optional injunction remedy is $\theta_D F(\theta_D) + F(1 - \theta_D)$. The optimality of damages set at θ_D can be understood by contemplating a marginal change away from θ_D. The marginal benefit of increasing θ_D is equal to the reduction in *ex post* waste, $F(\theta_D) + \theta_D f(\theta_D)$, while the marginal cost of increasing θ_D is equal to the increase in overcompensation, $f(1 - \theta_D)$. At θ_D the marginal benefit equals the marginal cost. Increasing damages beyond θ_D implies that the gains from reduction in waste are outweighed by the increased costs of overcompensation. Conversely, decreasing damages below θ_D implies that the gains from decreased overcompensation are swamped by the increased costs of waste.

This discussion illustrates the importance of the court in implementing the optional injunction remedy. But due to the formality of proposition 1, courts are unlikely to set damages optimally, implying that the remedy will be subject to error. If the court sets damages too low, too many plaintiffs will choose injunctive relief, which is needlessly costly for the defendant. If the court offers damages that are too high, damages will be far too overcompensatory, which is again needlessly costly for the defendant. Despite this, the following result shows that the optional injunction remedy strictly dominates traditional fully compensating remedies, even in the presence of errors by the court.

COROLLARY 1 Offering the optional injunction remedy with incorrectly specified damages is less expensive than cost of performance damages or an injunction, so long as the court offers damages within the bounds of the plaintiff's possible subjective values: $\theta_D \in (0, 1)$.
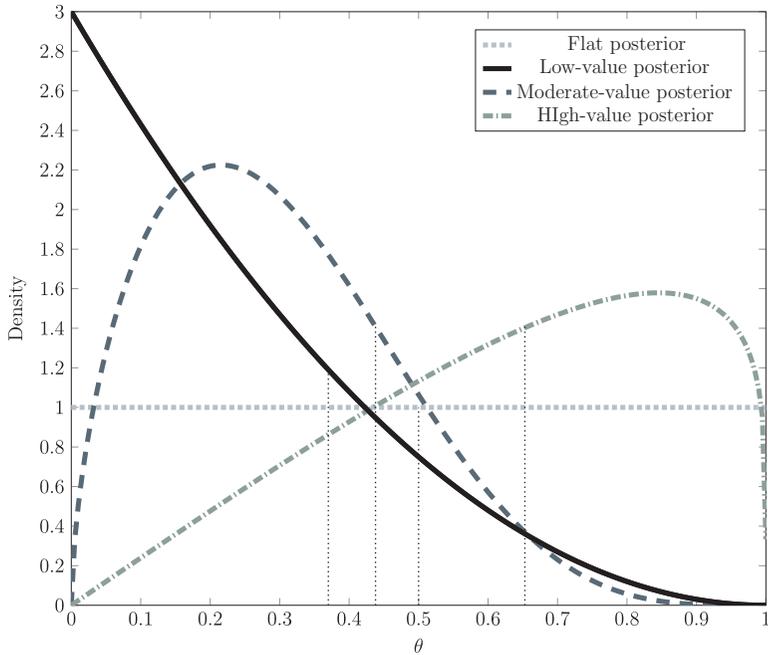
Figure 2. Optimal Damage Offers for a Variety of Posterior Distributions.

Corollary 1 formalizes a pattern seen in Figure 1—that the cost of the remedy is increasing as damages move away from θ_D, but the cost never exceeds the costs of the injunction or cost of performance damages (which both cost 1). In addition to showing the dominance of the optional injunction remedy compared to other remedies, this result gives an indication of the importance of the court. While corollary 1 shows that the court could do better than traditional remedies simply by picking θ_D at random, this is not optimal. Instead, the court must translate the facts of the case into a posterior distribution and then must translate that posterior distribution into the level of damages. The facts of the trial will inform the court about the plaintiff's valuation, and the court can use that information to reduce the cost of the remedy.

While Figure 1 shows how the cost of the remedy changes in the choice of damages, Figure 2 gives examples of how the optimal level of damages

varies with the posterior distribution of plaintiff types. Each curve represents a posterior distribution of plaintiff types, $f(\theta)$, and the vertical lines indicate the optimal offer of damages for the given distribution, θ_D. These posterior distributions comprise all of the information at the court's disposal, including the facts of the case, expert witness testimony, and the arguments made by litigants and their attorneys. Given this information, proposition 1 tells courts how to structure a remedy that induces plaintiffs to reveal information about their true type.

But while the optional injunction remedy induces truth-telling at the remedy stage, it does not eliminate the incentive to lie during trial. Credible lies told during the trial will influence the court's posterior and therefore will affect the level of damages offered. In a trial with a standard damage award, both parties have strong incentives to tell credible lies in order to influence the damage award—the plaintiff wants to convince the court that she has suffered a high harm while the defendant wants to convince the court that the plaintiff has suffered a low harm.

The optional injunction remedy reduces litigants' incentives to lie relative to a standard damage award. Low-value plaintiffs still have an incentive to lie under the optional injunction remedy, because doing so will increase the damage offer. However, the optional injunction remedy reduces higher-value plaintiffs incentives to lie. A high-value plaintiff who would elect for injunctive relief in the absence of lies only benefits from lying if doing so increases the damage award above the harm that she suffered. Given that lying to the court is costly, the optional injunction remedy reduces plaintiffs incentives to lie.[17]

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17. More formally, suppose that the court will offer the optional injunction remedy with damages θ_D in the absence of any further influence by the plaintiff. As is, a low-value plaintiff with a valuation $\theta < \theta_D$ stands to be overcompensated by an amount $\theta_D - \theta$. Any lie that will influence the court to increase damages will benefit her. Contrast this with a high-value plaintiff with valuation $\theta > \theta_D$ who, as is, will choose the injunction. Even if the plaintiff can influence the court to increase damages to $\theta_D' > \theta_D$, it may not be worthwhile to do so. If $\theta_D' > \theta$, the plaintiff will choose damages and will be overcompensated by an amount $\theta_D' - \theta$. But if $\theta_D' < \theta$, then damages remain undercompensatory and the plaintiff will still choose the injunction. Therefore a given amount of effort to influence the court is less beneficial to a high-value plaintiff than it is to a low-value plaintiff.

Unlike the plaintiff, the defendant's incentives are perfectly aligned with the court under the optional injunction remedy. Both the defendant and the court wish to minimize the cost of compensation, and therefore prefer the court's posterior distribution to match the true distribution of plaintiff types. The defendant only has an incentive to lie if doing so counteracts the plaintiff's influence, and moves damages closer to the optimal level. The defendant's preference for the truth under the optional injunction remedy stands in stark contrast to the defendant's incentives under a damage award. The optional injunction remedy moderates incentives to lie for both plaintiffs and defendants. This implies that courts will have a more accurate posterior distribution, which in turn allows the damage offer to be calibrated more accurately.

In some cases there may be uncertainty over the cost of providing injunctive relief—just as the court cannot directly observe the plaintiff's harm, the court may not be able to calculate the cost of an injunction. However in many cases—particularly in cases of property damage such as *Corbello v. Iowa Production*—the defendant may have an accurate estimate of the cost of providing an injunction. At first glance, it may seem that the court now needs to design a mechanism to elicit that information from the court, but this is not the case. An appealing feature of the remedy is that it is in the defendant's best interest to truthfully reveal any private information about the cost of the injunction to the court, because doing so will lower the expected cost of the remedy. As discussed above, the interests of the court and the defendant are perfectly aligned at the remedy stage.

Nonetheless, in some cases there may be substantial uncertainty over the cost of providing the injunction.[18] In these cases, the court could choose the remedy that minimizes the expected cost to the defendant or minimizes the maximum cost to the defendant. However, practical difficulties arise when the injunction has an open-ended time horizon. When there is a moderate degree of uncertainty, these problems can be addressed through the use of an equitable helper. However, substantial uncertainty over the cost of

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18.   A prime example is providing injunctive relief related to pain and suffering. However, recent work by Avraham (2015a) suggests that it is easier than ever for courts to estimate pain and suffering. As more is learned about the management and treatment of pain and suffering, the costs will become more clear.

providing injunctive relief may indicate that a standard damage award would be preferable to the optional injunction remedy.[19]

Up to this point, the analysis has assumed that courts care first about compensating the plaintiff and second about minimizing the cost to the defendant. But courts may have alternative secondary goals, and may care more about the degree of overcompensation or waste rather than the total cost borne by the defendant. In particular, some legal and policy analysts hold a fundamental belief that avoidable economic waste should be avoided. Alternatively, fairness-minded judges may object to the fact that the optional injunction overcompensates plaintiffs in expectation. The following proposition illustrates that courts can achieve alternative goals, but that doing so comes at a cost:

COROLLARY 2 Minimizing the cost to the defendant is equivalent to minimizing the sum of overcompensation and waste. Therefore,

(1)   The court can decrease waste, but doing so increases both the cost to the defendant and the overcompensation of the plaintiff.
(2)   The court can decrease overcompensation, but doing so increases both the cost to the defendant and economic waste.

Corollary 2 formalizes the graphical intuition of Figure 1 and illustrates that there is a fundamental trade-off between cost, overcompensation, and waste. Overcompensation is necessary to induce some plaintiffs to choose damages instead of the injunction, while waste is necessary to prevent all plaintiffs from choosing excessive damages. The cost to the defendant is minimized when the sum of overcompensation and waste are jointly minimized.

For the defendant, this trade-off is immaterial. The defendant is interested in the remedy that minimizes cost, so the defendant always prefers the optional injunction remedy as developed in proposition 1 (among the set of fully-compensatory remedies). Nonetheless, the court may weigh the degree of overcompensation and waste independently of the total cost to

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19.   But any such damage award again raises the problem of undercompensation. See Avraham (2015b) for an economic argument of why pain and suffering damages deserve to be fully compensated.

the defendant. Corollary 2 illustrates that an efficiency-minded judge can limit waste, but doing so necessarily increases overcompensation and the total cost paid by the defendant. Alternatively, a fairness-minded judge can reduce overcompensation, but must necessarily increase waste and the total cost paid by the defendant.

