Split-Awards and Disputes: An Experimental Study of a Strategic Model of Litigation*

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Abstract

This paper studies experimentally the impact of the split-award statute, where the state takes a share of the plaintiff's punitive damage award, on litigation outcomes. Our findings indicate that dispute rates are significantly lower when bargaining is performed under the split-award institution. Defendants' litigation losses and plaintiffs' net compensation are significantly reduced by the split-award statute.

KEYWORDS: Settlement; Bargaining; Litigation; Asymmetric Information; Experiments
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1 Introduction

Tort reform in the U.S. has typically been motivated by the common perception that excessive punitive damage awards[1] have contributed to the escalation of liability insurance premiums.[2] Some reforms take the form of caps or limits on punitive damage awards while others mandate that a portion of the award be allocated to the plaintiff with the remainder going to the state.[3] These latter reforms, called "split-awards," have been implemented in Alaska, California,[4] Georgia, Illinois, Indiana, Iowa, Missouri, Oregon, and Utah.[5] In addition, New Jersey and Texas have contemplated, but not yet adopted, split-award statutes (White 2002).

Theoretical models of litigation have been developed to study the effects of split-awards on litigants' behavior and likelihood of trial. However, there are no empirical tests of these models, perhaps because most litigation outcomes are partially or totally unobserved by researchers so that data sources are rarely available (Daughety 2000). The proposed research is an attempt to test, using experimental methods, the effect of the split-award institution on the likelihood of trial and

[1] Justice O'Connor stated that punitive damage awards had "skyrocketed" more than 30 times in the previous ten years, with an increase in the highest award from $250,000 to $10,000,000 (Browning-Ferris Indus., Inc. v. Kelco Disposal, Inc., 492 U.S. 257, 282, 1989).

[2] In 1990, the total tort liability payments were approximately $65 billion, of which 93.5 percent were made by liability insurers (O'Connell, 1994).

[3] The magnitude of the resources currently spent in the U.S. tort and, therefore, diverted from economic activities, has generated an urgency for further reform of the tort system. The 2004 Economic Report of the President devotes a whole chapter to the tort system, describing its effects and proposing reforms. "Expenditures in the U.S. tort system were $233.4 billion in 2002, equal to 2.2 percent of gross domestic product (GDP), more than twice the amount spent on new automobiles in 2002. The expansive tort system has a considerable impact on the U.S. economy. Tort liability leads to lower spending on research and development, higher health care costs, and job losses" (Economic Report of the President, 2004, p. 203).

[4] On August 16, 2004, Governor Arnold Schwarzenegger signed the state budget legislation SB 1102 as an "urgency" matter, becoming effective immediately instead of January the 1st of next year. The SB 1102 provided that 75 percent of all punitive damages were payable to the state; that is, split-awards were enacted in that legislation (Metropolitan News Enterprise; August 18, 2004). Given that California has approximately 10 percent of the U.S. population, the effects of this statute may have a great impact on the U.S. tort system.

[5] Statutes vary with the state: the base for computation of the state's share can be the gross punitive award or the award net of attorney's fees, the state's share can be 50 percent, 60 percent or 75 percent and, the destination of the state's funds can be the Treasury, the Department of Human Services or indigent victims funds. For details, see Dodson (2000), Epstein (1994), Stevens(1994), and Sloane (1993).

Legal commentators have focused their analyses of theses statutes on their effects on the plaintiff's windfall (i.e., any amount in excess of the costs of pursuing the punitive claim) and the constitutionality of the reform (Evans 1998, Epstein 1994, Stevens, 1994, Sloane 1993). Commentators argue that in contrast to caps that reduce both the plaintiff's windfall and the deterrence effect of the punitive awards, the split-award statute constitutes a "move toward effectuating the true purpose of punitive damages" (Sloane, p. 473). They claim that split-awards reduce the plaintiff's windfall but maintain adequate levels of deterrence and punishment. In addition, split-awards allow the plaintiffs to receive a share of the awards for payment of attorney fees and rewards for their civil duty as "private attorney generals" (Case Note, 1993; Dodson, 2000; Evans, 1998; Epstein, 1994; Stevens, 1994; Sloane, 1993).

the level of care chosen by potential injurers. We adopt a simplified version of Landeo and Nikitin's (2005) model as a theoretical framework.

Among previous formal studies of the split-award statute is the work of Kahan and Tuckman (1995). They construct a simultaneous-move game between a plaintiff and a defendant and find that, in the absence of agency problems between plaintiffs and lawyers, split-awards reduce the plaintiff's litigation effort and expenses and, consequently, reduce the expected amount paid by the defendant.[6] Their framework does not allow for an analysis of the effects of split-awards on the likelihood of trial because the pre-trial bargaining stage is not explicitly modeled. Daughety and Reinganum (2003) examine the effects of the split-award reform on the likelihood of trial and settlement amounts by modeling the pre-trial bargaining as a strategic game of incomplete information between two Bayesian players, an informed defendant[7] and an uninformed plaintiff, using signaling and screening games setups. They find that holding filing constant, split-award statutes simultaneously lower settlement amounts and the likelihood of trial.

Landeo and Nikitin extend the analysis of the split-award reform by exploring its effects not only on litigation outcomes but also on the potential injurer's level of care.[8] They construct a strategic model of litigation consisting of two stages. First, there is a potential injurer's optimization stage, where a level of care is chosen by the potential injurer according to its cost of preventing accidents and the expected litigation loss in case of an accident. The level of care determines the probability that an accident occurs. If an accident occurs, a litigation stage begins. It is modeled as a signaling-ultimatum game where two Bayesian risk-neutral parties, an uninformed plaintiff and an informed defendant,[9] negotiate prior to a costly trial.

Consistent with Daughety and Reinganum, their model predicts that under certain conditions, a decrease in the plaintiff's share of the award decreases the probability of trial. Given that the split-award statute applies only when the case is settled in court, the parties have an incentive to settle out of court in order to cut out the state. In addition, they find that a reduction in the

[6] If agency problems exist, the effects of split-awards are indeterminate.

[7] The defendant knows the true probability that he will be found liable for gross negligence and made to pay punitive damages should the case go to trial.

[8] We will use the terms firm, defendant and potential injurer interchangeably.

[9] The defendant possesses private information about its cost of preventing accidents and, therefore, about its level of care and decision of the court should the case go to trial.

plaintiff's share of the award increases the probability of accidents. This effect arises because a decrease in the plaintiff's share reduces expected litigation costs. The potential injurer reacts to these lower expected costs by reducing expenditures on safety.[10] Despite the higher likelihood of accidents under the split-award statute, they find, however, that the overall effect of the reform can be welfare improving if the harm caused by accidents is below some threshold.[11]

We try here to further Landeo and Nikitin's research by investigating experimentally the effects of the split-award statute institution. In assessing the validity of the qualitative theoretical predictions, our experimental study analyzes the effect of a reduction in the plaintiff's share of punitive award on potential injurer's level of care and litigation outcomes using a two-treatment between-subjects design.

This experimental investigation is important for two reasons. First, from a theoretical perspective, these experimental conditions allow us to verify whether the theoretical model has captured the main variables that determine litigation outcomes and level of care choice. Hence, our findings provide information that might contribute to the improvement of game theoretic models of litigation. Second, the theoretical model shows the impact of the split-award statute on reducing the likelihood of dispute but at the expense of increasing the likelihood of accidents (by reducing the potential injurer's level of care). However, this tort reform has not been previously subjected to any experimental or field-testing. Given that data on the process of decision-making of the participants involved in lawsuits are not available or are incomplete, conducting an experiment to evaluate the effects of this litigation institution seems to be a valuable alternative.

Our findings indicate that dispute rates are significantly lower when bargaining is performed

[10] Polinsky and Che (1991) propose a liability system where the award to the plaintiff differs from the payment by the defendant (i.e., awards are decoupled). This system makes the defendant's payment as high as possible, and therefore, it allows the award to the plaintiff to be lowered. The authors claim that this policy reduces the incentives to sue without affecting the firm's incentives to take care. Note that the reduction in the plaintiff's award resembles the split-award statute. However, the split-award reform does not involve an increase in the award paid by the defendant.

Choi and Sanchirico (2004) show that the system proposed by Polinsky and Che may still have a negative effect on deterrence. Given that the award paid by defendants is increased, they will spend more on legal advice. This will force plaintiffs to spend more on attorneys as well and discourage some plaintiffs from filing a lawsuit.

[11] If the harm to society due to accidents is low enough, the positive welfare effects of the split-award of lowering the likelihood of trial (and therefore, reducing the resources spent on litigation) and reallocating economic resources from expenditures on safety to productive activities may offset the negative welfare effect of increasing the likelihood of accidents.

under the split-award institution. Defendant's litigation expenses and plaintiff's net compensation are significantly reduced by the split-award statute. The examination of subjects' decisions suggests strategic behavior.

The rest of the paper is organized as follows. Section 2 outlines the theoretical model and predictions. Section 3 presents a parameterization of the model. Section 4 describes the experimental design. Section 5 examines the results from the experimental sessions. Section 6 concludes the paper.

2 The Theoretical Model

Landeo and Nikitin study theoretically the effects of split-awards on the potential injurer's level of care and litigation outcomes. They construct a strategic model of litigation that consists of two stages. First is a potential injurer's optimization stage, where a level of care is chosen by the potential injurer according to its cost of preventing accidents (i.e., type) and the expected litigation loss in case of an accident. The level of care determines the probability that an accident occurs. If an accident occurs, a litigation stage begins; modeled as a signaling-ultimatum game between two Bayesian risk-neutral parties, an uninformed plaintiff and an informed defendant[12] negotiate prior to a costly trial. In their model there is a continuum of potential injurer's types.

To test experimentally the effects of the split-award institution on level of care and litigation outcomes, we do not require, however, a continuum of potential injurer's types. Therefore, we adapt Landeo and Nikitin's model by allowing for only two types of potential injurers, avoiding in this way to add unnecessary complexity to the experimental design.[13]

2.1 A Simplified Version of Landeo and Nikitin's Model

Nature first decides the efficiency type i of the potential injurer from two possible types ($i = 1, 2$). The potential injurer's type determines its cost $c^i(y)$ of achieving a given level of care y. Type-1 potential injurers are less efficient than type-2 potential injurers, so for any level of care y,

[12]The defendant possesses private information about its cost of preventing accidents and, therefore, about its level of care and decision of the court should the case go to trial.

[13]The theoretical predictions derived from this simplified model are consistent with the predictions from the original model.

$c^1(y) > c^2(y)$ (i.e., potential injurers of type 1 need to spend more to achieve the same level of care). The share of type-1 potential injurers is $\phi < 1$. The realization of i is revealed only to the potential injurer, but ϕ is common knowledge. We define $\lambda(y)$ as the probability of an accident that depends on the level of care y, and assume that the higher the level of care y, the lower the probability of an accident (i.e., the probability of accident is a decreasing function of the level of care).

After observing its type, the potential injurer then decides its optimal level of care, that is, the one that minimizes its total expected loss L. We define the defendant's total expected loss function as $L^i = c^i(y) + \lambda(y)l$, where l is the expected loss from legal action, different for careful and negligent defendants. The potential injurer is careful if the chosen level of care is greater than or equal to the due standard of care $\bar{y}$ (exogenous and common knowledge parameter); otherwise, the potential injurer is negligent.[14]

If an accident occurs, the litigation stage starts. The plaintiff first decides whether to file a lawsuit. This decision is based on her beliefs about the negligence of the defendant conditional on the occurrence of an accident: with probability q she believes that the defendant is negligent, and with probability $(1 - q)$ she believes that the defendant is careful.[15] We assume that the plaintiff's expected payoff from suing is positive. Therefore, every injured plaintiff has an incentive to file a suit. The pre-trial bargaining negotiation is modeled as a signaling-ultimatum game. The defendant has the first move and makes a settlement proposal. After observing the proposal, the plaintiff, who knows only ϕ, decides whether to drop the case, to accept the defendant's proposal (out-of-court settlement) or to reject the proposal (bring the case to the trial stage). The plaintiff's decision is based on her updated beliefs about the type of defendant she is confronting after observing the defendant's proposal. If the plaintiff drops the case, both players incur no legal costs. If the plaintiff

[14] In real-world settings, punitive damages are awarded only in cases where the defendant is found grossly negligent. This implies that a care standard is applied.

We refer to firms who just meet or exceed the care standard for gross negligence as careful firms and firms who fail to meet the standard as negligent firms.

[15] These beliefs are taken as parametric for the analysis of the litigation subgame; however, the equilibrium values for q and $(1 - q)$ will ultimately be determined as part of the overall equilibrium. These equilibrium values depend on the optimal levels of care chosen by all firms in the first stage of the game, according to their types and expected litigation costs (that correspond to the equilibrium in the litigation stage). Note that the values of q and $(1 - q)$ are common knowledge, but the firm's type and the chosen level of care are known only by the firm.

accepts the defendant's proposal, the game ends, the defendant pays to the plaintiff the proposed amount, and neither player incurs legal costs.

If the plaintiff rejects the proposal, the plaintiff and the defendant incur legal costs ($K_P > 0$ and $K_D > 0$, respectively). If the defendant is negligent, the court awards punitive damages $A > 0$ to the plaintiff. Under the split-award regime, the plaintiff receives only a fraction f of the total punitive award, and the state gets a share $(1-f)$ of the award.[16] If the plaintiff rejects the proposal and the defendant is careful, no punitive damages are awarded.[17]

Note that the total harm caused by an accident includes 1) the private harm caused to the plaintiff, which we assume is fully compensated with the compensatory damage award; and, 2) the social harm H, generated by the defendant's wanton behavior and which warrants punitive damages. H may include additional losses directly caused to the plaintiff but not compensated with the compensatory award such as time spent on and emotional distress caused by the compensatory damages lawsuit and social losses such as undermining of society's moral standards and institutions due to the wanton behavior of the defendant.[18]

Note also that without loss of generality, for the sake of mathematical tractability and given that our primary goal is to explore the effect of the split-award statute, which applies to the punitive damage award only, we abstract from compensatory damages.[19]

The sequence of events in the game is shown in Figure 1.