In a world of perfect information, waste can be avoided and transfers can be used to achieve perfect compensation. But in a world of asymmetric information, no such easy and costless solution exists. Overcompensation, waste, and the cost borne by the defendant are inexorably linked, and the court must decide which imperfect world is best. The optional injunction remedy is built on the idea that litigation should protect the fundamental interests of the parties involved, and therefore the costs to the defendant should be minimized. Corollary 2 illustrates that costs for the defendant increase if the court instead aims to minimize overcompensation or waste. If the court does so, then the question must be asked—why is the present litigation, the ultimate means of dispute resolution in our legal system, being subverted by aims that are external to the litigants at hand? Deviating from the optional injunction remedy will necessarily upset the compensation of the plaintiff, increase the cost to the defendant, or both. One possibility is that the court may view the interests of the litigants to be less important than broader notions of welfare and deterrence, a case I consider in Section 6 after exploring the possibility of offering the plaintiff a broader set of choices in the next section and considering the effects of renegotiation in Section 5.

4. Offering the Plaintiff More Options

Proposition 1 shows that the court can reduce costs relative to traditional remedies by offering the simple choice between intermediate damages and injunctive relief. By separating the plaintiffs into two groups, the court can provide differential compensation. This raises the question: Can the court achieve further cost savings by offering the plaintiff more choices? In short, no, because inducing further separation is costly. This section discusses the intuition of why it is more costly to offer more options. Appendix B extends the model developed in Section 2 to allow for the court to offer an arbitrary
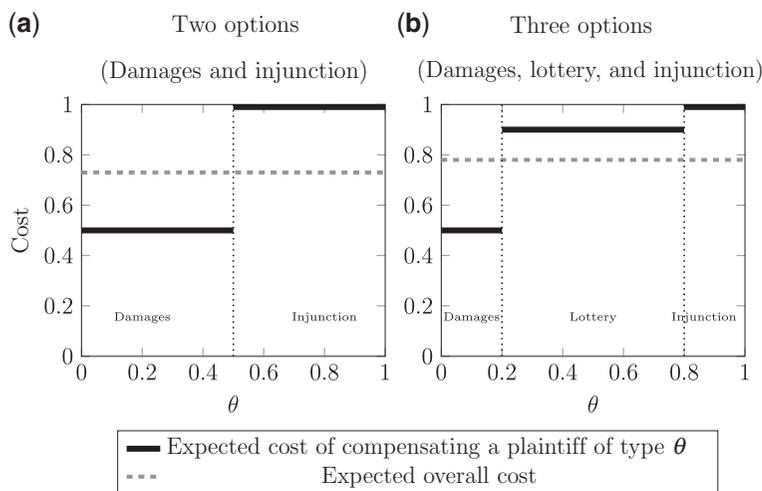
(a)   Two options
          (Damages and injunction)

(b)   Three options
          (Damages, lottery, and injunction)

Figure 3. Cost of Offering Two Options Versus Offering Three Options.

number of remedy options and proves that the optional injunction remedy remains the least costly way to fully compensate plaintiffs for unobservable losses. To obtain some intuition as to why offering more choices is counterproductive, consider a numerical example.

Numerical Example 2. Suppose that plaintiffs are uniformly distributed, $f(\theta) = 1$. Figure 3 shows the cost of providing the remedy to each type of plaintiff. The horizontal axis represents a plaintiff of a given type, while the vertical axis represents cost. The left panel of Figure 3 shows the cost from offering the optional injunction remedy with the optimal damage offer, $\theta_D = \frac{1}{2}$. The horizontal black line from 0 to 0.5 indicates that it costs 0.5 to provide low-value plaintiffs with damages. The line from 0.5 to 1 indicates that it costs 1 to provide high-value plaintiffs with the injunction. The horizontal dashed line calculates the expected cost of compensation, $C = 0.75$.

Suppose that the court attempts to lower costs by adding a third option for the plaintiff—a lottery that awards damages of 0.8 or an injunction, each with equal probability. This implies that the expected cost to compensate a plaintiff who opts for the lottery is 0.9. The lottery will change the plaintiff's decision calculus. Plaintiffs with values between 0.5 and 0.8 will now prefer the lottery to the injunction, because it results in higher expected compensation. This lowers the expected cost of the remedy for high types, because it now only costs 0.9 to compensate plaintiffs between 0.5 and 0.8. But the offer of the lottery also

changes the decision calculus of lower-value plaintiffs. Plaintiffs with values between 0.2 and 0.5 will now choose the lottery instead of the certain damages.[20] Only plaintiffs in the range 0–0.2 will choose certain damages. The overall effect of introducing the lottery can be seen in Figure 3b. While costs are reduced for plaintiffs in the range 0.5–0.8, costs are increased for plaintiffs in the range 0.2–0.5. The horizontal dashed line indicates that the expected cost of compensation has increased to 0.78, showing that the introduction of the lottery increases the expected cost of compensation.[21]

So while offering more choices may lower the expected cost for some plaintiffs, it will increase the overall cost of compensation. Whenever an additional choice is offered that reduces the cost of compensating some plaintiffs, it always increases the cost of compensating other plaintiffs. The increased costs outweigh the benefits of adding an additional option. The intuition from separating plaintiffs into three groups extends to inducing further separation. The court can induce an arbitrary degree of separation (including full separation), but inducing additional separation is always costly for the defendant, so the court will not do so.[22]

This section has shown that the simple choice between intermediate damages and an inalienable injunction is superior to offering lotteries over outcomes. The optimality of this simple separation into two groups differs from some other papers that apply a mechanism design approach to remedies. Stole (1992) shows that parties will design contracts in which

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20.   By choosing certain damages, these plaintiffs receive utility $0.5 - \theta$. By choosing the lottery, these plaintiffs receive utility $\frac{1}{2}(0.8 - \theta)$. Therefore the indifferent plaintiff is $\theta = 0.2$.

21.   To see this more formally, suppose that plaintiffs are uniformly distributed, and the court offers the choice of damages of θ_{D1} with certainty, an injunction with certainty, and a lottery where damages of θ_{D2} are awarded with probability p and an injunction is awarded with probability $1 - p$. Fixing the values of θ_{D1}, θ_{D2}, and p, the plaintiff who is indifferent between certain damages and the lottery is $x_1 = \frac{\theta_{D1} - p\theta_{D2}}{1 - p}$, while the plaintiff who is indifferent between the lottery and a certain injunction is $x_2 = \theta_{D2}$. The court's expected cost is therefore $x_1\theta_{D1} + (x_2 - x_1)(p\theta_{D2} + (1 - p)) + (1 - x_2)$. Substituting in x_1 and x_2, the optimal value of θ_{D1}, fixing θ_{D2} and p, is given by $\theta_{D1}^* = \frac{1}{2}(1 - p + 2p\theta_{D2})$. Similarly, the optimal value of θ_{D2}, fixing θ_{D1} and p is given by $\theta_{D2}^* = \theta_{D1}$. Substituting this back into the formula for θ_{D1}^* yields $\theta_{D1}^* = \theta_{D2}^* = \frac{1}{2}$, which implies that the least expensive remedy only separates plaintiffs into two types.

22.   An example of a fully separating remedy consists of awarding plaintiffs the remedy $(p(\hat{\theta}), M(\hat{\theta})) = (\hat{\theta}, \frac{1}{2}(1 + \hat{\theta}))$. Both the probability of providing the injunction and the amount of damages are increasing in the plaintiff's declared type, which are calibrated to ensure that all plaintiffs declare truthfully.

liquidated damages clauses are fully separating. Similarly, Avraham and Liu (2006) show that contracting parties can improve welfare by creating sequential options that more finely separate parties. The difference in the results between these papers and the present one is due to the timing of the mechanism, and thereby, the timing of the *individual rationality* constraint.[23] Both Stole (1992) and Avraham and Liu (2006) consider contracting parties who exhibit *ex ante* individual rationality. *Ex ante* individual rationality requires a participant's expected utility to be weakly positive, but does not guarantee that her final utility will be positive. It is generally reasonable to consider *ex ante* individual rationality in contracting situations because the parties are willing to accept the possibility of a negative payoff in the pursuit of maximizing the expected payoff.

This article considers a plaintiff with an *ex post* individual rationality constraint. *Ex post* individual rationality requires a participant's final utility to be weakly positive, and makes sense in cases, where one of the parties never agreed to the possibility of being undercompensated. For example, in tort cases, victims generally have no opportunity to negotiate with potential tortfeasors. Furthermore, in many contract cases, parties explicitly contract for full compensation, indicating that the contract exhibits *ex post* individual rationality.[24] *Ex post* individual rationality constraints are more stringent than *ex ante* constraints. Most mechanisms (including those analyzed by Stole (1992) and Avraham and Liu (2006)) induce separation by providing differential compensation based on type, with undercompensation of some types in equilibrium. However, *ex post* individual rationality requires that all types receive an adequate level of compensation, which limits the ability

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23. An individual rationality constraint is the requirement that an individual weakly prefers participating in a mechanism to not participating. An individuality rationality constraint can be defined based on timing (Jackson, 2014). The weakest form is *ex ante*, which stipulates a party will agree to participate in the mechanism before she knows her exact type. The strongest form is *ex post*, which requires that a party agrees to participate in the mechanism even after all information has been revealed. The *ex post* constraint therefore requires that no type receives negative utility from participating in the mechanism.