[**INSERT FIGURE 1**]

[16]Note that K_P, K_D, A and f are exogenous and common knowledge parameters of the model.

[17]We have restricted the proposal space to $[0, fA - K_P]$ (i.e., a proposal cannot be negative or greater than the maximum amount the plaintiff can get in court).

[18]Given that we have not assumed that the court perfectly estimates the social harm caused by the negligent behavior of the defendant, our model allows for H and A to be different.

[19]The model can be modified to incorporate compensatory damages without altering the qualitative predictions presented here in the following way. Assume that the court awards compensatory damages CDA (common-knowledge) whenever the accident happens (i.e., strict liability applies), but it awards punitive damages A only if the firm fails to achieve the care standard for gross negligence. Assume also bifurcation of trial: two separate trials decide on compensatory and punitive damage awards, that the compensatory damages game has the same structure as the punitive damages game presented here, and that legal costs, K_{PCDA} and K_{DCDA}, are paid by the plaintiff and defendant, respectively, only in case of trial. Then, in case of an accident, the plaintiff and the defendant do not have asymmetric information with regard to prospective compensatory damage awards, and therefore, they settle out of court. Thus, every defendant will offer $CDA - K_{PCDA}$, and every plaintiff will accept.

Thus, the total loss function is given by $L = c(y(n), n) + \lambda(y(n))(CDA - K_{PCDA} + l)$, where l is the expected loss from legal action related to punitive damages. It is easy to show that all qualitative results presented in Sections 2 and 3 will hold.

The model is solved backwards. We start by finding the solution of the litigation stage, using the Perfect Bayesian equilibrium concept and the universal divinity refinement (Banks and Sobel 1987). Second, we analyze the defendant's optimization problem and find the defendant's optimal level of care. This level of care depends on the defendant's type and the litigation stage equilibrium.[20]

In equilibrium, (1) the more efficient firms (type-2 firms) choose to be careful (optimal level of care greater than or equal to the due care standard)[21] while the less efficient firms (type-1 firms) choose to be negligent (optimal level of care lower than the due care standard), and (2) some lawsuits are dropped, some are resolved out-of-court, and some go to trial.

2.2 Qualitative Predictions

The qualitative predictions of the model are summarized in Propositions 1–5.[22]

Proposition 1. A decrease in the plaintiff's share of the punitive award, f, reduces the aggregate level of care.

A reduction in f decreases the expected litigation loss for the defendant, and it reacts by lowering its level of care.

Proposition 2. A decrease in the plaintiff's share of the punitive award, f, increases the probability of an accident.

By assumption, the probability of an accident is negatively related to the level of care. By Proposition 1, a decrease in f reduces the aggregate level of care. Then, the probability of an accident will increase.

[20]The solution to the model is presented in Appendix A, available on the JEBO website at www.elsevier.com/locate/econbase.

The solution of the litigation stage is the same for both the original model and the simplified version presented here. The proofs related to the optimization problem of the defendant and to the qualitative predictions, presented in Appendices A and B, are different from the original model proofs. However, the qualitative predictions are the same for both models.

[21]If type-2 firms are very efficient, then their optimal level of care will be greater than the due care standard; otherwise, their optimal level of care will be equal to the due care standard.

[22]The proofs of the propositions are presented in Appendix B, available on the JEBO website at www.elsevier.com/locate/econbase.

We can make unambiguous predictions about the unconditional and conditional probabilities of trial if type-2 potential injurers just meet the due care standard. It is important to note, however, that this condition is sufficient (but not necessary) for the results of Proposition 3 to hold.

Proposition 3. A decrease in the plaintiff's share of the punitive award, f, reduces the unconditional and the conditional probabilities of trial if type-2 potential injurers just meet the due care standard.

Given that the split-award statute applies only when the case is settled in court, the parties have an incentive to settle out of court in order to cut out the state. Note that given that litigation costs are paid by the parties only in case of a trial, split-awards also reduce the expected total litigation costs paid by both parties.

We define the plaintiff's rejection threshold as the proposal level below which all (positive) proposals are rejected by the plaintiff.[23]

Proposition 4. A decrease in the plaintiff's share of the punitive award, f, reduces the plaintiff's rejection threshold and the defendant's equilibrium (positive) proposal.

Under the split-award, the plaintiff expects to obtain a lower payoff at trial, so the plaintiff is more willing to accept lower out-of-court settlement proposals and the defendant, anticipating the behavior of the plaintiff, will make lower settlement offers.

Proposition 5. A decrease in the plaintiff's share of the punitive award, f, reduces the defendant's expected loss from legal action.

Under the split-award, the plaintiff's rejection threshold (and the defendant's equilibrium proposal) and the dispute rate are lower. Therefore, the split-award reduces the defendant's expected loss from legal action.

Note that a welfare analysis of the split-award tort reform should consider all its individual effects, such as, the effect on the aggregate expenditure on care, the harm that an accident causes

[23] We do not consider here proposals equal to zero.

to society, and the costs of litigation.[24]

Define the social cost of accidents as the sum of aggregate expenditures on accident prevention, unconditional expected damage that accidents cause to society, and unconditional expected litigation costs. A decrease in f reduces the level of care of low-type firms and does not affect the level of care of high-type firms. Therefore the aggregate expenditures on accident prevention must decrease. In addition, given that a decrease in f lowers the level of care and, therefore, increases the probability of an accident, we can conclude that a decrease in f increases the unconditional expected damage that accidents cause to society. Finally, assuming that the high-type firms just meet the standard of care, a reduction in f reduces the unconditional probability of trial. Hence, if the level of the harm an accident causes to society is sufficiently low (for a particular value of f), we may expect that split-awards decrease the social costs of accidents.

Finally, note that when y is large enough (which can be interpreted as overdeterrence), the positive effect of the split-award reform outweighs the negative effect. In fact, for sufficiently large values of y, the probability of an accident approaches zero, so, a marginal change in f has almost no impact on the probability of an accident and, therefore, almost no effect on the unconditional expected damage that accidents cause to society. In addition, given that $\lambda(y)$ is very close to zero, a marginal reduction in y due to a reduction in f has a negligible effect on the probability of an accident caused by a careful defendant. Therefore it has a negligible impact on the unconditional probability of trial and on the expected litigation costs.[25] Hence the only non-negligible (and positive) welfare effect of lower f will be the effect on reducing the aggregate expenditures on accident prevention.

3 Model Parameterization

The model parameterization presented in this section will be used in the experimental design. The functional forms and parameter values chosen follow the assumptions on primitives of the model[26] and are presented below.

[24]The welfare analysis is presented formally in Appendix C, available on the JEBO website at www.elsevier.com/locate/econbase.

[25]Note that this analysis does not rely on the assumption that the high-efficiency type just meets the standard.

[26]Primitives of the model are all the conditions stated at the beginning of Section 2.1 and in the Appendix A.

Let n^i denote the efficiency factor associated with the type-i potential injurer. Assume that the expenditures-on-care function is $c^i(y) = \frac{(1-n^i)y^3}{10^5}$ and the probability of an accident is $\lambda(y) = (1-0.001y)^2$. Therefore, the potential injurer's total expected loss is $L = \frac{(1-n^i)y^3}{10^5} + (1-0.001y)^2 l$, where l is the expected litigation cost in case of an accident; $l = fA - K_P$ for the negligent potential injurer ($y < \bar{y}$), and $l = \frac{(fA-K_P)}{A+K_D}K_D$ for the careful one ($y \geq \bar{y}$).

Differentiating the total expected loss function with respect to y and setting to zero, we obtain

$$\frac{\partial L}{\partial y} = \frac{30(1-n^i)y^2 - 2(1000-y)l}{10^6} = 0. \quad (1)$$

Solving for y, in case the potential injurer chooses an interior solution, yields the optimal level of care

$$y = \frac{-l + \sqrt{l^2 + 60,000l(1-n^i)}}{30(1-n^i)}. \quad (2)$$

Assume the following parameter values: $n^2 = .99$, $n^1 = -.6$; the share of the low-skill potential injurers (Type-1 potential injurers) $\phi = .8$; $A = 500$, $K_D = K_P = 100$, $\bar{y} = 290$. Assume also that the potential injurer's proposal S can be $S = 0$ or $S > 100$.[27] Consider two values for f: $f = 1$ (no split-award regime, all punitive damages award going to the plaintiff) and $f = .5$ (split-award regime, only half of the punitive damages award going to the plaintiff).[28]

Under the no-split award regime ($f = 1$), the unique divine Perfect Bayesian Equilibrium (PBE) is as follows. For the type-2 potential injurer, 1) the optimal level of care will be $y^2 = 480 > \bar{y}$, that

[27] We have limited the set of possible offers to $S = 0$ and $S > 100$ in order to rule out the separating PBE that do not survive the Banks and Sobel's divinity refinement. See Appendix A for description of these other PBE that are not divine PBE. Therefore, under this set of possible offers, there is a unique PBE.

[28] Our model parameterization satisfies all the model assumptions on primitives and, therefore, the predictions derived from these assumptions. In addition, this examination satisfies the theoretical prediction stated in Proposition 3 without relying on the sufficient (but not necessary) condition (which implies that the type-2 defendants just meet the due care standard). Instead, it assumes the existence of two very different types of defendants characterized by very different values for the parameter n, the efficiency factor. Type 1, the low efficiency type chooses to be negligent in equilibrium, and type 2, the very efficient type, exceeds the due care standard in equilibrium.

The chosen functional forms for the expenditure-on-care $c^i(y)$ and probability of an accident $\lambda(y)$ functions are the simplest possible forms that satisfy the theoretical assumptions. In addition, these functional forms restrict the expenditure-on-care function to take positive and easy-to-comprehend values (i.e., real numbers between 0 and 1000) and the probability of accident function to take values between 0 and 1. Note also that given the functional form for λ, the maximum value that the level of care y can take is $y_{max} = 1000$.

Note also that this model parameterization permits us to meet the requirements of the experimental design: 1) two experimental treatments (split-award and no split-award) sufficiently different from each other (in particular, the value of f in the case of the split-award needed to be much less than 1 in order to have a plaintiff's award in case of trial substantially smaller under the split-award condition), and 2) a probability of an accident sufficiently high, in order to have an efficient collection of data related to the litigation stage. Finally, note that the parameters chosen provide empirically relevant predictions, such as a low probability of trial.

is, the high-skilled potential injurer chooses to be careful and its level of y is above the standard; this level of care corresponds to a level of expenditure on care equal to 11, and 2) the defendant will propose $S = 0$ with certainty. For the type-2 potential injurer, 1) the optimal level of care will be $y^1 = 121 < \bar{y}$, that is, the low-skilled potential injurer chooses to be negligent; this level of care corresponds to a level of expenditure on care equal to 28, and 2) the defendant will randomize between a compensation proposal $S = 0$ (Prob. $= .02$) and $S = 400$ (Prob. $= .98$). The plaintiff will randomize between accepting (Prob. $= .33$) and rejecting (Prob. $= .67$) an offer $S = 0$ and will always accept an offer $S = 400$.

Under the split-award regime ($f = .5$), the unique divine PBE is as follows. For the type-2 potential injurer, 1) the optimal level of care will be $y^2 = 333 > \bar{y}$ (i.e., the high-skilled potential injurer still chooses a level of y above the standard), a level of care corresponding to a level of expenditure on care equal to 4, and 2) the defendant will propose $S = 0$ with certainty. For the type-1 potential injurer, 1) the optimal level of care will be $y^1 = 76 < \bar{y}$ (i.e., the low-skilled potential injurer chooses to be negligent), a level of care that corresponds to a level of expenditure on care equal to 7, and 2) the defendant will randomize between a compensation proposal $S = 0$ (Prob. $= .07$) and $S = 150$ (Prob. $= .93$). The plaintiff will randomize between accepting (Prob. $= .75$) and rejecting (Prob. $= .25$) an offer $S = 0$ and will always accept an offer $S = 150$.

The qualitative effects of the split-award statute are summarized in Table 1. Split-awards will reduce the conditional probability of trial (and the expected total litigation costs) but will also reduce the expenditure on care and, therefore, will increase the probability of accidents. In addition, the defendant's equilibrium (positive) proposal and the plaintiff's rejection threshold will be lower under the split-award statute. Finally, the defendant's expected litigation loss from legal action and the plaintiff's expected net compensation (net of litigation cost) will be reduced by the split-award statute.[29]

[**INSERT TABLE 1**]

[29]The effect of split-awards on plaintiff's expected net compensation is in general ambiguous. However, under this model parameterization, split-awards unambiguously reduce the plaintiff's expected net compensation.

4 Experimental Design

In assessing the validity of the qualitative theoretical predictions, our experimental study analyzes the effect of a reduction in the plaintiff's share of punitive award on the potential injurer's level of care and probability of trial using a two-treatment between-subjects design.

We have specified the experimental setting in a way that satisfies the assumptions of the theory.[30] Although our experiment cannot predict the effects of decreasing the plaintiff's share of punitive award in richer environments, the experiment can provide a reasonable amount of evidence regarding whether the reduction of plaintiff's share of punitive award in an environment such as the one we have structured here will have the predicted effects.