24. Schwartz and Scott (2008) sampled 110 contract cases involving economic waste, and showed that in many cases parties explicitly agreed to cost of performance damages. Nonetheless, courts frequently failed to award cost of performance damages. In these cases, the nonbreaching party had agreed to an *ex post* individually rational contract that was not honored by the court.

to achieve cost-effective separation. Given the *ex post* individual rationality constraints, further separation is only optimal under very particular circumstances. In order for additional separation to be optimal, the plaintiffs would need to have utility functions such that the marginal utility of a partial injunction is not constant, and the court would need to be able to elicit those preferences. The court could then provide an option consisting of a partial injunction coupled with intermediate damages. However, in many cases it would be hard to determine what would constitute partial injunction and it would be similarly difficult for a plaintiff to estimate her benefits from a partial injunction.[25]

5. Robustness of the Remedy to Renegotiation

The optional injunction remedy consists of the choice between damages and an *inalienable* injunction. The inalienability of the injunction ensures that plaintiffs only choose the injunction if damages are undercompensatory. But things are less clear if litigants can engage in post-judgment renegotiation. Because providing the injunction is costly for the defendant, plaintiffs may choose the injunction in order to renegotiate and extract a large settlement payment from the defendant. This opportunism could threaten the effectiveness of the optional injunction remedy.

The key result of this section, proposition 2, shows that the cost savings of the optional injunction remedy persist so long as there is a chance that renegotiation will not occur. The intuition of this result is that when renegotiation is uncertain, there always exists a level of damages that simultaneously increases expected compensation for some plaintiffs while decreasing the expected cost for the defendant, relative to providing all plaintiffs with the injunction. If, however, renegotiation always occurs, the optional injunction

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25.   For example, suppose that the injunction could be partial and could therefore take any value $p \in [0, 1]$, and suppose that the plaintiff has a utility function $u(\theta, p, M) = \theta v(p) + M - \theta$, where $v(.)$ is an increasing and concave function. The optimal mechanism would then then induce further separation. However, such a mechanism is unworkable. The court would have to assume a particular functional form for $v(.)$, and would also have to assume that plaintiffs differ only in the multiplier θ. Alternatively, the court could forgo the assumptions about $v(.)$, but would then need to ask the plaintiff to directly declare $v(.)$. Nonetheless, in footnote 50 of Appendix B, I show the form of the optimal remedy under these assumptions.

remedy costs the same as standard compensatory remedies. For this reason, the court should make the injunction inalienable and should take steps to prevent renegotiation. There are two primary ways that a court can do so. First, the judge could employ an equitable helper, so that the ability to renegotiate is taken away from the parties. In the absence of an equitable helper, the defendant directly provides the plaintiff's injunction, so the parties may be able to negotiate and come to a mutually beneficial settlement. Contrast this with an equitable helper, who directly provides the the injunction for the defendant, and collects the cost of the injunction from the defendant. Because the equitable helper is an agent of the court, the litigants could no longer negotiate away the defendant's duty to provide the injunction. Second, the court could monitor and find the parties if it finds that renegotiation has occurred. The court could do so by requiring that the parties submit evidence that the injunction has been performed. Alternatively, the court could employ an equitable helper to monitor the litigants. If the court finds that the parties have not complied with the order, the court may initiate contempt proceedings to punish the parties or induce compliance.[26]

While the use of an equitable helper and the possibility of contempt proceedings should effectively deter most renegotiation, some parties may engage in renegotiation despite the court's order. To explore this possibility, I amend the model of Section 2 to capture three stylized facts. First, empirical evidence shows that renegotiation rarely occurs, even in the absence of any explicit constraints (Farnsworth, 1999; Arbel, 2015). I therefore analyze probabilistic renegotiation.[27] Second, I model renegotiation as a take-it-or-leave-it offer. This simple formulation captures much of the fundamental intuition of the bargaining literature without complicating the analysis.[28]

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26. Bray (2016) illustrates that "equitable remedies may be enforced by contempt proceedings, through which a court may impose a range of highly discretionary punishments—including a new injunction, the payment of money to the plaintiff, the payment of fines to the sate, or, less commonly, imprisonment" (p. 565).

27. At the conclusion of this section I discuss the implications of renegotiation that occurs strategically rather than probabilistically.

28. The renegotiation process presented in this section is similar to that presented in Sobel and Takahashi (1983). The authors show that the results of a two-stage bargaining game are qualitatively similar to an infinite horizon game. Similarly, Ausubel et al. (2002) review key results of the theoretical and empirical literature on bargaining with incomplete information. The authors compare one-stage and sequential bargaining games and identify the properties shared by Bayesian equilibria of all bargaining games.

Third, differential bargaining power is captured by varying the probability with which each party makes the take-it-or-leave-it offer.

Formally, I extend the model as follows: if the plaintiff chooses the injunction, renegotiation occurs with probability $\delta \in [0, 1]$. If renegotiation occurs, nature randomly selects one of the two parties to make a take-it-or-leave-it offer, s, to the other party.[29] The defendant has proposal power with probability λ and the plaintiff has proposal power with probability $(1 - \lambda)$, where $\lambda \in [0, 1]$. The nonproposing party can either accept or reject the offer (I assume indifferent parties accept the offer), and utilities are realized. The goal of the court remains compensating the plaintiff at the lowest possible cost to the defendant.

Informally, the equilibrium takes the following form.[30] The plaintiff makes an inference about the expected value of the defendant's settlement offer based on the court's offer of damages. The plaintiff then decides whether to choose damages or the injunction based on her expectations about the defendant's future behavior. When making a settlement offer, the defendant makes an offer that is conditionally optimal based on the plaintiff's choice of the injunction in the first period. The court anticipates the behavior of the litigants and selects the offer of damages. In equilibrium, parties' expectations are fulfilled.

In Section 3, the cost of the optional injunction remedy was compared against the cost of the injunction and cost of performance damages, both of which cost 1. In the presence of renegotiation, the injunction and cost of performance damages are no longer equivalent in cost. Cost of performance damages are still equal to 1, but to determine the expected cost of the injunction, the court must factor in the outcome of renegotiation. Formally, the cost of providing the injunction in the presence of renegotiation given by:

$$C = \delta\big[\lambda[sF(s) + [1 - F(s)]] + [1 - \lambda]\big] + [1 - \delta] \in [0, 1]. \quad (1)$$

The cost will be less than 1 so long as renegotiation occurs ($\delta > 0$) and the plaintiff does not hold all of the bargaining power ($\lambda > 0$). This is because conditional on having proposal power, the defendant's decision is

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29.   The distribution of plaintiff types, $f(\theta)$ is assumed to be common knowledge.
30.   Formally, the equilibrium concept is Perfect Bayesian Equilibrium.

identical to the court's decision when no renegotiation was possible. Therefore when the defendant has the proposal power, $s = \theta_D$, by proposition 1. This implies that the value of equation 1 is less than 1 so long as $\delta > 0$ and $\lambda > 0$. Therefore in the presence of renegotiation, the expected cost of the injunction is (weakly) less than the cost of providing cost of performance damages. So in the discussion that follows I restrict my attention to comparing the optional injunction remedy to providing all plaintiffs with the injunction.

The following proposition shows the optimality of the optional injunction remedy:

PROPOSITION 2 If renegotiation always occurs, $\delta = 1$, the optional injunction remedy costs the same in expectation as providing an injunction to all plaintiffs. If there is a positive probability that renegotiation will not occur, $\delta < 1$, the expected cost of the optional injunction remedy is strictly less than providing an injunction to all plaintiffs.

The intuition of this result is best understood by considering two separate cases. First, consider the case where renegotiation always occurs, $\delta = 1$. When the plaintiff has proposal power, she will offer $s = 1$, and therefore extracts the full cost of providing the injunction. When the defendant has the proposal power, he makes an offer based on his knowledge that the plaintiff turned down the damage offer of θ_D. The defendant will therefore make a settlement offer at least as large as the court's damage offer, $s \geq \theta_D$. When deciding whether or not to elect for the injunction, the plaintiff anticipates this and therefore chooses the injunction. Recognizing that all types will elect for the injunction, the defendant makes a settlement offer of $s = \theta_D$. Therefore when renegotiation always occurs, all plaintiffs elect for the injunction and the cost of the optional injunction remedy equals the cost of providing all plaintiffs with the injunction.

Second, consider the case where renegotiation does not occur with certainty, $\delta \in [0, 1)$. When renegotiation occurred with certainty, the plaintiff did not risk anything by choosing the injunction and proceeding to renegotiation. But this incentive to behave opportunistically is reduced when renegotiation is uncertain. A low-value plaintiff who chooses the injunction runs the risk that renegotiation will not occur and is therefore worse off than

she would have been had she chosen damages. The court can therefore set damages, θ_D, such that some plaintiffs prefer certain damages to uncertain renegotiation.

But setting damages high enough to induce some plaintiffs to choose damages implies that the defendant's conditionally optimal settlement offer will be greater than the court's damage offer, $s > \theta_D$. This follows from the fact that the plaintiff's choice of the injunction indicates that her valuation is above a certain level, which allows the defendant to more accurately calibrate the settlement offer. The plaintiff in turn uses the damages offered by the court to make a prediction about the defendant's settlement offer, and to decide whether to choose damages or the injunction. Therefore, conditional on the defendant making a settlement offer, the expected cost to the defendant is increasing in the level of damages. But as the formal proof shows, this increase in cost is outweighed by the savings yielded by inducing a fraction of plaintiffs to choose damages. This general intuition is illustrated by the following example:

Numerical Example 3. Suppose that plaintiffs are uniformly distributed, $f(\theta) = 1$, the probability of renegotiation is $\delta = \frac{1}{2}$, and bargaining power is evenly distributed, $\lambda = \frac{1}{2}$. Figure 4 shows the cost to the defendant of the optional injunction remedy as a function of damages in the presence of renegotiation. The horizontal axis represents the damage offer, θ_D, and the vertical axis represents the expected cost, given equilibrium behavior by the plaintiff and the defendant. The uppermost function represents the total cost to the defendant, while the remaining four curves decompose that cost into constituent components. These four components are: costs from plaintiffs accepting the court's damage offer, θ_D; costs from plaintiffs rejecting damages where there is no renegotiation; costs from plaintiffs rejecting damages where the plaintiff makes a settlement proposal; and costs from plaintiffs rejecting damages where defendant makes a settlement proposal. The horizontal dotted line indicates the expected cost if the court were to award injunctions to all plaintiffs instead of awarding the optional injunction remedy. The court minimizes the defendant's cost with a damage offer of $\theta_D = 0.65$, which results in a cost of 0.83. The cost of awarding injunctions to all plaintiffs is 0.94.