The experimental design consists of 2 conditions corresponding to two levels of plaintiff's share of punitive award f: $f = .5$, which implies that 50 percent of the punitive award goes to the plaintiff (split-award condition), and $f = 1$, which implies that the total punitive award goes to the plaintiff (no split-award condition).

4.1 The Games

Procedural regularity is accomplished by developing a software program that permits subjects to play the game by using networked personal computers. The software consists of 2 versions of the game, reflecting the two experimental conditions. The software includes two information boxes (one containing the role and type of the subject, and the other containing the current balance). Subjects are provided with written instructions and a simple calculator. The instructions contain information about the possible choices for each player at each stage of the game, a graphical representation of the stages of the game, and payoff tables.[31]

The experiment is a multi-stage game. Subjects play the role of player A (the potential injurer)[32] or player B (the plaintiff). We motivate the game to the subjects using a litigation context.[33] We

[30]Even though the theoretical model assumes risk neutrality of players, we have decided not to control for risk preferences. If the behavior of subjects deviates systematically from the qualitative theoretical predictions based on risk neutrality, then the model will not capture essential elements of bargaining such as risk preferences. Therefore, a modification of the game theoretic model should be pursued (see Davis and Holt 1993; Smith 1989).

[31]Software screens and written instructions are available from the authors upon request.

[32]The potential injurer becomes the defendant after an accident occurs.

[33]Research on cognitive psychology indicates that subjects may seem like zero intelligence agents when they are

use a laboratory currency called the "token" (1 token = 2 Canadian cents).[34] The parameter values used in this experiment follow the numerical examination presented in the previous section. Subjects are each given 800 tokens at the beginning of the game. After roles are randomly assigned to subjects, the type of potential injurer is drawn by the computer from a binomial distribution (low-type probability equal to .8 and high-type probability equal to .2). This type is revealed only to the potential injurer. The plaintiff knows only the probability distribution from which the type is chosen.

The game consists of at most two stages. In the first stage (potential injurer's decision-making stage), the potential injurer chooses the level of expenditure on safety (called "investment level" in the experiment), which is not revealed to the plaintiff. In order to facilitate the understanding of the game, we simplify the sets of possible expenditure levels for each potential injurer's type. These sets, similar in both conditions, consist of three options for the low-type potential injurer (7, 28 and 390 tokens) and three options for the high-type potential injurer (2, 4 and 11 tokens). Each set contains the equilibrium expenditures specified by theory (i.e., 7 and 28 for the low-type potential injurer in conditions 1 and 2, respectively; and, 4 and 11 for the high-type potential injurer in conditions 1 and 2, respectively). Note that, in order to achieve the standard of care $\bar{y} = 290$, and given the strong efficiency difference between both types, the high-type injurer needed to spend 4 tokens, and the low-type injurer needed to spend 390 tokens.

The chosen expenditure on care (that determines the probability that an accident occurs) is subtracted from the potential injurer's initial endowment. The possible expenditure levels for each type of potential injurer and the associated probabilities of accident are common knowledge. Given the level of investment chosen, the computer randomly decides if an accident happens and informs both players of the result. If the accident does not occur, the game ends. The payoff for the plaintiff is equal to his initial endowment, and the payoff for the potential injurer is equal to her

placed in the unfamiliar and abstract context of an experiment, even if they function quite adequately in familiar settings. In these cases, subjects will apply their own labels (Loewenstein 1999). Also a study conducted by experimental economists (Cooper and Kagel 2003) reports compelling evidence for the existence of context effects.

However, we use neutral labels for the subjects' roles (Player A and Player B) because we consider that the use of more realistic labels (i.e., potential injurer and plaintiff) will not contribute to the subjects' understanding of the game and may generate noise in the subjects' responses due to the degree of identification with the role described by the label.

[34] The use of tokens allows us to create a fine payoff grid that underlines the payoff differences among actions.

initial endowment minus the chosen level of investment.

If the accident happens, the second stage (litigation stage) starts and a level of damage equal to 200 tokens (equal in both conditions) is deducted from the plaintiff's initial endowment,[35] then the defendant proposes a level of compensation S ($S = 0$ or $100 < S \leq$ defendant's current balance) to the plaintiff. The plaintiff needs then to decide whether to accept or reject it. If the plaintiff rejects the defendant's proposal, the court decides the award based on the level of investment chosen by the defendant. If the defendant is negligent, he loses an amount equal to $A + K_D$ and the plaintiff receives a compensation equal to $fA - K_P$; if the defendant is careful, he loses K_D, and the plaintiff loses K_P.[36] Then the game ends. If the plaintiff accepts the proposal, the defendant pays the plaintiff the proposed amount and the game ends.

4.2 The Experimental Sessions

We ran 8 80-minute sessions of 8 to 12 subjects each (70 subjects in total) at the experimental laboratory of the University of Alberta School of Business. The subject pool was recruited from undergraduate classes at the University of Alberta, mostly by posting advertisements on public boards and on an electronic bulletin board.

At the beginning of each session, written instructions were provided to the subjects. The instructions about the game and the software used were presented aloud by the experimenter to create common knowledge.[37] Subjects were informed about the random process of allocating roles and about the randomness and anonymity of the process of forming pairs. Game structure,

[35] Note that the deduction of 200 tokens can be interpreted as the additional losses directly caused to the plaintiff but not compensated with the compensatory award. Empirically, the argument of uncompensated losses is used by supporters of punitive damages. They state that given that plaintiffs are not fully compensated with the compensatory award, they deserve at least part of the punitive damage award. In this way, our experimental design resembles the situation experienced by plaintiffs in lawsuits involving punitive damages. Note also that the deduction of 200 tokens after an accident occurs makes the task more understandable to subjects without violating the theory. Finally note that given that both conditions are similar except for the value of f, any difference between these conditions can be attributed to the effects of the split-award tort reform.

[36] The values used are as follows: $A = 500$, $K_D = K_P = 100$, $f = 1$ in the no-split-award condition and $f = 0.5$ in the split-award condition.

[37] Given that we needed to explain the payoff structure in detail and aloud and given that the payoff structure in case of trial is different for each condition, we run only 1 version of the game per session.

However, internal validity was preserved by random assignment of subjects to conditions. Also, sessions under both conditions were run each day and similar populations of subjects were used in both conditions. Finally, independence of observations was guaranteed by the one-shot game characteristic of the experiment.

initial endowment, possible levels of investment and probabilities of accident associated, payoffs, prior beliefs about the distribution of Player A's types were common knowledge among subjects. Subjects were informed only about the game version they were assigned to play. Subjects were also instructed that they would receive the dollar equivalent of the tokens they held at the end of the experiment, and they were informed about the token/dollar equivalence. Subjects were then required to fill out a short questionnaire to ensure their ability to read the information tables.

To ensure subjects' understanding of the task to be performed, 30 practice games were played before the play of the actual game. The structure of the practice games and computer screens used were similar to the actual game; the only difference was that the practice games were played against a computer partner while the actual game was played against a human partner. During the first 15 practice games the subjects played the role of Player A and during the last 15 practice games they played the role of Player B. The structure of the practice games allowed subjects to familiarize themselves with the structure of the game, the likelihood to confront any of the two types of Player A, and the consequences of the decisions of both players in terms of payoffs, without conditioning subjects' behavior.

Note that the practice games were not stationary repetitions of the real game. They present enough variation in roles and decisions of the computer partner to help subjects to understand the mechanics of the game, while avoiding conditioning their behavior. The number of practice games was chosen (i) to allow the computer-partner to choose the same number of times each of the three investment levels per type and, therefore, avoid conditioning the behavior of subjects, (ii) to help subjects to understand, through the realizations of types, the meaning of the probabilities of encountering low and high types (80 percent and 20 percent respectively), and (iii) to allow subjects to play as players A or B the same number of times. The realization of the random variables "actions of the computer-partner" and the realization of the random variable "accident occurrence" (determined by the level of investment chosen by Player A, computer or human subject) were fixed for each practice game, across conditions, subjects and experimental sessions.

During the first 15 practice games, where the subject was Player A, (i) 12 times the subject was a low type Player A (80 percent of the time player A was low type) and 3 times the subject was a high type Player A (20 percent of the time Player A was high type), and (ii) the computer-partner played the acceptance/rejection decision according to the realization of the binomial random variable "acceptance of proposal" (with probability equal .5 that the realization be acceptance) that was fixed for each practice game, across conditions, subjects and sessions. During the last 15 practice games, where the subject was Player B, (i) 12 times the computer partner was a low-type Player A and chose 7, 28, and 390 as a level of investment 4 times each (80 percent of the time Player A was a low type and each level of investment was played an equal number of times) and 3 times the computer partner was a high-type Player A and chose 2, 4 and 11 as a level of investment 1 time each (20 percent of the time player A is high type and each level of investment was played an equal number of times), and (ii) if an accident occurred, the computer made a proposal according to the realization of the uniform random variable "proposal", which was fixed for each practice game, across conditions, subjects and sessions.

After the last practice game was played, every participant was randomly assigned a role and randomly and anonymously paired with another participant and played a one-shot game. Each player was equally likely to have the role A or B and to be paired with any other participant, and players were completely anonymous to one another. Communication between players was done through a computer terminal.[38]

We decided to use a one-shot game because the analysis of how people learn in highly repetitive situations (learning in games) was not the focus of this study. We were interested in the predictive power of the theoretical model on the effects of the split-award tort reform in real-world settings where stationary replications are almost impossible and, therefore, the type of learning studied in the laboratory under stationary repetitions is not present.[39] In addition, psychological research

[38]This experimental environment did not permit the formation of reputations.

Given that the purpose of the practice games was to facilitate the understanding of the mechanics of the experiment (game structure, payoffs and consequences of the decisions), we made subjects play practice games against a computer terminal. Subjects were informed that their partner during these practice games was a computer and that they should not expect that their human partner in the real game would necessarily behave as the computer did and that they would not necessarily need to behave as the computer did. In this way, the experience to play against a human partner was a one-shot experience.

[39]As noted by Camerer (1997) and stressed by Loewenstein, "the situation that participants face in experiments of this type [resembles] that of the protagonist in the film 'Groundhog Day', who repeatedly relives the same day until he 'gets it right'. Outside of this fictional film, how many people are exposed to the situation of repeatedly, and in close succession, bidding on the same good [?] Stationary replication is simply not a common feature of economic life" (Loewenstein, p. F28; comments in brackets).

shows that people's behavior at the end of a series of stationary repetitions is not necessarily more representative of their behavior in economic settings than their behavior at the beginning. "Repetition tends to repress certain types of psychological motives that may play a prominent role in early-period play [and may be important in real-world settings]" (Loewenstein, p. F29; comments added in brackets).

The participation fee was CA $5.00, and the average game payoff was CA $13.50. At the end of each experimental session, subjects received their monetary payoffs in cash.

5 Results

In general, our findings are consistent with the qualitative theoretical predictions of the litigation stage. Tables 2, 3, 4 and 5 summarize the experimental results.[40]

[**INSERT TABLE 2**]

The first column of Table 2 presents information regarding the effect of the split-award institution on potential injurer's level of care. Contrary to the theoretical predictions, the results do not suggest a significant difference between the expenditures on care chosen under the two conditions.[41] Given that subjects understood the structure of the payoff tables, the structure of the game, and the consequences of their choices (i.e., they understood the link between the choice of investment in care, the probability of an accident and the litigation outcomes),[42] this finding may suggest

[40]The information presented in these tables correspond to data pooled on defendant's type.

Given the small number of observations and to avoid the t-test normality assumptions, we used the robust rank-order test. This non-parametric test was chosen instead of the more commonly used Mann-Whitney test because the Mann-Whitney test assumes that the samples come from distributions with identical second (dispersion) and higher-order moments, whereas the robust rank-order test makes no such assumption. In general, this test has the same power as the Mann-Whitney test (when the assumptions of that test are met); however, this test appears to approach the normal distribution somewhat faster as the number of observations gets larger (Siegel and Castellan, 1988).

In case of the analysis of the defendant's proposal, the number of observations was smaller than 13. Then, we used the small-sample distribution of $\grave{U}$ rather than the normal approximation. In this case, we were constrained to use only four significant levels, .10, .05, .025, and .01, rather than the near-continuum available for the normal approximation (Fligner and Policello 1981).

Because of the small number of observations, we used the Fisher exact test (instead of the χ^2-test) to perform the median test of accepted proposals and to evaluate the null hypothesis of independence between experimental conditions and dispute rates (Siegel and Castellan).

[41]Given the results on expenditures on care and given that the probability of accidents depends on the level of expenditures on care chosen, we have not included here the analysis of the probability of accidents.

[42]The results from the questionnaire filled out by subjects before the beginning of the game indicated that subjects understood the structure of the payoff tables, the structure of the game, the consequences of their choices, and the

an inability of subjects to incorporate the future implications of their decisions in their current decisions due to their limited computational abilities.[43] In addition, the complexity of the decision on care[44] might induce subjects to make decisions about the investment on care by applying heuristic-based-reasoning.[45] Given the random assignment of subjects to conditions, it is expected that the use of heuristic-based-reasoning was common to both conditions.

The second column of Table 2 reports the findings on dispute rates conditional on the occurrence of an accident. Dispute rate was defined as the percentage of total cases that proceed to the stage of a trial. As predicted by the model, dispute rates were significantly reduced by the split-award institution. In fact, 88 percent of the pairs in the no split-award condition went to trial, but only 31 percent of cases in the split-award condition were resolved at the trial stage, a strongly significant difference ($p = .002$). The third column of Table 2 outlines the findings on total litigation costs conditional on accident occurrence. We defined total litigation costs as the sum of costs incurred by each litigant. Our findings provide strong support for the theoretical prediction of the effect of the split-award in reducing the total litigations costs. We found that when pairs bargained under the split-award institution, the total litigation costs were 65 percent lower than those without a split-award, a significant difference ($p = .000$).

[**INSERT TABLE 3**]

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links between their decisions.

[43]Previous experimental tests of game-theoretic models report similar results. Referring to the play of games by experimental subjects, Camerer and Johnson (2004) state that, "motivated intelligent subjects behave sensibly, but do not exhibit the extent of strategic reasoning which is commonly assumed when game theory is applied to understand ... political maneuvering, incentive design, and so forth" (p. 15). Also Camerer (2003) reports that "[his work with Johnson et al., (2002) indicates that] players in a three round game [do] not look ahead to the second and third rounds as much as backward induction requires" (p. 197; comments added in brackets).

[44]Note that the decision on care and the realization of the litigation losses were separated by the random realization of the accident and the pre-trial bargaining negotiation.

[45]Findings from cognitive psychology suggest that human subjects present limited computational abilities. When confronting complex situations, people make use of heuristic reasoning, such as, shortcuts used by individuals to make decisions. Tversky's (1972) theory of "elimination by aspects," for example, states that individuals choose among alternatives, not only by comparing alternatives in all aspects at once, but rather by the heuristics of comparing one randomly chosen aspect at a time, eliminating alternatives along the way. Simon (1955, 1987) hypothesizes that agents perform only limited searches, accepting the first satisfactory decision, process coined as "bounded rationality." Heuristics are rational in the sense that they appeal to intuition and avoid deliberation cost, but boundedly rational in the sense that they often lead to biased choices (Conlisk 1996). Applying the findings from cognitive psychology to the study of the law, Korobkin (in press) finds that "difficult decisions ... are resolved by making easier choices ... Reliance on a heuristic implies neglect of at least some potentially relevant information, and if the heuristic is not precisely suited to the relevant problem, suboptimal outcomes will result" (p. 3).

The first column of Table 3 shows the plaintiff's rejection threshold.[46] All proposals below this threshold were always rejected by the plaintiff.[47] As predicted by the theory, we found that the split-award reduced this threshold by 58 percent. The threshold under the split-award was equal to 130 and the threshold under the no-split award was equal to 310. This effect may suggest strategic behavior of plaintiffs in forming their rejection decision. If plaintiffs were strategic, they would form their rejection decision on the basis of the payoff at trial. Given that the payoff at trial in case of confronting a negligent defendant is reduced by the split-award, they would reduce their rejection threshold under the split-award institution.[48] The strategic behavior of plaintiffs is also suggested by the median accepted proposal under both conditions. In fact, the median accepted proposal under the split-award was 53 percent lower than the median accepted proposal under the no split-award condition, a significant difference ($p = .055$).[49]

The second column of Table 3 provides information about the defendant's mean proposals under the two institutions.[50] The findings provide some support for the theoretical predictions about the effect of the split-award in reducing the defendant's mean proposal. In fact, the defendant's mean proposal under the split-award was 22 percent lower than the one without a split-award (but not significantly different, $p > .10$).[51]

[**INSERT TABLE 4**]

The first column of Table 4 provides information about the defendant's expected total litigation

[46] The analysis in this table refers to positive proposals from the defendant (i.e., proposals greater than 0).

[47] In condition 1, all proposals greater than or equal to the rejection threshold were always accepted by the plaintiff except for the proposal equal to 200 that was proposed by four defendants and rejected by one plaintiff; in condition 2, all proposals greater than or equal to the rejection threshold were always accepted by the plaintiff.

[48] Note that in equilibrium, the plaintiff should expect that only negligent defendants make a positive proposal.

[49] The median accepted proposals were equal to 167 and 357.5 for the split-award and no split-award conditions, respectively. The p value corresponds to the Fisher exact probability for a Median test.

[50] The data correspond to cases where the defendant made a positive proposal (i.e., proposals greater than zero).

[51] Note that the proposals were located in the intervals $[101, 250]$ and $[101, 405]$ for the split-award and the no split-award conditions respectively.

Note also that 33 percent of the defendants in both conditions chose a proposal equal to 200 (i.e., equal to the plaintiff's loss due to an accident). This might suggest that the 200 worked as a focal point for some non-strategic defendants. However, given that 50 percent of offers made in condition 1 were lower than or equal to 150 and 33 percent of offers made in condition 2 were greater than 200, we still observe strategic behavior in some defendants. The analysis of the plaintiffs' responses to offers equal to 200 suggests that strategic behavior prevailed over other considerations in plaintiffs' behavior. In fact, 75 percent of offers equal to 200 were accepted in condition 1, while no offer equal to 200 was accepted in condition 2. The dispute rates under both conditions, without considering the offers equal to 200, are also significantly different (Fisher exact $p = .026$).

loss. We defined the defendant's total litigation loss as the accepted proposal that is transferred from the defendant to the plaintiff in case of an out-of-court settlement or as the deduction from the defendant's payoff imposed by the court in case of trial plus the defendant's litigation costs. We found a positive and strongly significant effect ($p = .000$) of the split-award in reducing the defendant's expected total litigation loss. This effect can be explained by the lower probability of trial and the lower plaintiff's rejection threshold (and therefore, the lower out-of-court transfers on average) under the split-award institution.[52] The second column of Table 4 summarizes the results about the plaintiff's expected net compensation (net of litigation cost). We also found that the split-award reduced significantly ($p = .000$) the plaintiff's net compensation. This result is obviously related to the reduction of plaintiff's rejection threshold (and lower out-of-court transfers on average) and to the lower plaintiff's payoff at trial (in case of confronting a negligent defendant) under the split-award institution.

In the next step we will contrast the quantitative predictions of the model and the experimental results. Table 5 summarizes the quantitative theoretical predictions and the experimental results.

[**INSERT TABLE 5**]

Under both institutions, the predicted values from the theory overestimate the empirical results for the plaintiff's rejection threshold and underestimate the empirical results for the expenditures on care, dispute rate (and total litigation costs), defendant's litigation loss and plaintiff's net compensation. This might suggest that the experimental subjects did not satisfy the assumptions of the model as well as the existence of non-modeled factors that affect subjects' decisions.

For instance, the patterns of the levels of care that defendants followed in the first stage of the game (under both conditions) and the comparison of these levels of care to the predicted values suggest risk-averse attitudes. More risk-averse subjects prefer to spend reasonably more (24 instead of 7 tokens, but not 390 tokens) on care in order to reduce the likelihood of an accident. In fact, the mean expenditure on care under the split-award was 38.47, a value higher than the predicted value (equal to 6.40), with 94 percent of these defendants spending more than the predicted value.

[52] The mean accepted proposals are equal to 175.78 and 357.5, under the split-award and no split-award conditions, respectively.

Similarly, under the no split-award condition, the mean expenditure on care chosen by the defendants was 52 percent higher than the predicted value (equal to 24.60), with 50 percent of these defendants spending more than the predicted value.

Anomalous plaintiff's behavior (under both conditions) may be also a result of non-neutral attitudes toward risk. Since the theoretical model assumes risk neutral players, the risk aversion may explain why observed plaintiff's rejection thresholds under both conditions are more than 13 percent lower than those stated by the theory. More risk-averse plaintiffs prefer to accept a low settlement offer in order to avoid the risk of not receiving any award in court when confronting a careful defendant. In addition, the observed dispute rates (higher than the predicted rates under both conditions) may suggest that there are other non-modeled factors, such as decision errors that contribute to impasse, besides asymmetric information.

Finally, we will analyze the observed behavior of players in more detail and contrast it with the predictions about the equilibrium strategies. In general, these predictions are inconsistent with the experimental observations. For instance, when bargaining is performed under the split-award institution, the model predicts that there will be an equilibrium with out-of court settlement for cases where proposals are equal to 150. The results show, however, that the proposal for cases that settle out-of-court are located in the interval $[130, 250]$ and the mean accepted proposal is 175.78. In fact, only 22 percent of the cases that settled out-of-court had proposals equal to the level predicted by the theory, and 33 percent of those cases were located within 15 units of the prediction (i.e., in the interval $[135, 165]$). The model also predicts that only the negligent defendant will make an out-of-court settlement offer and that this offer will be equal to 150. However, we observed that 8 percent of defendants who made settlement offers were careful, that the settlement offers were located in the interval $[101, 250]$, and only 18 percent of negligent defendants made an offer equal to 150.[53]

When bargaining is performed under the no split-award institution, the theory predicts an equilibrium with out-of-court settlement where the defendant's proposal is equal to 400. The empirical results show, however, that the accepted offers are located in the interval $[310, 405]$ and

[53] All proposals equal to 150 were accepted.

that the mean accepted proposal is 357.5. In addition, according to the theoretical predictions, we should observe that only the negligent defendant makes an out-of-court settlement proposal equal to 400. However, we found that 8 percent of defendants who made settlement offers were careful, settlement offers were located in the interval $[101, 405]$, and no defendant made an offer equal to 400.

We can inquire now about the reliability of the theoretical model in helping us to understand the patterns of data. Our results indicate that the qualitative predictions of the model about the effect of the split-award on litigation outcomes are consistent with the observed behavior and outcomes. Therefore, the theoretical model contributes significantly to the understanding of the influence of the split-award institution on litigation outcomes. The significant qualitative effect that the split-award institution had on the observed litigation behavior provides some evidence of strategic behavior on the part of the subjects.

6 Conclusions

This study reports several important findings. In the experiment, the split-award institution affected the likelihood of disputes as predicted by the theoretical model. The dispute rate and total litigation costs were significantly lower under the split-award compared to the no split-award case. Defendants' litigation losses and plaintiffs' net compensation were positively and significantly influenced by the split-award institution. Contrary to the theoretical predictions, the experimental results do not suggest a significant difference between the expenditures on care chosen under the two conditions. The significant qualitative effect that the split-award institution had on the observed litigation behavior suggests strategic behavior of the subjects. The examination of the subjects' decisions also suggests risk-aversion.

Our findings provide useful information that can be used to improve game theoretic models of litigation. Directions for future theoretical research include enhancements to the current models to explain the discrepancies we found, perhaps by incorporating non-neutral attitudes toward risk in models of incomplete information and adding some relevant behavioral characteristics of subjects (i.e., the use of heuristics under limited computational abilities) that influence decisions. Our findings stress the importance of combining experimental and behavioral observation with theoretical modeling.

Our study shares a weakness in terms of external validity that is common to all laboratory experimental research. Although our experiment cannot predict the effects of the split-award institution on levels of care and settlement in richer environments, this experiment provides a reasonable amount of evidence regarding whether the addition of the split-award institution into the bargaining process we have structured here will have the predicted effects.

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Appendix A. Model Solution

The solutions of the litigation stage[54] and of the optimization problem of the defendant follow.

Solution of the Litigation Stage

We focus our analysis on the unique empirically relevant equilibrium of the litigation stage under conditions $qfA - K_P > 0$ and $fA - K_P > K_D$, that survives Banks and Sobel universal divinity refinement:[55] a partially separating equilibrium in which some cases are dropped, some proceed to trial, and others settle before trial.[56]

Proposition A1 characterizes the equilibrium of the litigation stage.

Proposition A1. Assume that $qfA - K_P > 0$ and $fA - K_P > K_D$. The following litigation strategy profile, together with the plaintiff's beliefs, represents the equilibrium path of the unique universally divine Perfect Bayesian equilibrium of the litigation stage.

Strategy Profile

1) The plaintiff always files a suit. In response to an offer $S_1 = 0$, the plaintiff rejects the offer (goes to trial) with probability $\alpha = \frac{fA-K_P}{A+K_D}$ and accepts the offer (drops the action) with probability $(1-\alpha) = \frac{A+K_D-fA+K_P}{A+K_D}$; the plaintiff always accepts the offer $S_2 = fA - K_P$ (settles out-of-court).

2) The negligent defendant makes no offer (offers $S_1 = 0$) with probability $\beta = \frac{K_P(1-q)}{q(fA-K_P)}$ and offers $S_2 = fA - K_P$ with probability $(1-\beta) = \frac{q(fA-K_P)-K_P(1-q)}{q(fA-K_P)}$. The careful defendant always makes no offer (offers $S_1 = 0$).

Plaintiff's Beliefs

[54]The solution of the litigation stage is the same for both Landeo and Nikitin's (2005) model and for the simplified version presented in this paper. The proof of existence and uniqueness of the litigation stage are the same as the original model proofs. The proofs related to the optimization problem of the defendant and to the qualitative predictions are different from the original model proofs.

[55]The condition $qfA - K_P > 0$ ensures that plaintiffs always file a suit (necessary condition) and the condition $fA - K_P > K_D$ rules out pooling equilibria (sufficient condition). Under these conditions, there are other partially separating equilibria; they are non-empirically relevant (i.e., they do not allow for lawsuits to be dropped) and do not survive the universal divinity refinement.

[56]Data from the U.S. Department of Justice indicate that for a sample of the largest 75 counties (1-year period ending in 1992), 76.5 percent of product liability cases were disposed through agreed settlement and voluntary dismissal and 3.3 percent were disposed by trial verdict. The other 20.2 percent were disposed as follows: 4.5 percent by summary judgment, .5 percent by default judgment, 6 percent were dismissed, 2.7 percent by arbitration award, 6.1 percent by transfer, and .3 percent by other dispositions (Smith et al., 1995).