This example illustrates some features of the optional injunction remedy in the presence of renegotiation. First, if damages are too low, all plaintiffs will choose the injunction. This is illustrated by the costs being constant to the left of the vertical dotted line. In this case, the defendant faces high costs, particularly from the probability that renegotiation will not occur. However, cost savings can
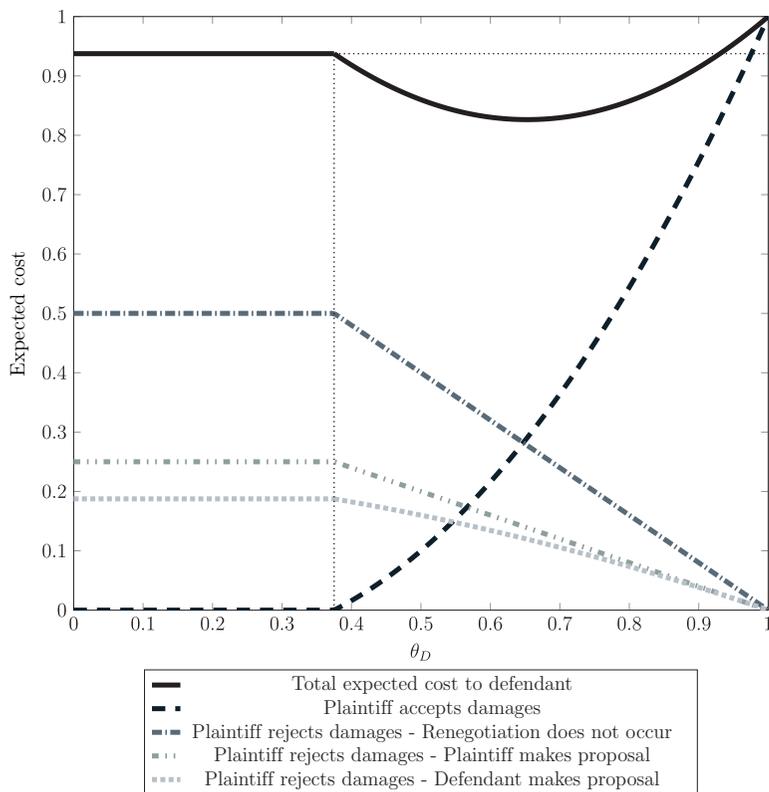
Figure 4. Expected Cost as a Function of the Damage Offer with Renegotiation (uniform distribution of plaintiff values, $\delta = \lambda = \frac{1}{2}$).

be achieved if damages are set high enough to induce some plaintiffs to choose damages. With damages just higher than the dashed vertical line, plaintiffs with low valuations find it profitable to take guaranteed damages instead of gambling with uncertain renegotiation. Total cost therefore decreases as the increased cost associated with plaintiffs choosing damages is outweighed by the cost savings from fewer plaintiffs choosing opportunistic injunctions. While the court can decrease the defendant's costs by setting damages high enough, this example illustrates that if damages are set too high, then the increased costs swamp the savings from fewer plaintiffs choosing injunctions.

Even in the presence of renegotiation, the optional injunction remedy is less expensive than standard remedies. The degree of cost savings is a

function of the likelihood of renegotiation and the distribution of bargaining power. The defendant benefits from holding more bargaining power, because it leaves less room for the plaintiff to extract rents. Decreases in the likelihood of bargaining are also beneficial to the defendant, because increased uncertainty induces more plaintiffs to choose damages rather than injunctions. The defendant dislikes renegotiation even when he has all of the bargaining power, because he offers a higher settlement offer than he would if he could have committed himself before the plaintiff chose an injunction.

These results demonstrate that the court should attempt to prevent renegotiation where possible. For simplicity, I have modeled renegotiation as occurring probabilistically rather than strategically. A full strategic model would include the litigants' decision to engage in bargaining coupled with the court's decision about how to monitor and punish renegotiation. Aside from complicating the analysis, making the choice of entering into renegotiation a strategic decision would in fact strengthen the results of this section. This follows from the fact that the plaintiffs with the strongest incentive to engage in renegotiation are those with low values. Given this, the defendant's optimal settlement offer would be lower for a fixed level of damages. This in turn would induce more plaintiffs to accept court-awarded damages and forgo renegotiation, thereby lowering the cost to the defendant.[31]

This section has shown that even in the presence of renegotiation, the optional injunction remedy is able to induce plaintiffs to reveal information

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31. In addition to the possibility of post-judgment renegotiation, parties may engage in pre-trial settlement negotiations. Like all settlement negotiations, the outcome of the settlement will depend on the form of the settlement offer and the expected outcome of the trial (see Spier (2007) for an overview of models of settlement). An additional complication arises in that a settlement offer by the defendant may alter the court's posterior over the plaintiff's type. If the defendant makes a standard monetary settlement offer, a plaintiff can turn it down and credibly claim that it would be undercompensatory. If instead the defendant offers the plaintiff the optional injunction remedy, the court will learn about the plaintiff's type. High types would accept the defendant's offer and elect for injunctive relief, because they cannot expect to do better at trial. Therefore by declining the settlement offer, the plaintiff reveals that she is a low type and that she is seeking overcompensation. The court will therefore adjust the damages offered in the optional injunction remedy downward. Anticipating this, the plaintiff will generally accept pretrial settlement offer in the form of the optional injunction remedy. Whether it is optimal for the defendant to make this offer will depend on the probability of the plaintiff prevailing at trial and the amount of information that will be learned at trial (which can be used to more accurately calibrate the damage offer of the optional injunction remedy).

about their true valuations. When there is no possibility of renegotiation, the optional injunction remedy can effectively separate high-value and low-value plaintiffs, resulting in substantial savings relative to standard remedies. As the probability of renegotiation increases, the optional injunction remedy remains less expensive than traditional remedies, but the degree of cost savings decreases. So while the effectiveness of the optional injunction remedy is diluted in the presence of post-judgment renegotiation, it remains the least expensive way to compensate plaintiffs for private values.[32]

6. Social Welfare

Thus far, this article has focused on the litigants in a given case and has ignored deterrence and broader social welfare questions. From a social welfare perspective, there are two primary critiques of the optional injunction remedy. First, the optional injunction remedy results in waste. And second, the optional injunction remedy, as developed, ignores the *ex ante* incentives of individuals. The key result of this section, proposition 3, takes these concerns into account and shows that the optional injunction remedy may result in higher social welfare than optimal damages. The intuition of the result is that the optional injunction remedy limits risk relative to awarding damages. So if plaintiffs are sufficiently risk averse, awarding the optional injunction remedy is less expensive than awarding optimal damages, thereby improving social welfare. While I do not claim that the optional injunction remedy always dominates damages in terms of social welfare, the results of this section explain that the remedy that maximizes social welfare depends on individuals' behavioral primitives. To analyze social welfare more broadly, I amend the court's problem as follows.

First, victims (plaintiffs) are assumed to have concave utility functions as is standard in models of social welfare, such that utility is given by $u(w)$, where $u' > 0, u'' < 0$, and the the victim's compensation is given by

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32. There are two empirical studies that provide information on the prevalence of post-judgment renegotiation. Farnsworth (1999) finds that $\delta = 0$ in a sample of tort cases. Arbel (2015) does not provide enough data to determine δ in his sample of contract cases, but explains that some parties do not even attempt to renegotiate, implying that $\delta < 1$.

$w = \theta I + M - \theta$.[33] Utility function $v(w)$ is said to exhibit more risk aversion
than utility function $u(w)$ if $v(w) = \lambda(u(w))$, where $\lambda(0) = 0$, $\lambda' > 0$, and
$\lambda'' < 0$. Second, injurers (defendants) decide whether or not to engage in
a harmful action that creates private benefit g and harm to victim θ.[34] The
benefit to the injurer and the harm to the victim are both unobservable by the
courts. The distribution of gains is assumed to have full support on $[0, \infty)$.
Injurers harm only if their expected private gains from doing so exceed their
expected private costs from doing so. The goal of the court is to implement
a legal regime that induces injurers to harm the victim only when doing so
is expected to increase social welfare.

I begin by considering optimal damages. The Pigouvian level of dam-
ages induce the injurer to internalize his expected externality. Let D_u^* be
the level of damages such that the victims' expected utility is zero given
the utility function $u(.)$: $E[u(w|D_u^*)] = 0$. Therefore injurers will only take
actions that are expected to increase social welfare. Under optimal dam-
ages, victims bear risk because some are overcompensated while others are
undercompensated. The next result shows that the optimal level of damages
is increasing in the degree of victims' risk aversion.

LEMMA 1   For any $D_u^* \in (0, 1)$, there exists a more risk-averse utility
function v such that $D_u^* < D_v^*$.