The equilibrium beliefs are as follows. If an accident occurs, the plaintiff believes with probability $(1-q)$ that she is confronting a careful defendant and with probability q that she is confronting a negligent defendant. When the plaintiff receives an offer, she updates her beliefs using Bayes' rule: when she receives an offer $S_1 = 0$, she believes with probability $\frac{(1-q)}{q\beta+(1-q)}$ that she is confronting a careful defendant and with probability $\frac{q\beta}{q\beta+(1-q)}$ that she is confronting a negligent defendant; when the plaintiff receives an offer $S_2 = fA - K_P$, she believes with certainty that she is confronting a negligent defendant.

The off-equilibrium beliefs are as follows. When the plaintiff receives an offer S' such that $0 < S' < fA - K_P$, she believes that this offer was made by a negligent defendant.

The expected payoffs for the plaintiff and careful and negligent defendant are $V_P = qfA - K_P$, $V_{D_C} = -\left[(\frac{fA-K_P}{A+K_D})K_D\right]$ and $V_{D_N} = -(fA - K_P)$, respectively.

The conditional probabilities of out-of-court settlement (acceptance of an offer $S_2 = fA - K_P$), dropping a lawsuit (acceptance of an offer $S_1 = 0$), and trial (rejection of an offer $S_1 = 0$) are as follows: the conditional probability of out-of-court settlement $q(1-\beta) = \frac{qfA-K_P}{fA-K_P}$, the conditional probability of dropping the lawsuit $(1-\alpha)[1-q(1-\beta)] = \left[\frac{A(1-f)+K_D+K_P}{A+K_D}\right]\left[\frac{fA(1-q)}{fA-K_P}\right]$, and the conditional probability of trial $\alpha[1-q(1-\beta)] = \frac{fA(1-q)}{A+K_D}$.

Proof of Proposition 1A. The proof has two main parts. In the first part, we prove the existence of perfect Bayesian equilibria, one of which is the partially separating PBE stated in Proposition 1, under conditions $qfA - K_P > 0$ and $fA - K_P > K_D$, In the second part, we show that the equilibrium proposed in Proposition 1 is the only partially separating equilibrium that survives the universal divinity refinement and therefore, is the unique universal divine PBE of the litigation stage.

Part 1. Existence of Perfect Bayesian Equilibria of the Litigation Game

Part 1.1. We eliminate the dominated and iteratively dominated strategies for each player.

Rationality suggests that since the plaintiff can get at most $fA-K_P$ at trial, the plaintiff should accept any pretrial offer over $fA - K_P$. That is, any strategy that calls for the plaintiff to reject an offer greater than $fA - K_P$ is weakly dominated by a strategy in which he accepts the offer.[57] Rationality also suggests, given that the plaintiff can drop the case and lose nothing, the plaintiff should reject any pretrial offer $S < 0$. That is, any strategy that calls for the plaintiff to accept an offer lower than zero is dominated by a strategy in which he rejects the offer.

Because the plaintiff accepts all offers over $fA - K_P$ (maximum payoff at trial), any strategy in which the defendant offers more than $fA - K_P$ when she is negligent is iteratively dominated by a strategy in which she offers exactly $fA - K_P$. Rationality also tells us that the defendant will offer no more than K_D (loss for a careful defendant at trial) if she is careful. Finally, because the plaintiff rejects all offers below zero, any strategy in which the defendant offers less than zero is iteratively dominated by a strategy in which she offers exactly zero. Then, the minimum possible offer is $S = 0$ and represents the defendant's refusal to settle.

Hence, after eliminating the dominated strategies and a first round of elimination of the iteratively dominated strategies for each player, we can restrict our attention to the offer space $[0, fA - K_P]$ for the negligent defendant (i.e., a proposal cannot be negative or greater than the maximum payoff the plaintiff can get in court), and to the offer space $[0, K_D]$, for the careful defendant (i.e., a proposal cannot be negative or greater than the maximum loss the careful defendant can get in court).

Let's apply iterative elimination of dominated strategies again. Because the careful defendant never offers more than K_D and since the plaintiff can get $fA - K_P$ at trial, rationality suggests that the plaintiff should reject any pretrial offer over K_D and lower than $fA - K_P$. That is, any strategy that calls for the plaintiff to accept such an offer is iteratively dominated by a strategy in which he rejects the offer. Rationality also tells us that the negligent defendant will not make any offer greater than K_D and lower than $fA - K_P$. Then, the offer space for a negligent defendant gets reduced to $[0, K_D]$ U $\{fA - K_P\}$.

Part 1.2. We prove that in equilibrium the negligent defendant randomizes at most between two possible strategies. In Part 1.1. we show that the offer space for the negligent defendant is

[57] It is only weakly dominated because the second strategy does not result in a strictly higher payoff against every one of the defendant's strategies. In particular, it does not result in a strictly higher payoff if the defendant's strategy is to refuse to offer a settlement (i.e., offer $S = 0$) whether negligent or careful.

given by $[0, K_D]$ U $\{fA - K_P\}$; then it suffices to show that there is no more than one equilibrium offer $S_1 \in [0, K_D]$.[58]

We consider 3 steps. First, we show that there is no equilibrium offer in this interval that is proposed by the negligent defendant only. Second, we show that there is no equilibrium offer in the interval proposed by the careful defendant only. Finally, we show that no two distinct equilibrium proposals are proposed by both types of defendant.

Part 1.2.1.

If such an equilibrium offer $\tilde{S}$ existed, the plaintiff would reject it with probability 1. Hence the case would be resolved at trial, and the negligent defendant would lose $A + K_D$. He is better off offering $fA - K_P$, which is accepted with certainty.

Part 1.2.2.

If such an equilibrium offer $\tilde{S}$ existed, then the plaintiff would accept it with probability 1. Hence the negligent defendant would be better off switching to this offer.

Part 1.2.3.

We prove it by contradiction. Assume that there exist two such offers, S_1 and S_2, such that $0 \leq S_1 < S_2 \leq K_D$. Denote by p_1 and p_2 the respective equilibrium probabilities of acceptance of these proposals by the plaintiff. Each type of defendant is indifferent between these proposals. Hence

$$S_1 p_1 + (1 - p_1) K_D = S_2 p_2 + (1 - p_2) K_D \tag{A1}$$

and

$$S_1 p_1 + (1 - p_1)(A + K_D) = S_2 p_2 + (1 - p_2)(A + K_D). \tag{A2}$$

Subtracting the first equation from the second one, we get

$$(1 - p_1) A = (1 - p_2) A. \tag{A3}$$

[58] No more than one equilibrium offer $S_1 \in [0, K_D]$ implies that the negligent defendant randomizes at most between 2 possible strategies, one of which is $fA - K_P$.

Hence, $p_1 = p_2$, but in that case defendants of both types are strictly better off offering S_1. Contradiction follows.

Part 1.3. We show that under conditions $qfA - K_P > 0$ and $fA - K_P > K_D$, there are infinitely many partially separating equilibria (one of them is the one stated in Proposition 1) and infinitely many pooling equilibria.[59]

Part 1.3.1. Existence of Partially Separating Equilibria

The description of the partially separating equilibria is as follows. If $qfA - K_P > 0$ and $fA - K_P > K_D$, 1) careful defendants offer S_1 such that $0 \leq S_1 \leq K_D$, and negligent defendants mix the two strategies, offer S_1 such that $0 \leq S_1 \leq K_D$ with probability $\tilde{\beta}$ and offer $S_2 = fA - K_P$ with probability $(1-\tilde{\beta})$, and 2) plaintiffs always file a lawsuit; plaintiffs always accept S_2[60] and mix between rejection (with probability $\tilde{\alpha}$) and acceptance (with probability $(1 - \tilde{\alpha})$) when the offer is S_1 such that $0 < S_1 \leq K_D$.[61]

Consider the expected payoffs for the plaintiff, careful and negligent defendants in terms of $\tilde{\alpha}$ and $\tilde{\beta}$. The expected payoff for the plaintiff V_P is

$$V_P = (1-q)[\tilde{\alpha}(-K_P) + (1-\tilde{\alpha})(S_1)] + q\{\tilde{\beta}[\tilde{\alpha}(fA - K_P) + (1-\tilde{\alpha})(S_1)] + (1-\tilde{\beta})(fA - K_P)\}. \quad (A4)$$

The expected payoff for the careful defendant V_{D_C} is

$$V_{D_C} = \tilde{\alpha}(-K_D) + (1-\tilde{\alpha})(S_1), \quad (A5)$$

and the expected payoff for the negligent defendant V_{D_N} is

$$V_{D_N} = \tilde{\beta}[\tilde{\alpha}(-(A + K_D)) + (1-\tilde{\alpha})(S_1)] + (1-\tilde{\beta})[-(fA - K_P)]. \quad (A6)$$

[59] Condition qfA - $K_P > 0$ rules out the equilibrium where no lawsuit is filed, and condition $fA - K_P > K_D$ rules out the pooling equilibrium where the careful defendant behaves as a negligent defendant by making a positive settlement offer.

A separating equilibrium is not possible in this game. Suppose that a separating equilibrium exists: careful defendants offer $S_1 \leq K_D$ and negligent defendants $S_2 \neq S_1$. Given that S_1 is always accepted by the plaintiff and S_2 is always rejected by the plaintiff, then the negligent defendant has an incentive to deviate to S_1 because $S_1 < A + K_D$.

[60] A defendant offering S_2 reveals his type, and hence S_2 should be equal to $fA - K_P$ to be always accepted.

[61] As the plaintiff accepts some of the offers of S_1, a negligent defendant has an incentive to mimic the behavior of the careful defendant and offer S_1 as well.

The values of $\tilde{\alpha}$ and $\tilde{\beta}$ are calculated from the condition that both parties (the plaintiff and the negligent defendant) have to be indifferent between their strategies to mix them. Thus,

$$fA - K_P = \tilde{\alpha}(A + K_D) + (1 - \tilde{\alpha})S_1 \qquad (A7)$$

and

$$S_1 = \frac{q\tilde{\beta}}{q\tilde{\beta} + (1-q)}(fA - K_P) + \frac{1-q}{q\tilde{\beta} + (1-q)}(-K_P). \qquad (A8)$$

Equation (A4) says that a negligent defendant is indifferent between admitting his negligence (i.e., offering $S_2 = fA - K_P$) and stating that he is careful (i.e., offering S_1) with the risk to lose $A+K_D$ if the case goes to court. Equation (A5) says that a plaintiff is indifferent between dropping the case and getting a payoff of S_1 and going to court. Solving (A4) for $\tilde{\alpha}$ and (A5) for $\tilde{\beta}$ we get $\tilde{\alpha} = \frac{fA - K_P - S_1}{A + K_D - S_1}$ and $\tilde{\beta} = \frac{(S_1 + K_P)(1-q)}{q(fA - S_1 - K_P)}$.[62]

Next, the expected payoffs for the plaintiff and careful and negligent defendant are $V_P = qfA - K_P$, $V_{D_C} = -\left\{\frac{S_1[(1-f)A + K_P] + (fA - K_P)K_D}{A + K_D - S_1}\right\}$ and $V_{D_N} = -(fA - K_P)$, respectively.

The equilibrium beliefs are as follows. If an accident occurs, the plaintiff believes with probability $(1-q)$ that she is confronting a careful defendant and with probability q that she is confronting a negligent defendant. When the plaintiff receives an offer, she updates her beliefs using Bayes' rule: when she receives an offer S_1, she believes with probability $\frac{(1-q)}{q\tilde{\beta}+(1-q)}$ that she is confronting a careful defendant and with probability $\frac{q\tilde{\beta}}{q\tilde{\beta}+(1-q)}$ that she is confronting a negligent defendant; when the plaintiff receives an offer S_2, she believes with certainty that she is confronting a negligent defendant.

The off-equilibrium beliefs are as follows. When the plaintiff observes an offer $S' < S_1$ or an offer $S_1 < S' < fA - K_P$, she believes that she faces a negligent defendant. Then, the plaintiff rejects the offer with certainty because she will obtain a higher payoff $(fA - K_P)$ if she brings the negligent defendant to trial. Given that S' is rejected with certainty, the careful defendant will not make the offer S' because he will receive a higher payoff by offering S_1, which is accepted with positive probability in the proposed equilibrium. Given that the plaintiff will reject the offer S'

[62] Note that $\tilde{\alpha}(S_1 = 0) = \alpha$ and $\tilde{\beta}(S_1 = 0) = \beta$; that is, the equilibrium path just described corresponds to the partially separating perfect Bayesian equilibrium stated in Proposition 1.

with certainty, the negligent defendant will not make an offer $S^{'}$ because he will receive a higher payoff by offering $S_2 = fA - K_P$ with probability $(1 - \tilde{\beta})$ and S_1 with probability $\tilde{\beta}$ (as stated in the proposed equilibrium).

Note also that $V_P = qfA - K_P > 0$. Therefore, plaintiffs file a suit with probability one.

Part 1.3.2. Existence of Pooling Equilibria

The description of the pooling equilibria is as follows. If $qfA - K_P > 0$ and $fA - K_P > K_D$, 1) negligent and careful defendants offer the same amount S, where $0 < S \leq K_D$ and $S \geq qfA - K_P$, and 2) plaintiffs always file a lawsuit; plaintiffs always accept the offer S.[63]

The equilibrium beliefs are as follows. If an accident occurs, the plaintiff believes with probability $(1-q)$ that she is confronting a careful defendant, and with probability q that she is confronting a negligent defendant. Given that defendants pool, when the plaintiff receives an offer, she cannot update her beliefs. Then, the plaintiff accepts if the offer is greater than or equal to her ex-ante expected return from trial ($S \geq qfA - K_P$).[64] The off-equilibrium beliefs compatible with this equilibrium are as follows. If the defendant offers $\tilde{S} \neq S$, then the plaintiff believes with certainty that he faces the negligent defendant and rejects the offer.

Part 2. Uniqueness of the Litigation Stage Equilibrium

We prove that the PBE stated in Proposition 1 is the only PBE that survives the universal divinity refinement is the partially separating PBE, and therefore, this is the unique equilibrium of the litigation stage. We proceed first to apply the universal divinity refinement to the partially separating equilibria, and second, to the pooling equilibria. The implementation of the universal divinity refinement proceeds as follows. First, we find (for careful and negligent defendants) the minimum probability of acceptance (by the plaintiff) of an offer that differs from the equilibrium offers (deviation offer) such that the defendant is willing to deviate. Second, we compare these

[63] if $S \leq K_D$ fails to hold, the careful defendant will find it optimal to deviate, to offer 0, and go to trial; if $S \geq qfA - K_P$ fails to hold, the plaintiff will find it profitable to deviate and reject the proposal S.

Note also that there is no possible pooling with $S = 0$ and plaintiff accepting the offer with certainty; if every defendant offers $S = 0$, then the plaintiff will be better off by rejecting the offer because $qfA - K_P > 0$ (i.e., her ex-ante expected payoff from going to trial is greater than the offer). Then, it would be optimal for the negligent defendant to deviate from offering $S = 0$ to $S^{'} = fA - K_P < A + K_D$ (loss at trial).

[64] The plaintiff computes the ex-ante return from trial by using her prior beliefs and the payoffs at trial from confronting negligent and careful defendants, so the ex-ante return from trial $q(fA - K_P) + (1-q)(-K_P) = qfA - K_P$.

minimum probabilities. The defendant with the lower minimum probability will be the one the plaintiff should expect (with probability one) to deviate.

Part 2.1. Elimination of the Other Partially Separating Equilibria

Consider the deviation $S^{'}$ from an equilibrium offer S_1 or S_2. We will cover the analysis of three cases: $0 \leq S^{'} < K_D$, $S^{'} = K_D$ and $K_D < S^{'} < fA - KP$.

Case I: $0 \leq S^{'} < K_D$

For mathematical convenience, define $S^{'} = S_1 - \epsilon$. If $\epsilon < 0$, then the deviation offer $S^{'} > S_1$ and if $\epsilon > 0$, then the deviation offer $S^{'} < S_1$.

Proceed first to analyze the case of the negligent defendant. The negligent defendant will be willing to deviate if

$$p_N(S_1 - \epsilon) + (1 - p_N)(A + K_D) \leq (fA - K_P), \qquad (A9)$$

where the left-hand side of the inequality represents the expected loss for the negligent defendant from deviating and the right-hand side represents his expected loss in equilibrium.[65] Solving for p_N we get

$$p_N \geq \frac{(1-f)A + K_P + K_D}{A + K_D - S_1 + \epsilon}, \qquad (A10)$$

then the minimum probability of acceptance of the deviation offer made by the negligent defendant is

$$\underline{p_N} = \frac{(1-f)A + K_P + K_D}{A + K_D - S_1 + \epsilon}. \qquad (A11)$$

Now find the minimum probability of acceptance of the deviation by the plaintiff, such that the careful defendant is still willing to propose it:

$$p_C(S_1 - \epsilon) + (1 - p_C)K_D \leq \left[S_1(1 - \frac{fA - K_P - S_1}{A + K_D - S_1}) + K_D\frac{fA - K_P - S_1}{A + K_D - S_1}\right], \qquad (A12)$$

[65]Note that in every partially separating PBE of the litigation game (under the conditions $qfA - K_P > 0$ and $fA - K_P > K_D$) the expected payoff for the negligent defendant is $fA - K_P$.

where the left-hand side of the inequality represents the expected loss for the careful defendant from deviating and the right-hand side represents his expected loss in equilibrium.[66] Solving for p_C we get

$$p_C \geq \frac{[(1-f)A + K_D + K_P](K_D - S_1)}{(A + K_D - S_1)(K_D - S_1 + \epsilon)}, \qquad (A13)$$

then the minimum probability of acceptance of the deviation offer made by the careful defendant is

$$\underline{p_C} = \frac{[(1-f)A + K_D + K_P](K_D - S_1)}{(A + K_D - S_1)(K_D - S_1 + \epsilon)}. \qquad (A14)$$

Compare the threshold probabilities for the negligent and careful defendant:

$$\underline{p_C} - \underline{p_N} = [(1-f)A + K_D + K_P]\left[\frac{(K_D - S_1)(A + K_D - S_1 + \epsilon) - (A + K_D - S_1)(K_D - S_1 + \epsilon)}{(A + K_D - S_1)(K_D - S_1 + \epsilon)(A + K_D - S_1 + \epsilon)}\right] =$$

$$= \frac{-A\epsilon[(1-f)A + K_D + K_P]}{(A + K_D - S_1)(K_D - S_1 + \epsilon)(A + K_D - S_1 + \epsilon)}, \qquad (A15)$$

where the expressions in bracket and parentheses are positive. Then, if $\epsilon < 0$, $\underline{p_N} < \underline{p_C}$, and if $\epsilon > 0$, $\underline{p_N} > \underline{p_C}$.

Following the universal divinity refinement, if $0 \leq S^{'} < K_D$ and $\epsilon < 0$ ($S^{'} > S_1$), the plaintiff should believe that the deviation $S^{'}$ comes from a negligent defendant with probability one. On the other hand, if $\epsilon > 0$ ($S^{'} < S_1$), the plaintiff should believe with probability one that the deviation $S^{'}$ comes from a careful defendant.

Apply the universal divinity refinement to the other partially separating equilibria (where $0 < S_1 \leq K_D$). The off-equilibrium beliefs imply that the plaintiff should infer that any deviation $S^{'}$ comes from a negligent defendant. In case of $\epsilon > 0$ ($S^{'} < S_1$), these off-equilibrium beliefs do not survive the refinement. The plaintiff should believe that the deviation comes from a careful defendant and accept the offer. This response from the plaintiff will generate an incentive for the negligent defendant to deviate and offer $S_1 - \epsilon$. Hence, the other partially separating equilibria (where $0 < S_1 \leq K_D$) do not pass the test of universal divinity for $0 \leq S^{'} < K_D$.

[66] Remember that $\tilde{\alpha}(S_1 = 0) = \alpha$. Given that we need to apply the results of this proof to check all partially separating PBE of the litigation game, we will use $\tilde{\alpha}$ in the computation of the expected payoff for the careful defendant. Note that in every partially separating PBE of the litigation game (under the conditions $qfA - K_P > 0$ and $fA - K_P > K_D$), the expected payoff for the careful defendant does depend on S_1.

We will apply now the universal divinity refinement to the empirically relevant equilibrium (where $S_1 = 0$). The off-equilibrium beliefs imply that the plaintiff should infer that any deviation comes from a negligent defendant. Note also that given that $S_1 = 0$ is the lowest possible offer, only deviations above S_1 (i.e., $S' > S_1$) are possible. Therefore, the off-equilibrium beliefs survive the universal divinity refinement. Hence, the empirically relevant equilibrium passes the test of universal divinity for $0 \leq S' < K_D$.

Case II: $S' = K_D$

The minimum probability of acceptance of a deviation offer made by the negligent defendant is still given by equation (A8).

For the case of the careful defendant, note that his expected deviation loss is K_D and his expected equilibrium loss is in the interval $(\frac{fA-K_P}{A+K_D}, K_D)$ (for $0 < S_1 < K_D$) and is equal to $\frac{fA-K_P}{A+K_D} < K_D$ (for $S_1 = 0$). Then, for any probability of acceptance, the careful defendant will not be willing to deviate when $S' = K_D$.

By universal divinity, the plaintiff should expect that any deviation offer $S' = K_D$ comes from a negligent defendant. Thus, all partially separating PBE pass the test of universal divinity for $S' = K_D$.

Given that the partially separating PBE stated in Proposition 1 is the only partially separating equilibrium that survives the universal divinity refinement in both cases, then the equilibrium proposed in Proposition 1 is the only universal divine partially separating PBE.

Part 2.2. Elimination of the Pooling Equilibria

Consider the deviation S' from an equilibrium offer S. We will cover the analysis of two cases: $0 \leq S' < K_D$ and $S' = K_D$.

Case I: $0 \leq S' < K_D$

For mathematical convenience, define $S' = S - \epsilon$. If $\epsilon < 0$, then the deviation offer $S' > S$, and if $\epsilon > 0$, then the deviation offer $S' < S$.

Proceed first to analyze the case of the negligent defendant, who will be willing to deviate if

$$p_N(S - \epsilon) + (1 - p_N)(A + K_D) \leq S, \tag{A16}$$

where the left-hand side of the inequality represents the expected loss for the negligent defendant from deviating and the right-hand side represents his expected loss in equilibrium.[67] Solving for p_N we get

$$p_N \geq \frac{A + K_D - S}{A + K_D - S + \epsilon}. \tag{A17}$$

Then, the minimum probability of acceptance of the deviation offer made by the negligent defendant is

$$\underline{p_N} = \frac{A + K_D - S}{A + K_D - S + \epsilon}. \tag{A18}$$

Now find the minimum probability of acceptance of the deviation by the plaintiff, such that the careful defendant is still willing to propose it:

$$p_C(S - \epsilon) + (1 - p_C)K_D \leq S, \tag{A19}$$

where the left-hand side of the inequality represents the expected loss for the careful defendant from deviating and the right-hand side represents his expected loss in equilibrium. Solving for p_C we get

$$p_C \geq \frac{K_D - S}{K_D - S + \epsilon}, \tag{A20}$$

then, the minimum probability of acceptance of the deviation offer made by the careful defendant is

$$\underline{p_C} = \frac{K_D - S}{K_D - S + \epsilon}. \tag{A21}$$

Note that inspection of equations (A21) and (A18) show that if $\epsilon < 0$, the left-hand side of the inequalities will be greater than 1. Given that the right-hand side of the inequalities correspond to probabilities (which cannot be greater than 1), the inspection of these equations permits us to conclude that the universal divinity refinement is not applicable for cases where $\epsilon < 0$, then we will proceed to the application of the universal divinity refinement only in cases where $\epsilon > 0$.

Compare the threshold probabilities for the negligent and careful defendant:

$$\underline{p_C} - \underline{p_N} = \frac{-A\epsilon}{(K_D - S + \epsilon)(A + K_D - S + \epsilon)}, \tag{A22}$$

[67]Note that in every pooling PBE of the litigation game (under the conditions $qfA - K_P > 0$ and $fA - K_P > K_D$), the expected payoff for the negligent defendant is S.

where A and the expressions in parentheses are positive. Then, if $\epsilon > 0$, $\underline{p_N} > \underline{p_C}$.

Following the universally divinity refinement, if $0 \leq S^{'} < K_D$ and $\epsilon > 0$ ($S^{'} < S$), the plaintiff should believe with probability one that the deviation $S^{'}$ comes from a careful defendant.

Apply the universal divinity refinement to the pooling equilibria (where $0 < S \leq K_D$). The off-equilibrium beliefs imply that the plaintiff should infer that any deviation $S^{'}$ comes from a negligent defendant. These off-equilibrium beliefs do not survive the refinement. The plaintiff should believe that the deviation comes from a careful defendant and accept the offer. This response from the plaintiff will generate an incentive for the negligent defendant to deviate and offer $S-\epsilon$. Hence, the pooling equilibria (where $0 < S \leq K_D$) do not pass the test of universal divinity for $0 \leq S^{'} < K_D$.

Case II: $S^{'} = K_D$

The minimum probability of acceptance of a deviation offer made by the negligent defendant is still given by equation (A11).

For the case of the careful defendant, note that his expected deviation loss is K_D and his expected equilibrium loss is in the interval $(\frac{fA-K_P}{A+K_D}, K_D)$ (for $0 < S < K_D$) and is equal to $\frac{fA-K_P}{A+K_D} < K_D$ (for $S = 0$). Then, for any probability of acceptance, the careful defendant will not be willing to deviate when $S^{'} = K_D$.

By universal divinity, the plaintiff should expect that any deviation offer $S^{'} = K_D$ comes from a negligent defendant. Thus, all pooling PBE pass the test of universal divinity for $S^{'} = K_D$.

Given that no pooling PBE survive the universal divinity refinement in both cases, there is no universal divine pooling PBE.

Hence, the partially separating PBE stated in Proposition 1 is the unique universally divine PBE of the litigation stage. Q.E.D.

Optimization Problem of the Defendant

The optimization problem of a defendant type i is to choose the level of care that minimizes his total expected loss $L^i = c^i(y) + \lambda(y)l$, where l is the expected loss from legal action, different for careful and negligent defendants.[68] Then, L^i is defined as

$$\begin{cases} c^i(y) + \lambda(y)(fA - K_P) & \text{if} \quad y \ < \ \bar{y} \\ c^i(y) + \lambda(y)\frac{fA-K_P}{A+K_D}K_D & \text{if} \quad y \ \geq \ \bar{y}. \end{cases} \quad (A23)$$

The total expected loss L^i (for a given i) is then a discontinuous function of y, with discontinuity at the point $y = \bar{y}$. L follows the function $c^i(y) + \lambda(y)(fA - K_P)$ until the point of discontinuity; after this point, L follows the function $c^i(y) + \lambda(y)\frac{fA-K_P}{A+K_D}K_D$. Given that $fA - K_P > \frac{(fA-K_P)K_D}{A+K_D}$, the function L shifts down discontinuously at the point $y = \bar{y}$.