The intuition of this result follows from the fact that plaintiffs bear risk
from damage awards. Given damages $D \in (0, 1)$, low-value plaintiffs, $\theta \in
[0, D)$ are overcompensated, while high-value plaintiffs, $\theta \in (D, 1]$ are
undercompensated. As risk aversion increases, damages must be increased
to compensate for the risk of being undercompensated.

Unlike optimal damages, the optional injunction remedy costs the same
amount regardless of victims' risk aversion:

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33.   While I have assumed that utility is a function of a single variable w for
simplicity, that is not necessary. A utility function of the more general form $u(\theta, I, M)$
could be used instead. The functional form of the utility function will determine whether
or not the optional injunction remedy is superior to damages.

34.   The injurer is assumed to be risk-neutral, as corporate defendants are generally
assumed to be risk-neutral with respect to small risks. If the defendant were risk averse,
the analysis would depend on the relative risk aversion of the injurer and the victim.

LEMMA 2 The cost of the optional injunction remedy is invariant to the plaintiff's risk aversion.

This result follows from the fact that the optional injunction remedy always compensates all plaintiffs at the lowest possible cost. The plaintiff's utility depends on the degree of risk aversion, but the design of the remedy does not.[35] Together, lemmas 1 and 2 imply the final result:

PROPOSITION 3 For any distribution of plaintiff types, there exists a degree of risk aversion such that the optional injunction remedy results in higher social welfare than optimal damages.

This result follows from the fact that the cost of the optional injunction remedy is invariant in the degree of risk aversion while the cost of optimal damages is increasing. As risk aversion increases, damages must be increased to compensate for risk. When risk aversion is sufficiently high, the expected cost to the defendant of optimal damages is greater than the expected cost of the optional injunction remedy. Under both regimes, defendants only harm victims when it is expected to increase social welfare. However, because of the high cost of damages under risk aversion, defendants are *overdeterred* by damages relative to the optional injunction remedy. Therefore, when risk aversion is sufficiently high, defendants take more welfare-improving actions under the optional injunction remedy than under a regime of damages.

Proposition 3 offers an ambiguous answer to the question of which legal regime is better for social welfare. The answer depends on the degree of victim risk aversion and the distribution of plaintiff types. Proposition 3 illustrates that optimal damages are just that—optimal damages—not the

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35.   However, there does exist a variant of the optional injunction remedy that does depend on the degree of risk aversion. The optional injunction remedy results in positive expected utility for the victims, because some victims are perfectly compensated and others are overcompensated. Therefore, plaintiffs bear beneficial risk. The court could award the optional injunction remedy, and then enjoin plaintiffs to pay damages *to the defendant*. This implies that relatively high types would be undercompensated, while low types would still be overcompensated. These damages could be calibrated such that the expected utility of plaintiffs is zero. Doing so would reduce the cost of the optional injunction remedy, and would thereby allow the injurer to take more welfare-increasing actions.

optimal remedy. Optimal damages do not necessarily produce the "correct" incentives. This result shows that it is possible to design remedies that have better incentives than optimal damages.

To focus on the fundamental intuition, I have left the social welfare model simple, and many modeling choices could be altered without disturbing the underlying principle. The key element of the social welfare model is victim risk aversion. If all parties are risk neutral, overcompensation of some victims balances the undercompensation of others. With risk neutrality, fines are simply wealth transfers that have no effect on social welfare, whereas injunctions create waste and therefore decrease social welfare. If however, victims are risk averse, a given level of undercompensation decreases social welfare by more than that level of overcompensation increases social welfare. In this case, wasteful injunctions can help to increase social welfare relative to damages alone.[36] The relative strength of the optional injunction remedy is that it results in less risk-bearing than damages. Which remedy is superior in practice depends on individuals' behavioral primitives.[37] A pure welfarist assessment would endorse whichever remedy maximizes social welfare. If we can observe the plaintiff's risk aversion and the distribution of plaintiff types, it is simple to choose between damages and the optional injunction remedy. However, as Kaplow and Shavell (2001) note, there are times when a direct assessment of policies cannot be undertaken and fairness may be a good proxy. In this case, given difficulties of a direct assessment of victims' risk aversion, the optional injunction remedy might be useful as a proxy principle for averting risk.

While this section has shown that the optional injunction remedy can improve social welfare relative to damages through risk reduction, social welfare benefits arise through other channels as well. If the social welfare

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36. Furthermore, an unexplored option—such as mandatory first-party insurance—may improve social welfare further. Levmore (1982) discusses how first-party insurance can be used to make tort victims declare their valuation *before* any harm occurs.

37. Work in financial economics has estimated individuals' coefficients of relative risk aversion to be around 2, with some estimates much higher (Blake, 1996; Campbell, 1996; Pålsson, 1996). Similarly, estimates based on labor supply (Chetty, 2006) and consumption (Kniesner and Ziliak, 2002) are also around 2. Together these results indicate that the optional injunction remedy may have social welfare benefits relative to optimal damages, which leave plaintiffs bearing downside risk.

function incorporates distributional concerns, then the optional injunction remedy may be optimal because it results in less distributional inequality than damages. Alternatively, if individuals have preferences for fairness, a social welfare assessment would take these tastes into account. Ultimately, the benefits of the optional injunction remedy would affect social welfare in a variety of ways, and no model will be able to parsimoniously capture and weigh all of the trade-offs between legal regimes.

7. Applications of the Remedy

I have presented a general theory of the optional injunction remedy and have shown theoretical implications. But the true value of the theory is in the application of the optional injunction remedy to real cases. This section considers a range of cases to illustrate the broad applicability of the optional injunction remedy. In some cases, particularly cases of property damage like *Corbello v. Iowa Production*, the application is straightforward. But in other cases, there are considerable obstacles to finding an injunction that restores the plaintiff's underlying interest.

EXAMPLE 1 In *Berg v. Reaction Motors*,[38] a defense corporation tested supersonic jets over residential areas, where the resulting sonic booms damaged foundations and caused cracks in floors, walls, and ceilings of neighboring residents. The court found that the cost of repairing the damages to be $25,605 (cost of performance), whereas the value of the property dropped by only $3,700 (market value). The court was unsure about the plaintiffs' valuations and awarded cost of performance damages. The court could have provided an injunction by ordering that the defendant pay to repair the damages to the plaintiffs' property. By offering the plaintiffs the choice of intermediate damages or an injunction, the optional injunction remedy could compensate the plaintiffs at a lower expected cost.

EXAMPLE 2 *Hymowitz v. Eli Lilly & Co.*[39] Over three decades, millions of women took the drug DES to prevent pregnancy complications. Daughters

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38. *Berg v. Reaction Motors Div.*, 37 N.J. 396, 405, 181 A.2d 487, 495 (1962).
39. *Hymowitz v. Eli Lilly & Co.*, 539 N.E.2d 1069, 1078 (N.Y. 1989).

of these women suffered from increased risks of cancer, infertility, and other reproductive issues. Some women were successful in obtaining damages, but many lost the ability to bear children. Unlike the property damage in the first two examples, this case deals with intangible harms—what is the correct compensatory remedy for losing the ability to bear children? Monetary damages attempt to compensate for this harm, but are clearly imperfect. Furthermore, women are differentially affected by the inability to bear children—those who intended to have children require more damages to be "compensated" than do women with no intention of having children. Specifically, women who can no longer bear children may spend large amounts of money and time on adoption or surrogacy processes.

In this case, an injunction might take the form of providing the plaintiff with adoption or surrogacy services. Women who intended to have children (in particular, women who intended to have many children) and substitute with adoption would be undercompensated by just receiving damages, due to the high cost of adoption. By offering the optional injunction remedy, DES victims may be better compensated at a lower aggregate cost. Women with no intention of having children could opt for damages, while women who intended to have children could opt for an injunction consisting of adoptive or surrogacy services. The optional injunction remedy can better tailor compensation and save costs. In cases of mass torts, this is especially important due to the sheer number of plaintiffs and the possibility of defendant insolvency. If litigation may lead to insolvency, reducing the cost of compensating an individual increases the funds available for other victims.

EXAMPLE 3   In *Seffert v. Los Angeles Transit Lines*,[40] a woman sustained permanently painful injuries to her foot as a result of a bus driver's negligence. Awarding accurate pain and suffering damages is notoriously difficult due to the subjectivity of pain and the dearth of verifiable information. Furthermore, this type of pain and suffering damages account for over roughly half of damages awarded in personal injury cases (Avraham, 2006).

In this case, an injunction could take the form of the defendant paying for expenses related to pain management. Applying the optional injunction

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40.   *Seffert v. Los Angeles Transit Lines*, 364 P.2d 337 (Cal. 1961)

remedy, the choice between pain management tools and damages should induce the high-pain plaintiffs to choose the injunction, whereas low-pain plaintiffs would choose damages, simultaneously ensuring compensation and lowering costs.[41] Unlike property damage, there is likely to be a high degree of uncertainty about the cost of providing injunctive relief in the case of pain and suffering. However, Avraham (2015a) explains that new techniques make estimating pain and suffering easier than ever before.

EXAMPLE 4 *Elberon Bathing Co. v. Ambassador Insurance Co.*[42] After a fire damaged insured plaintiff's property, the plaintiff and the defendant insurance company disagreed over the methods to ascertain "actual cash value" under a standard form insurance policy. The majority of courts have rejected market value compensation and replacement cost compensation because "[u]nder-valuation denies the insured the indemnification due him under the policy. Over-valuation tempts the insured to cause the very loss covered, or at least, to provide inadequate safeguards against the loss." The court recognized that "[v]alue, after all, is a matter of opinion," and that a broad evidence rule should be used to permit the consideration of all evidence in determining value. The broad evidence rule attempts to mitigate the issues of undercompensation and excessive cost by allowing an insurance appraiser to condition compensation on her beliefs about the insured party's valuation. But this method still suffers from potential issues of undercompensation and excessive cost. By extending the broad evidence rule to include the option of an inalienable injunction, adjusters could ensure compensation while simultaneously limiting windfalls to the plaintiff.