In order to guarantee the existence of an interior solution to the defendant's optimization problem, we assume that $\lambda'(y) < 0$ (the probability of accident is a decreasing function of the level of care), $\lambda''(y) > 0$ (expenditures on accident prevention exhibit diminishing marginal returns), $\lim_{y\to+\infty} \lambda(y) = 0$ (infinitely high level of care makes the probability of accident infinitely small), and $\lambda(0) = 1$. In addition, we assume that $c^1(y) > c^2(y)$ (the potential injurers of type 2 are more efficient and need to spend less to achieve a given level of care than the potential injurers of type 1) and that $c^i_y(y) > 0$ (higher levels of care require larger expenditures on safety). We also assume that $c^i_{yy}(y) > 0$ (the marginal cost of care increases with the degree of care, i.e., $c^i_y(y)$ is increasing in y) and that $c^1_y(y) > c^2_y(y)$ (the marginal cost of care is greater for injurers of lower skill). For both functions $c(.)$ and $\lambda(.)$, we assume that their first and second partial derivatives are continuous functions. The final technical assumption is that $\lim_{y\to+0} \lambda'(y)\frac{(fA-K_P)K_D}{A+K_D} + c^i_y(y) < 0$ for any i. It is easy to show that under these assumptions the function $L = c^i(y) + \lambda(y)l$ is convex and U-shaped for any i and any $l \geq \frac{(fA-K_P)K_D}{A+K_D}$. Therefore, it has a single interior minimum.[69]

Lemmas A1 and A2 show that the value of y that minimizes the total expected loss function for a negligent defendant of a given type is higher than the value of y that minimizes the total expected loss function for a careful defendant of the same type. Therefore the combined loss function can

[68] Note that the values of l for the negligent and careful defendant are equal to -V_{D_N} and -V_{D_C} respectively.

[69] Assumptions $\lambda''(y) > 0$ and $c^i_{yy}(y) > 0$ guarantee that the function L is convex. Furthermore, given that $\lim_{y\to+0} \lambda'(y)\frac{(fA-K_P)K_D}{A+K_D} + c^i_y(y) < 0$, then $\lim_{y\to+0} L' < 0$ for both $l = \frac{(fA-K_P)K_D}{A+K_D}$ and $l = fA - K_P$. Therefore the function L is decreasing for sufficiently small values of y. On the other hand, given that $\lim_{y\to+\infty} \lambda(y) = 0$, the term $\lambda(y)l$ vanishes in the limit, and for sufficiently large values of y, the function L is increasing in y just because $c(y)$ is increasing in y.

have at most one interior local minimum.[70]

Lemma A1. For any i and any positive value of l, the value of y that minimizes the function $c^i(y) + \lambda(y)l$ is increasing in l.

Proof. Given the assumptions about the functions $c^i(y)$ and $\lambda(y)$, the function $c^i(y) + \lambda(y)l$ is convex, and it has a single minimum point that is characterized by the first-order condition,

$$c^i_y(y) + \lambda'(y)l = 0. \qquad (A24)$$

Totally differentiating this first-order condition yields

$$[c^i_{yy}(y) + \lambda''(y)l]dy = -\lambda'(y)dl. \qquad (A25)$$

The last equation can be rewritten as

$$\frac{\partial y}{\partial l} = \frac{-\lambda'(y)}{c^i_{yy}(y) + \lambda''(y)l} > 0. \qquad (A26)$$

This inequality holds because both second derivatives, $c^i_{yy}(y)$ and $\lambda''(y)$, are positive, $\lambda'(y) < 0$, and $l \geq \frac{(fA-K_P)K_D}{A+K_D} > 0$ by assumption. Q.E.D.

Lemma A2. For all i, the value of y that minimizes the function $c^i(y) + \lambda(y)(fA - K_P)$ is larger than the value of y that minimizes the function $c^i(y) + \lambda(y)\frac{(fA-K_P)K_D}{A+K_D}$.

Proof. $\frac{(fA-K_P)K_D}{A+K_D} < fA - K_P$. Hence the lemma is a direct application of Lemma A1. Q.E.D.

Note that the total expected loss function is different for each type i. Lemma A3 verifies that the minimum of the function $c^i(y) + \lambda(y)l$ is greater for the efficient (type 2) potential injurer than for the inefficient injurer. Hence a type-2 potential injurer is more likely to meet the due care standard than a type-1 potential injurer.

Lemma A3. For any positive l, arg min $\{(c^1(y) + \lambda(y)l)\}$ < arg min $\{c^2(y) + \lambda(y)l)\}$.

[70]If the value of y that minimizes the total expected loss for the careful defendant were larger than the value of y that minimizes the expected loss for the negligent defendant, it would be possible that the combined loss function had two interior minima, one greater than $\bar{y}$ (in the careful range) and one smaller than $\bar{y}$ (in the negligent range).

Proof. Assume the contrary and seek for a contradiction. Let $\hat{y}^1 \equiv \arg\min\{(c^1(y) + \lambda(y)l)\} \geq \arg\min\{(c^2(y) + \lambda(y)l)\} \equiv \hat{y}^2$. Then, we can write the first-order conditions of optimization for both types as

$$c_y^1(\hat{y}^1) + \lambda'(\hat{y}^1)l = 0 \tag{A27}$$

and

$$c_y^2(\hat{y}^2) + \lambda'(\hat{y}^2)l = 0. \tag{A28}$$

Combining these first-order conditions, we get

$$c_y^1(\hat{y}^1) - c_y^2(\hat{y}^2) = (\lambda'(\hat{y}^2) - \lambda'(\hat{y}^1))l. \tag{A29}$$

By assumption $\hat{y}^1 \geq \hat{y}^2$ and hence, $c^1_{y(}\hat{y}^1) \geq c^1_{y(}\hat{y}^2) > c^2_{y(}\hat{y}^2)$. Therefore the left-hand side of equation (A7) is positive. On the other hand, $\hat{y}^1 \geq \hat{y}^2$ implies $\lambda'(\hat{y}^1) \geq \lambda'(\hat{y}^2)$ because $\lambda'(y)$ is increasing in y. Therefore, the right-hand side of equation (A7) is non-positive. Contradiction follows. Q.E.D.

We are interested in an equilibrium in which type-1 potential injurers choose to be negligent and type-2 potential injurers are careful. Only in that case, plaintiffs face asymmetric information, and the empirically relevant equilibrium of the litigation game takes place. Proposition 2 describes conditions for this equilibrium.

Define $y_N^1 \equiv \arg\min\{c^1(y) + \lambda(y)(fA - K_P)\}$ and $y_N^2 \equiv \arg\min\{c^2(y) + \lambda(y)(fA - K_P)\}$. In words, y_N^1 is the interior minimum of the "negligent" part of the total loss function of a type-1 potential injurer, and y_N^2 is the interior minimum of the "negligent" part of the total loss function of a type-2 potential injurer.

Proposition A2. Type-1 potential injurers choose to be negligent if $y_N^1 < \bar{y}$ and $c^1(y_N^1) + \lambda(y_N^1)(fA - K_P) < c^1(\bar{y}) + \lambda(\bar{y})\frac{(fA-K_P)K_D}{A+K_D}$, and type-2 potential injurers choose to be careful if $y_N^2 \geq \bar{y}$ or $c_2(y_N^2) + \lambda(y_N^2)(fA - K_P) \geq c_2(\bar{y}) + \lambda(\bar{y})\frac{(fA-K_P)K_D}{A+K_D}$.

Proof. Define $L_N^1(y) \equiv c^1(y) + \lambda(y)(fA - K_P)$, $L_N^2(y) \equiv c^2(y) + \lambda(y)(fA - K_P)$, $L_C^1(y) \equiv c^1(y) + \lambda(y)\frac{(fA-K_P)K_D}{A+K_D}$, and $L_C^2(y) \equiv c^2(y) + \lambda(y)\frac{(fA-K_P)K_D}{A+K_D}$.

Type-1 potential injurers choose to be negligent only if $y_N^1 < \bar{y}$. Otherwise (i.e., if $y_N^1 \geq \bar{y}$), then $L_C^1(y_N^1) < L_N^1(y_N^1)$, and the type-1 potential injurers prefer to be careful.

By Lemma A2, $y_N^1 > \arg\min\{c^1(y)+\lambda(y)\frac{(fA-K_P)K_D}{A+K_D}\}$, and hence the "careful" part of the total loss function is strictly increasing for $y \geq \bar{y}$. Therefore, $L_N^1(y_N^1) < L_C^1(\bar{y})$ is the other necessary condition under which the type-1 potential injurers choose to be negligent. $L_N^1(y_N^1) < L_C^1(\bar{y})$ can be rewritten as

$$c^1(y_N^1) + \lambda(y_N^1)(fA - K_P) < c^1(\bar{y}) + \lambda(\bar{y})\frac{(fA - K_P)K_D}{A + K_D}. \tag{A30}$$

The condition

$$y_N^2 \geq \bar{y} \text{ or } c^2(y_N^2) + \lambda(y_N^2)(fA - K_P) \geq c^2(\bar{y}) + \lambda(\bar{y})\frac{(fA - K_P)K_D}{A + K_D} \tag{A31}$$

is the complement of the condition

$$y_N^1 < \bar{y} \text{ and } c^1(y_N^1) + \lambda(y_N^1)(fA - K_P) < c^1(\bar{y}) + \lambda(\bar{y})\frac{(fA - K_P)K_D}{A + K_D}, \tag{A32}$$

written for the type-2 potential injurers. These potential injurers certainly prefer to be careful, if $y_N^2 \geq \bar{y}$, and therefore, $c^2(y_N^2) + \lambda(y_N^2)\frac{(fA-K_P)K_D}{A+K_D} < c^2(y_N^2) + \lambda(y_N^2)(fA - K_P)$. Hence $y_N^2 \geq \bar{y}$ is a sufficient condition for type 2 agents to be careful. However, it is not necessary. Even if $y_N^2 < \bar{y}$, but $L_C^2(\bar{y}) \leq L_N^2(y_N^2)$, type-2 potential injurers choose to meet the standard. The condition $L_C^2(\bar{y}) \leq L_N^2(y_N^2)$ can be rewritten as

$$c^2(y_N^2) + \lambda(y_N^2)(fA - K_P) \geq c^2(\bar{y}) + \lambda(\bar{y})\frac{(fA - K_P)K_D}{A + K_D}. \tag{A33}$$

Q.E.D.

Using the previous results, we can now derive the unconditional probabilities of trial, out-of-court settlement and dropping the case. Define y^1 and y^2 as the optimal levels of care chosen by type-1 and type-2 potential injurers, respectively. Note that the probability of an accident is $\mu = \phi\lambda(y^1) + (1 - \phi)\lambda(y^2)$, and the probability of an accident involving a careful defendant is $\mu_c = (1 - \phi)\lambda(y^2)$. Note also that given that the probability of an accident involving a careful defendant is μ_c and $(1 - q)$ is the probability that a defendant has been careful conditional on the occurrence of an accident, then by Bayes' rule, $(1 - q) = \mu_c/\mu$ and $q = 1 - \mu_c/\mu$.

Given that the probability of trial conditional on the occurrence of an accident is $\frac{fA(1-q)}{A+K_D}$, then the unconditional probability of trial is $\frac{fA(1-q)}{A+K_D}\mu = \frac{fA}{A+K_D}\mu_c$. Similarly, given that the probability of out-of-court settlement conditional on occurrence of the accident is $\frac{qfA-K_P}{fA-K_P}$, then the unconditional probability of out-of-court settlement is $\mu - (\frac{fA}{fA-K_P})\mu_c$. Finally, given that the probability of dropping a case conditional on the occurrence of an accident is $\left[\frac{A(1-f)+K_D+K_P}{A+K_D}\right]\left[\frac{fA(1-q)}{fA-K_P}\right]$, then the unconditional probability of dropping a case is $\left[\frac{A(1-f)+K_D+K_P}{A+K_D}\right]\left[(\frac{fA}{fA-K_P})\mu_c\right]$.

Appendix B. Proofs of Propositions in the Main Text

Proofs of Propositions 1–5 follow.[71]

Proof of Proposition 1. We will prove the claim that a decrease in f decreases the level of care, if the optimal level of care differs from the care standard $\bar{y}$, and therefore, it reduces the aggregate level of care.

Consider the case when the potential injurer is negligent. Evaluating (A2) at $l = fA - K_P$ for $i = 1$ and totally differentiating it yields

$$c^1_{yy}(y^1_N)dy + \lambda''(y^1_N)[fA - K_P]dy + \lambda'(y^1_N)Adf = 0. \qquad (B1)$$

Rearranging terms,

$$\frac{\partial y}{\partial f} = -\frac{A\lambda'(y^1_N)}{c^1_{yy}(y^1_N) + \lambda''(y^1_N)[fA - K_P]} > 0. \qquad (B2)$$

The case when the potential injurer is careful can be proven in exactly the same way. If the type-2 potential injurers just meet the standard (i.e., if type-2 firms are just high-efficiency type firms), then a marginal change in f has no impact on their level of care, which remains equal to $\bar{y}$. Therefore, the aggregate level of care, $\phi y^1 + (1 - \phi)y^2$, decreases unambiguously. Q.E.D.

Proof of Proposition 2. Given that the probability of an accident is $\mu = \phi\lambda(y^1) + (1 - \phi)\lambda(y^2)$, we have $\frac{\partial \mu}{\partial f} = \phi\lambda'(y^1)\frac{\partial y^1}{\partial f} + (1 - \phi)\lambda'(y^2)\frac{\partial y^2}{\partial f} > 0$ because $\lambda'(y) < 0$ for any y by assumption, $\frac{\partial y^1}{\partial f} < 0$ (Proposition 1) and $\frac{\partial y^2}{\partial f} \leq 0$ (Proposition 1). Q.E.D.

Proof of Proposition 3. The unconditional probability of trial is equal to $\frac{fA}{A+K_D}\mu_c$. The first term, $\frac{fA}{A+K_D}$, depends positively on f. The second term is equal to

$$\mu_c = (1 - \phi)\lambda(y^2). \qquad (B3)$$

If the condition of the Proposition is satisfied, $y^2 = \bar{y}$ and is independent of f. Hence, a reduction in f decreases μ_c as well as the unconditional probability of trial.

[71] We assume that a change in f is small enough to preserve the conditions $qfA - K_P > 0$ and $fA - K_P > K_D$.

The conditional probability of trial equals $\frac{fA}{A+K_D}\mu_c\frac{1}{\mu}$, where μ, the unconditional probability of an accident, negatively depends on f (Proposition 2). Hence, the conditional probability of trial negatively depends on f as well. Q.E.D.

It is important to note, however, that the condition $y^2 = \bar{y}$ is a sufficient but not necessary condition for the results of Proposition 3 to hold. Even if type-2 potential injurers choose an interior solution and μ_c rises following an a reduction in f, a reduction in the first term, $\frac{fA}{(A+K_D)}$ can fully offset the previous effect.

Proof of Proposition 4. When confronting a negligent defendant, the plaintiff's payoff at trial is equal to $fA - K_P$. Then, the rational plaintiff will accept all (positive) out-of-court proposals $S \geq fA - K_P$. In addition, the plaintiff's off-equilibrium beliefs, which support the unique PBE, are as follows: when observing an offer S' such that $O < S' < fA - K_P$, the plaintiff believes that the offer comes from a negligent defendant and rejects the offer. Therefore, the plaintiff's rejection threshold is equal to $fA - K_P$, and this is also the equilibrium (positive) offer made by a negligent defendant. Note that

$$\frac{\partial(fA - K_P)}{\partial f} = A > 0, \qquad (B4)$$

so a reduction in f will reduce the plaintiff's rejection threshold and the negligent defendant's equilibrium (positive) proposal. Q.E.D.

Proof of Proposition 5. The negligent defendant's expected loss from legal action is equal to $(fA - K_P)$, and the careful defendant's expected loss from legal action is equal to $\frac{(fA-K_P)}{A+K_D}K_D$. Note that

$$\frac{\partial(fA - K_P)}{\partial f} = A > 0, \qquad (B5)$$

and

$$\frac{\partial\left[\frac{(fA-K_P)}{A+K_D}K_D\right]}{\partial f} = \frac{AK_D}{A+K_D} > 0, \qquad (B6)$$

so a reduction in f will reduce the expected loss from legal action for both the careful and the negligent defendants. Q.E.D.

Appendix C. Welfare Analysis

The welfare analysis of the split-award tort reform follows:

Define the social cost of accidents, C_S, as follows.

$$C_S = [\phi c^1(y, n^1) + (1-\phi)c^2(y, n^2)] + \mu \left[H + \frac{fA(1-q)}{A+K_D}(K_D + K_P) \right], \qquad (C1)$$

where ϕ represents the share of the low-skill potential injurers; K_D and K_P represent the litigation costs for the defendant and plaintiff, respectively; $c(y, n)$ represents the expenditures on accident prevention; μ is the probability of an accident; H represents the harm (damage) an accident causes to society, conditional on the occurrence of an accident;[72] $\frac{fA(1-q)}{A+K_D}$ is the conditional probability of trial; and $(K_D + K_P)$ are the resources spent on litigation when a trial occurs (litigation costs).

Given that $\mu = \phi\lambda(y^1) + (1-\phi)\lambda(y^2)$, $\mu_c = (1-\phi)\lambda(y^2)$, and $(1-q)$ is the probability that a defendant has been careful conditional on the occurrence of an accident, then $(1-q) = \frac{\mu_c}{\mu}$. Hence, the social welfare loss function can be rewritten as

$$C_S = [\phi c^1(y, n^1) + (1-\phi)c^2(y, n^2)] + \mu H + \frac{fA}{A+K_D}\mu_c(K_P + K_D). \qquad (C2)$$

The first term of this expression $[\phi c^1(y, n^1) + (1-\phi)c^2(y, n^2)]$ represents the aggregate expenditures on accident prevention. Assuming that the high-type firms just meet the standard, a decrease in f reduces the level of care of firms of the low-type and does not affect the level of care of firms of the high-type intervals. Therefore the aggregate expenditures on accident prevention must decrease. The second term μH is the unconditional expected damage that accidents cause to society. We know that a decrease in f lowers the level of care and, therefore, increases the probability of an accident μ, so we can conclude that a decrease in f increases the unconditional expected damage that accidents cause to society. The third term $\frac{fA}{A+K_D}\mu_c(K_P + K_D)$ denotes the unconditional expected litigation costs, where $\frac{fA}{A+K_D}\mu_c$ is the unconditional probability of trial. Assuming that the high-type firms just meet the standard of care,[73] a reduction in f reduces the unconditional

[72] Given that we abstract from the compensatory award in the litigation analysis, we also abstract here from the direct monetary damage to the plaintiff.

[73] If we assume, however, that the high-type firms exceed the standard of care, then the effect of f on the unconditional expected litigation costs is ambiguous. When f goes down, inefficient defendants remain negligent, but they reduce the level of care; efficient defendants remain careful, but they also reduce the level of care.

probability of trial. Hence, if the level of the harm an accident causes to society is sufficiently low (for a particular value of f), we may expect that split-awards decrease the social costs of accidents.

When y is large enough (which can be interpreted as overdeterrence), the positive effect of the split-award reform outweighs the negative effect. In fact, for sufficiently large values of y, $\lambda(y)$ approaches zero. Therefore, a marginal change in f has almost no impact on the probability of accident and, therefore, almost no effect on the unconditional expected damage that accidents cause to society. In addition, given that in our framework low-type defendants always find it optimal to be negligent and high-type defendants find it optimal to be careful, a negligible impact on the probability of accident implies a negligible impact on the probability of trial. Hence the only non-negligible (and positive) welfare effect of lower f will be the effect on reducing the aggregate expenditures on accident prevention.

The overall welfare effect of the split-award reform is then ambiguous: there is a positive effect due to the lower spending on care, a negative effect due to a higher probability of accident. The ambiguity comes from the effect of f on the conditional probability of trial.

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Table 1: Expected Direction of the Effects of the Split-Award Statute

	Split-Award
1. Expenditure on Care	decreases
2. Conditional Probability of Trial	decreases
3. Expected Total Litigation Costs	decreases
4. Defendant's Proposal	decreases
5. Plaintiff's Rejection Threshold	decreases
6. Defendant's Expected Litigation Loss	decreases
7. Plaintiff's Expected Net Compensation	decreases

Table 2: Mean Expenditures on Care, Dispute Rate and Mean Total Litigation Costs

	Expenditures on Care	Dispute Rate	Total Litigation Costs
Split-Award	38.47 (22.11) [$n = 17$]	.314 (.13) [$n = 13$]	61.54 (26.65) [$n = 13$]
No Split-Award	37.44 (20.89) [$n = 18$]	0.88 (.08) [$n = 17$]	176.47 (16.11) [$n = 17$]
$\grave{U}$	0.14	–	- 3.60
p	.889	.002	.000

Note: Standard errors are in parentheses; sample sizes are in brackets; for the first and third columns, p-values correspond to two-sided robust rank-order statistic test; for the second column, p-value corresponds to two-sided Fisher exact statistic test.

Table 3: Plaintiff's Rejection Threshold and Mean Defendant's Proposal

	Plaintiff's Rejection Threshold	Defendant's Proposal
Split-Award [$n = 12$]	130 (–)	165.58 (13.06)
No Split-Award [$n = 12$]	310 (–)	211.67 (26.55)
	– –	$\grave{U}$ = - 1.12 $p > .10$

Note: Standard errors are in parentheses; sample size are in brackets; p-value corresponds to two-sided robust rank-order statistic test.

Table 4: Mean Defendant's Litigation Loss and Mean Plaintiff's Net Compensation

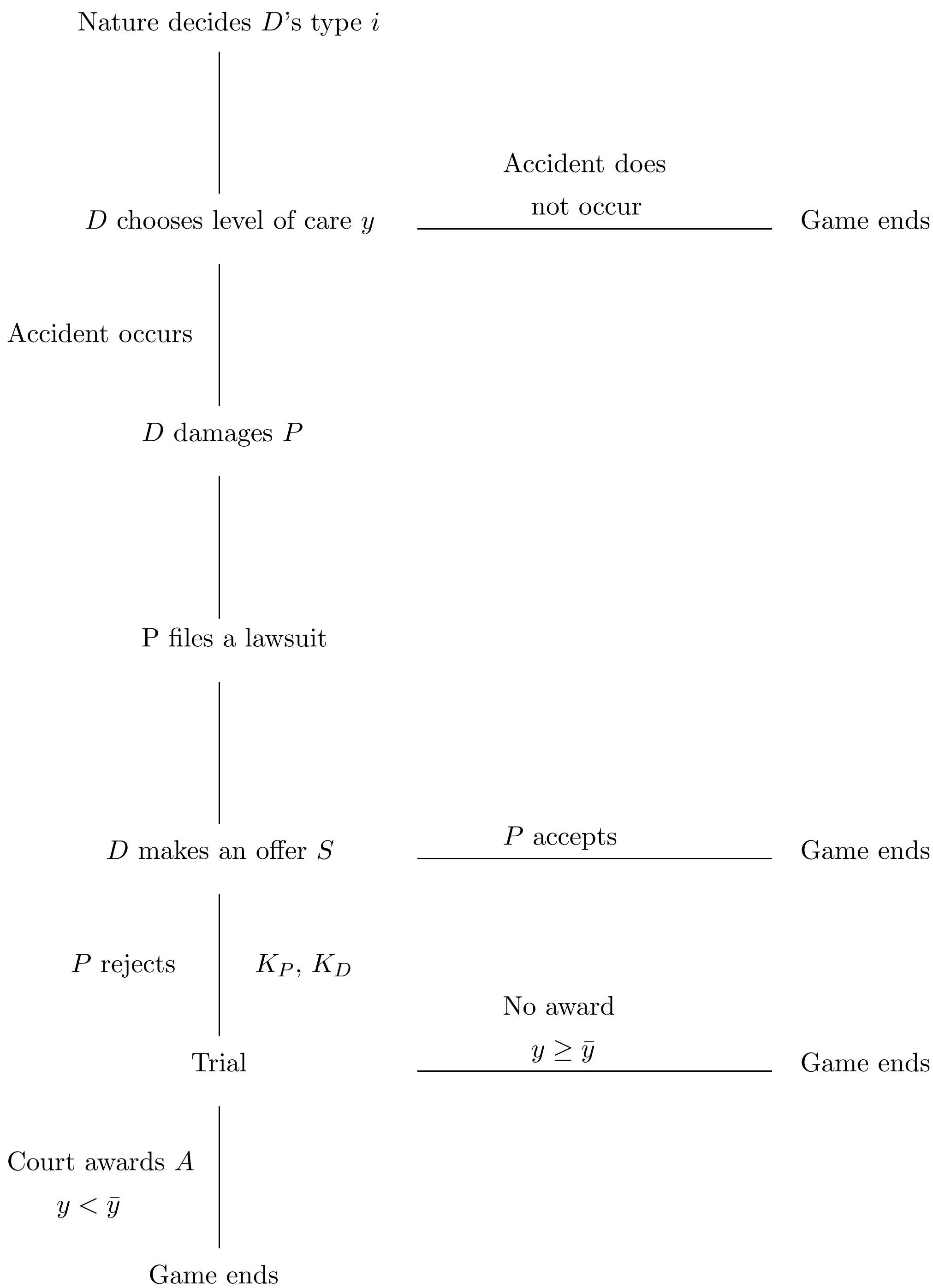
	Defendant's Litigation Loss	Plaintiff's Net Compensation
Split-Award	229.38	129.38
$[n = 13]$	(47.13)	(29.73)
No Split-Award	542.06	365.59
$[n = 17]$	(34.03)	(29.58)
$\grave{U}$	- 4.82	- 8.12
p	.000	.000

Note: Standard errors are in parentheses; sample size are in brackets; p-values correspond to two-sided robust rank-order statistic test.

Table 5: Quantitative Theoretical Predictions and Experimental Results

	Predicted	Actual
Split-Award		
1. Expenditures on Care	6.40	38.47
2. Dispute Rate	0.048	0.31
3. Total Litigation Costs	9.60	61.54
4. Defendant's Proposal	150.00	165.58
5. Plaintiff's Rejection Threshold	150.00	130.00
6. Defendant's Litigation Loss	135.61	229.38
7. Plaintiff's Net Compensation	121.21	129.38
No-Split Award		
1. Expenditures on Care	24.60	37.44
2. Dispute Rate	0.067	0.88
3. Total Litigation Costs	13.41	176.47
4. Defendant's Proposal	400.00	211.67
5. Plaintiff's Rejection Threshold	400.00	310.00
6. Defendant's Litigation Loss	373.18	542.06
7. Plaintiff's Net Compensation	359.77	365.59

FIGURE 1
SEQUENCE OF EVENTS IN THE GAME



Note: D = defendant, P = plaintiff, K_D = defendant's litigation costs, K_P = plaintiff's litigation costs, A = punitive damage award, $\bar{y}$ = negligence standard.