These applications illustrate the broad applicability of the optional injunction remedy. In cases relating to idiosyncratic value to property, it is straightforward for courts to apply the remedy, as the form of the injunction is clear. As cases move away from property damage, it may be more

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41. In cases such as this, it is possible that the plaintiff is unsure of which option is better, which could result in a choice that is not fully compensatory. To counteract this possibility, the court could award a probationary period, during which the plaintiff could switch her choice.

42. *Elberon Bathing Co., Inc. v. Ambassador Ins. Co.,Inc.*, 77 N.J. 1, 389 A.2d 439 (1978). I thank an anonymous reviewer for this example.

difficult for courts to find an injunction that is fully compensatory. In order to do so, judges should think about the underlying interest that has been upset by the plaintiff's conduct. The injunction should consist of restoring this interest as best as possible, as in Examples 2 and 3.

In some cases, the optional injunction remedy will not be applicable due to the impossibility of providing an injunction that undoes the harm. Despite a court's best intentions, no injunction will be able to regrow a lost limb or restore the life of a loved one. In these cases, the court will be restricted to awarding damages. In other cases, the cost of providing full compensation may be more than the court is willing to bear for reasons of foreseeability or fairness to the defendant. The optional injunction remedy is not the best remedy in every case, but across a variety of cases it can be used to fully compensate at the lowest cost, and deserves to be included in the toolkit of the common law.

8. Conclusion

People constantly suffer harms that are idiosyncratic and unobservable, yet compensating plaintiffs is difficult. With standard remedies, courts generally face the choice between undercompensating plaintiffs or overcharging defendants. This article shows that courts can fully compensate plaintiffs at a lower cost than previously thought possible.

The primary contribution of this article is the formal development of the optional injunction remedy, which leverages the plaintiff's private information. I have shown that offering the simple choice between intermediate damages and an injunction dominates traditional compensatory remedies. Furthermore, the results are robust to post-judgment renegotiation and errors by the court. Moreover, I have shown that a broad implementation of the optional injunction remedy may increase social welfare.

The model is extendable in a variety of directions, such as incorporating the possibility of pre-judgment settlements, the provision of insurance, and allowing courts to award partial injunctions. But in my view, the more interesting extensions are to explore the scope of applications of the optional injunction remedy within the legal system. Options abound: defendants may offer a version of the optional injunction remedy to plaintiffs in pre-trial

settlement negotiations; insurance companies could compensate enrollees at lower costs; and awards in class-action lawsuits may be able to be better tailored to individual plaintiffs. This article has suggested novel ways that judges could implement the remedy, but ultimately the scope and effectiveness of the remedy is limited only by the judge's creativity in structuring injunctions.

Appendix A – Proofs

Proof of Proposition 1.   First, observe that the court will never offer a remedy of an injunction coupled with damages: $(M, I) = (m, 1)$, where $m \in (0, 1]$. This results in a cost of $C = 1 + m$, which is greater than the cost of providing the injunction. Therefore attention can be limited to remedies that provide either only damages and those that provide only an injunction. Furthermore, observe that the court will never find it advantageous to include multiple damage remedies in the choice of remedies. To see this, suppose that the court offers the choices $\{(m_1, 0), (m_2, 0)\} \in \mathbb{S}$, where $m_1 > m_2$. All plaintiffs will prefer $(m_1, 0)$ to $(m_2, 0)$. So attention can be limited to the largest damage award. Therefore, the court will offer at most two choices, damages and an injunction.

The court therefore has three options for fully compensating the plaintiff: provide the plaintiff with cost of performance damages, $\mathbb{S} = \{(1, 0)\}$; provide the plaintiff with an injunction, $\mathbb{S} = \{(0, 1)\}$; or the plaintiff with a choice between damages and an injunction, $\mathbb{S} = \{(m, 0), (0, 1)\}$.

Suppose that the court offers the plaintiff the choice of an injunction or damages of θ_D, $\mathbb{S} = \{(\theta_D, 0), (0, 1)\}$. Plaintiffs with $\theta \leq \theta_D$ will maximize utility by choosing damages, and plaintiffs with $\theta > \theta_D$ will maximize utility by choosing the injunction. Both groups are fully compensated. The proportion of plaintiffs who choose damages is therefore $F(\theta_D)$ and the proportion who choose the injunction is $1 - F(\theta_D)$. The court's expected cost is then:

$$C = \theta_D F(\theta_D) + 1 - F(\theta_D).$$

Taking the first-order condition with respect to θ_D:

$$\theta_D f(\theta_D) + F(\theta_D) - f(\theta_D) = 0. \tag{A.1}$$

Which implies that the damages that minimize the court's cost are given by the θ_D that solves:

$$\theta_D = 1 - \frac{F(\theta_D)}{f(\theta_D)}. \tag{A.2}$$

There is a unique $\theta_D \in (0, 1)$ that solves Equation (A.2). By assumption, $\frac{F(\theta)}{f(\theta)}$ is nondecreasing. Continuity of the distribution implies that $F(0) = 0$ while full support implies that $f(\theta) > 0$, $\forall \theta$. Therefore $g(\theta) \equiv 1 - \frac{F(\theta)}{f(\theta)}$ is nonincreasing with $g(0) = 1$ and $g(1) < 1$. Let $h(\theta) \equiv \theta$. By the intermediate value theorem, there exists a point θ_D such that $g(\theta_D) = h(\theta_D)$. Finally, $g(.)$ is nonincreasing and $h(.)$ is strictly increasing, implying that $g(.)$ and $h(.)$ intersect at most one time. Therefore θ_D is the unique solution.[43]

And because $\theta_D \in (0, 1)$, the defendant's cost, given by $1 - (1 - \theta_D)F(\theta_D)$, is strictly less than 1.   □

Proof of Corollary 1.   Suppose that the court offers the optional injunction remedy with damages $\phi \in (0, 1)$ such that $\phi \neq \theta_D$. This implies that all types $\theta \leq \phi$ receive damages of ϕ and all types $\theta > \phi$ receive the injunction. The cost to the court is therefore:

$$C(\phi) = \phi F(\phi) + 1 - F(\phi)$$
$$= 1 - (1 - \phi)F(\phi).$$

Because $\phi \in (0, 1)$, this implies that $(1 - \phi)F(\phi) \in (0, 1)$, and therefore $C(\phi) < 1$. Therefore, even if the court uses an incorrect offer of damages, full compensation is achieved at a lower cost than employing either an injunction or cost of performance damages independently.   □

Proof of Corollary 2.   Let the court's cost function be given by:

$$\min_{\theta_D} C' = (1 - \alpha)\theta_D F(\theta_D) + \alpha(1 - F(\theta_D)),$$

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43.   The restriction that $\frac{F(\theta)}{f(\theta)}$ is nondecreasing ensures that there is a unique solution to the first-order condition. If the distribution is such that $\frac{F(\theta)}{f(\theta)}$ increases over some interval, then it is possible that there are multiple points that satisfy the first-order condition, and further analysis would be required to determine which minimizes costs.

where α is the court's weighting on waste and $(1 - \alpha)$ is the court's weighting on overcompensation. This is identical to the court's problem in proposition 1, but now the court minimizes the weighted sum of waste and overcompensation instead of total cost.

Differentiating with respect to θ_D in order to minimize pointwise, yielding:

$$\frac{\partial C'}{\partial \theta_D} = \alpha(1 - \theta_D)f(\theta_D) - (1 - \alpha)F(\theta_D)$$

This is precisely Equation (A.1), but with the addition of the terms α and $(1 - \alpha)$. Therefore the optimal remedy takes the same form as the optional injunction remedy, but with a different offer of damages:

$$\theta_D^\alpha = 1 - \frac{(1 - \alpha)}{\alpha} \frac{F(\theta_D^\alpha)}{f(\theta_D^\alpha)}. \tag{A.3}$$

At $\alpha = \frac{1}{2}$, this is precisely the damage offer under the optional injunction remedy. To see that the optimal damage award is increasing in α, assume fix α and consider the value θ_D^α that solves equation A.3. Now consider a marginal increase in α to α'. This implies that $\theta_D^\alpha < 1 - \frac{(1-\alpha')}{\alpha'} \frac{F(\theta_D^\alpha)}{f(\theta_D^\alpha)}$. By assumption, $\frac{F(\theta)}{f(\theta)}$ is nondecreasing in θ. Therefore there exists a $\theta_D^{\alpha'} > \theta_D^\alpha$ such that $\theta_D^{\alpha'} = 1 - \frac{(1-\alpha')}{\alpha'} \frac{F(\theta_D^{\alpha'})}{f(\theta_D^{\alpha'})}$, implying that the level of damages are increasing in α, with $\theta_D^\alpha \to 1$ as $\alpha \to 1$ and $\theta_D^\alpha \to 0$ as $\alpha \to 0$. $\quad\square$

Proof of Proposition 2. Working backward, consider optimal play given that renegotiation occurs. Renegotiation implies that the plaintiff has rejected the court's offer of damages, θ_D. With probability $(1 - \lambda)$ the plaintiff has proposal power and makes an offer of 1. With probability λ the defendant has proposal power and makes a settlement offer, s. A plaintiff who anticipates the settlement offer is therefore indifferent between choosing damages or an injunction if $\theta_D - \theta = \delta[\lambda[s - \theta] + [1 - \lambda][1 - \theta]] + [1 - \delta][\theta - \theta]$. Solving for the indifferent plaintiff yields a cutoff value k:

$$k(\theta_D) \equiv \frac{\theta_D - \delta[1 - \lambda[1 - s]]}{1 - \delta}.$$

In equilibrium, all plaintiffs with values $\theta \leq k$ will choose court-appointed damages of θ_D and all plaintiffs with values $\theta > k$ will choose the injunction.

Therefore, conditional on renegotiation occurring, the defendant knows that he is facing a plaintiff with type $\theta > k$. The defendant therefore updates his beliefs about the plaintiff's type using Bayes' rule: $f(\theta|\theta > k) = \frac{h(\theta)}{1-F(k)}$, where $h(\theta) = f(\theta)$ for $\theta \in (k, 1]$ and $h(\theta) = 0$ everywhere else. Following the proof of proposition 1, the defendant's optimal settlement offer is the value s that solves

$$s = 1 - \frac{F(s|\theta > k)}{f(s|\theta > k)}. \tag{A.4}$$

Define the defendant's expected cost conditional on renegotiation occurring from choosing s optimally by:

$$\pi(k) \equiv \frac{\lambda[s(k)[F(s) - F(k)] + [1 - F(s)]] + [1 - \lambda][1 - F(k)]}{1 - F(k)}, \tag{A.5}$$

where the first term in the numerator is the expected cost when the defendant has proposal power and the second term in the numerator is the cost when the plaintiff has the proposal power. The denominator conditions the cost on renegotiation occurring.

Given that the plaintiff and the defendant are playing optimally, the court chooses a damage offer θ_D that solves:

$$\min_{\theta_D} \theta_D F(k(\theta_D)) + \delta\pi(k(\theta_D))[1 - F(k(\theta_D))] + [1 - \delta][1 - F(k(\theta_D))]. \tag{A.6}$$

subject to

$$k(\theta_D) = \begin{cases} k & \text{where } k = \frac{\theta_D - \delta[1 - \lambda[1 - s]]}{1 - \delta} \text{ if such a } k \in [0, 1] \text{ exists,} \\ 0 & \text{otherwise.} \end{cases}$$

Rewriting the constraint on k in terms of θ_D yields $\theta_D = [1 - \delta]k + \delta[1 - \lambda[1 - s]]$. Substituting this into Equation (A.6) eliminates the term θ_D in the objective function:

$$\min_{k \in [0,1]} [1 - \delta]kF(k) + \delta[1 - \lambda[1 - s]]F(k)$$
$$+ \delta\pi(k)[1 - F(k)] + [1 - \delta][1 - F(k)]. \tag{A.7}$$

Let $\hat{k}$ be the value that solves equation A.7. The partial derivative of Equation (A.7) with respect to k is:[44]

$$H(k, \delta, \lambda) \equiv [1 - \delta][kf(k) + F(k)] + \delta[1 - \lambda[1 - s(k)]]f(k) \qquad \text{(A.8)}$$
$$+ \delta\lambda s'(k)F(k) - \delta\lambda s(k)f(k) - \delta[1 - \lambda]f(k) - [1 - \delta]f(k).$$

Canceling terms yields:

$$H(k, \delta, \lambda) = [1 - \delta][kf(k) + F(k)] + \delta\lambda s'(k)F(k) - [1 - \delta]f(k). \quad \text{(A.9)}$$

This function shows how the cost of the remedy changes with respect to the cutoff k. I now evaluate the function $H(k, \delta, \lambda)$ to show where the objective function in Equation (A.7) achieves its minimum:

(1)   Assuming $\delta < 1$. This implies that:

$$H(0, \delta, \lambda) = [1 - \delta][0f(0) + F(0)] + \delta\lambda s'(0)F(0) - [1 - \delta]f(0)$$
$$= -[1 - \delta]f(0)$$
$$< 0$$

Therefore when $\delta < 1$, the optimal value $\hat{k}$ is greater than 0, implying that some plaintiffs will choose damages instead of the injunction. Similarly:

$$H(1, \delta, \lambda) = [1 - \delta][1f(1) + F(1)] + \delta\lambda s'(1)F(1) - [1 - \delta]f(1)$$
$$= [1 - \delta] + \delta\lambda s'(1)$$
$$= 1 - \delta + \delta\lambda s'(1)$$
$$> 0.$$

Therefore when $\delta < 1$, the optimal value of $\hat{k}$ is less than 1, implying that some plaintiffs will choose the injunction instead of damages. The objective function will achieve its minimum for the value k such that $H(.) = 0$ These results together imply that the objective

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44.   The envelope theorem implies that, at the optimum, only the direct effect of k on the objective function matters. Therefore the partial derivative of $\delta\pi(k)[1 - F(k)]$ with respect to k is $-\delta\lambda s(k)f(k) - \delta[1 - \lambda]f(k)$.

function in Equation (A.7) achieves its minimum for $\hat{k} \in (0, 1)$. Observe that $\hat{k} = 0$ is equivalent to awarding the injunction to all plaintiffs. Therefore at the optimum, damages are set sufficiently high to induce some plaintiffs to choose damages over the injunction. Therefore when renegotiation is uncertain, the optional injunction remedy is less expensive than providing all plaintiffs with the injunction.

Finally observe that $0 < \hat{k}(\delta, \lambda) < \theta_D(\delta, \lambda) < s(\delta, \lambda) < 1$. This follows immediately since $k < s(k)$ implies that $\hat{k}(.) < \hat{s}(.)$ and $\theta_D(.)$ is a convex combination of $\hat{k}(.)$ and $s(.)$.

(2)   Assuming $\delta = 1$. This implies that:

$$H(k, 1, \lambda) = \lambda s'(k) F(k).$$

Implying that $H(0, 1, \lambda) = 0$ and $H(k, 1, \lambda) > 0$, $\forall k \in (0, 1]$. Therefore when renegotiation is certain, the optimum is $\hat{k} = 0$, which is equivalent to the injunction.   □

Proof of Lemma 1.   Suppose that damages D are optimal for utility function $u(.)$. A single victim's utility is given by $u(D - \theta)$. Because damages are optimal, it must be that $E[u(D - \theta)] = \int_0^1 u(D - \theta) f(\theta) d\theta = 0$. Now consider the utility function $v(w) = \lambda(u(w))$, where $\lambda(0) = 0$, $\lambda' > 0$, and $\lambda'' < 0$. This implies that $v(D - \theta) < u(D - \theta), \forall \theta \neq D$, and $v(D - \theta) = u(D - \theta)$ for $\theta = D$. Therefore $E[v(D - \theta)] = \int_0^1 v(D - \theta) f(\theta) d\theta < \int_0^1 u(D - \theta) f(\theta) d\theta = 0$, so $D < D_v^*$.   □

Proof of Lemma 2.   In the social welfare model, plaintiffs have utility functions $u(w)$, where $w = \theta p(\theta) + M(\theta) - \theta$. The constrained minimization problem of the court that resulted in the optional injunction remedy has the condition that $w \geq 0$. Therefore the constraint that $w \geq 0$ does not depend on the function $u(.)$, so the optional injunction remedy is invariant to the victim's risk aversion.   □

Proof of Proposition 3.   Lemma 2 implies that the cost to the defendant of the optional injunction remedy is $C \in (0, 1)$. The injurer therefore undertakes harmful actions under the optional injunction remedy when $g > C$, all

of which increase expected social welfare. Lemma 1 implies that there exists a degree of risk aversion such that $D^* > C$. The injurer undertakes harmful actions under optimal damages when $g > D^*$, all of which increase expected social welfare. Because $D^* > C$, the injurer undertakes more actions which are expected to increase social welfare under the optional injunction remedy than under optional damages.   □

Appendix B – Optimal Remedy When Offering Many Options

In the standard model, the court offered a choice of remedies, $\mathbb{S}$, where the set included a discrete number of choices. However, this limits the scope of possible remedies that the court can offer. In particular, the standard model did not allow the court to award probabilistic remedies or a continuous choice schedule. While this section considers a court that can design a more sophisticated remedy, proposition 4 shows that courts minimize cost by utilizing the same optional injunction remedy.

The setup is identical but for one change. The choice of remedies is now given by a pair of functions $(M(\hat{\theta}), p(\hat{\theta}))$, where the plaintiff receives damages of $M(\hat{\theta})$ with probability $1 - p(\hat{\theta})$ and the injunction with probability $p(\hat{\theta})$.[45] The plaintiff then selects a remedy by declaring a type, $\hat{\theta} \in [0, 1]$.

Given that the court offers the remedy schedule $(M(\hat{\theta}), p(\hat{\theta}))$, the plaintiff's utility can be rewritten as:

$$u(\theta, \hat{\theta}, M, p) = \theta p(\hat{\theta}) + (1 - p(\hat{\theta}))M(\hat{\theta}) - \theta,$$

and the defendant's cost function can be rewritten:

$$C(\hat{\theta}, M, p) = p(\hat{\theta}) + (1 - p(\hat{\theta}))M(\hat{\theta}).$$

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45.   Alternatively, if it is possible to provide partial injunctions, $p(\theta)$ can be interpreted as the proportion of the plaintiff's interest that is restored instead of the probability of providing a full injunction, assuming that a plaintiff's utility from receiving the injunction $p(\theta)$ is given by $\theta p(\theta)$.

Finally, the court's problem can be written:

$$\min_{p(\hat{\theta}),M(\hat{\theta})} \int_0^1 \left[p(\hat{\theta}) + (1 - p(\hat{\theta}))M(\hat{\theta})\right]f(\theta)d\theta \tag{B.1}$$

$$s.t.: \theta p(\hat{\theta}) + (1 - p(\hat{\theta}))M(\hat{\theta}) - \theta \geq 0, \ \forall\theta \tag{B.2}$$

$$\hat{\theta} = \arg\max_{\hat{\theta}\in[0,1]} \theta p(\hat{\theta}) + (1 - p(\hat{\theta}))M(\hat{\theta}) - \theta \tag{B.3}$$

Where Equation (B.1) is the court's goal of minimizing cost, Equation (B.2) restricts attention to remedies that fully compensate plaintiffs, and Equation (B.3) ensures that the plaintiff chooses $\hat{\theta}$ to maximize her personal utility. As in Section 3, the court cannot assume that the plaintiff will truthfully declare her type. But it is possible to structure the remedy in a manner that induces the plaintiff to declare truthfully. The court can do so by introducing an incentive compatibility constraint to its optimization problem:

$$\theta p(\theta) + (1 - p(\theta))M(\theta) \geq \theta p(\hat{\theta}) + (1 - p(\hat{\theta}))M(\hat{\theta}), \ \forall\theta,\hat{\theta}.$$

This constraint ensures that the structures of the functions $M(\hat{\theta})$ and $p(\hat{\theta})$ are such that the plaintiff maximizes her utility by declaring her true type, $\hat{\theta} = \theta$.[46]

Adding the incentive compatibility constraint yields the court's complete remedy design problem: minimize cost to the defendant (Equation (B.4)), subject to adequate compensation (Equation (B.5)), and subject to all plaintiffs find it in their interest to declare their true valuation (Equation (B.6)):

$$\min_{p(\theta),M(\theta)} \int_0^1 \left[p(\theta) + (1 - p(\theta))M(\theta)\right]f(\theta)d\theta \tag{B.4}$$

$$s.t.: \theta p(\theta) + (1 - p(\theta))M(\theta) - \theta \geq 0, \ \forall\theta \tag{B.5}$$

$$\theta p(\theta) + (1 - p(\theta))M(\theta) \geq \theta p(\hat{\theta}) + (1 - p(\hat{\theta}))M(\hat{\theta}), \ \forall\theta,\hat{\theta}. \tag{B.6}$$

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46.   This follows from the revelation principle (Myerson, 1981). In the context of this problem, the revelation principle states that the court only needs to consider one remedy per type of plaintiff. The court only needs to ensure that the set of remedies are designed such that each plaintiff will select the remedy that is designed for her.

Proposition 4 shows that the optional injunction remedy uniquely solves this more general problem.

PROPOSITION 4 The remedy that guarantees full compensation at the lowest cost is to give the plaintiff the choice between an inalienable injunction or damages $M = \theta_D$, where damages are uniquely defined by the θ_D that solves: $\theta_D = 1 - \frac{F(\theta_D)}{f(\theta_D)}$.

Proof of Proposition 4.   The court's cost is:

$$C = \int_0^1 (p(\theta) + (1 - p(\theta))M(\theta))f(\theta)d\theta. \tag{B.7}$$

Letting the *expected transfer* be denoted $T(\theta) = (1 - p(\theta))M(\theta)$, the cost can be rewritten as:

$$C = \int_0^1 (p(\theta) + T(\theta))f(\theta)d\theta.$$

The plaintiff's utility from being type θ and declaring her type as $\hat{\theta}$ is given by:

$$U(\theta) = \theta p(\hat{\theta}) + T(\hat{\theta}) - \theta. \tag{B.8}$$

And by the envelope theorem, $\frac{dU(\theta)}{d\theta} = \frac{\partial U(\theta)}{\partial \theta} = p(\hat{\theta}) - 1$. Applying the fundamental theorem of calculus:[47]

$$\int_\theta^1 U'(x)dx = U(1) - U(\theta)$$

$$U(\theta) = U(1) - \int_\theta^1 (p(x) - 1)\, dx.$$

For the remedy to be optimal, it must be that the plaintiff who has suffered the most harm, $\theta = 1$ will receive the injunction, $p(1) = 1$. Therefore it

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47.   The fundamental theorem of calculus states that $\int_a^b f(x)dx = F(b) - F(a)$. It is standard in mechanism design problems to see $F(a)$ written as $F(a) = F(0) + \int_0^a f(x)dx$. And in most problems, 0 is the lowest type, so $F(0) = 0$, and so this can be rewritten $F(a) = \int_0^a f(x)dx$. But if the lowest type is 1 then $F(1) = 0$, it is more convenient to write $F(a) = F(1) - \int_a^1 f(x)dx$. This then allows the problem to be simplified to $F(a) = -\int_a^1 f(x)dx$.

must be the case that this plaintiff receives no bonus utility, so $U(1) = 0$.[48] This implies that the plaintiff's utility can be written without the reference to $U(1)$:

$$U(\theta) = -\int_\theta^1 (p(x) - 1)\, dx. \tag{B.9}$$

The plaintiff's expected utility, Equation (B.8), can be rewritten in terms of the expected transfer payment:

$$T(\theta) = U(\theta) - \theta p(\theta) + \theta. \tag{B.10}$$

Equations (B.9) and (B.10) can be substituted into the court's cost function in order to solve for the optimal remedy mechanism:

$$
\begin{aligned}
C &= \int_0^1 (p(\theta) + T(\theta)) f(\theta) d\theta \\
&= \int_0^1 (p(\theta) - \theta p(\theta) + \theta + U(\theta)) f(\theta) d\theta \\
&= \int_0^1 \left(p(\theta) - \theta p(\theta) + \theta - \int_\theta^1 (p(x) - 1)\, dx \right) f(\theta) d\theta \\
&= \int_0^1 (p(\theta) - \theta p(\theta) + \theta) f(\theta) d\theta - \int_0^1 \left(\int_\theta^1 (p(x) - 1)\, dx \right) f(\theta) d\theta
\end{aligned}
$$

Integration by parts simplifies the double integral[49]:

$$
\begin{aligned}
&- \left[\int_0^1 \left(\int_\theta^1 (p(x) - 1)\, dx \right) f(\theta) d\theta \right] \\
&= - \left[\left[F(\theta) \int_\theta^1 (p(x) - 1) dx \right]_{\theta=0}^{\theta=1} - \int_0^1 (1 - p(\theta)) F(\theta) d\theta \right] \\
&= \int_0^1 (1 - p(\theta)) F(\theta) d\theta.
\end{aligned}
$$

---

48.   This is a monotonicity constraint that I verify at the end of the proof.

49.   Integration by parts implies that $\int_0^1 uv' = [uv]_0^1 - \int_0^1 u'v$. Let $u = \int_\theta^1 (p(x) - 1) dx$ and $v' = f(\theta)$.

Plugging this back in yields:

$$C = \int_0^1 (p(\theta) - \theta p(\theta) + \theta) f(\theta) d\theta + \int_0^1 (1 - p(\theta)) F(\theta) d\theta$$

$$= \int_0^1 [(p(\theta) - \theta p(\theta) + \theta) f(\theta) + (1 - p(\theta)) F(\theta)] d\theta \qquad (B.11)$$

To find the schedule $p(\theta)$, the court minimizes this expression point-wise, yielding:

$$\frac{\partial C}{\partial p(\theta)} = (1 - \theta) f(\theta) - F(\theta) \qquad (B.12)$$

This expression describes how the court's cost changes by changing the probability of providing the injunction. Because $p(\theta)$ does not come into this expression, we will have a "bang-bang" solution in which the remedy is provided deterministically rather than randomly. Therefore for each θ it must be that $p(\theta) \in \{0, 1\}$.[50]

The court will be indifferent between providing the injunction or damages when $(1 - \theta) f(\theta) - F(\theta) = 0$. The court will award damages when $(1 - \theta) f(\theta) - F(\theta) > 0$. And the court will award the injunction when $(1 - \theta) f(\theta) - F(\theta) < 0$. This implies that there is a cutpoint value θ_D that determines whether a plaintiff receives damages or the injunction. This is

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50.   As discussed in Section 4, the bang-bang solution arises from the linear constraints. As in standard monopoly problems, it is not optimal to randomize the provision of an indivisible good. However, if it is possible to provide a partial injunction *and* plaintiffs' utilities over partial injunctions are nonlinear, then it may be optimal to induce further separation.

Consider rewriting the problem as follows. Let the plaintiff's utility (Equation (B.8)) instead be given by $U(\theta) = \theta v(p(\hat{\theta})) + T(\hat{\theta}) - \theta$, where $v(.)$ is an increasing and concave function and where $p(.)$ is the amount of the partial injunction (rather than the probability of awarding a full injunction). In this case, Equation (B.11) becomes:

$$C = \int_0^1 [(p(\theta) - \theta p(\theta) + \theta) f(\theta) + (1 - v(p(\theta))) F(\theta)] d\theta,$$

And therefore the first-order condition (Equation (B.12)) becomes:

$$\frac{\partial C}{\partial p(\theta)} = (1 - \theta) f(\theta) - v'(p(\theta)) F(\theta).$$

Therefore the optimal schedule of partial injunctions is given by the function $p(\theta)$ that solves this first-order condition. Coupling this with each type's partial monetary compensation, Equation (B.10), yields the complete remedy.

the value θ_D that solves:

$$\theta_D = 1 - \frac{F(\theta_D)}{f(\theta_D)}. \tag{B.13}$$

The level of damages must ensure that all types truthfully declare their harm. Damages must therefore be set such that the plaintiff of type θ_D is indifferent between damages and the injunction. This is uniquely satisfied at setting damages equal to θ_D.

The court's optimal remedy schedule is therefore identical to proposition 1:

$$(M(\hat{\theta}), p(\hat{\theta})) = \begin{cases} (0,1) & \text{if } \hat{\theta} > \theta_D \\ (\theta_D, 0) & \text{if } \hat{\theta} \leq \theta_D. \end{cases}$$

The optimal remedy is therefore increasing in the declared type of the plaintiff, with the increase occurring discontinuously at θ_D.

All that remains to be shown is to show that the assumption $U(1) = 0$ holds with this remedy. This is trivially satisfied, because type $\theta = 1$ will receive the injunction, leaving her perfectly compensated. $\square$

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