FINANCIALLY-CONSTRAINED LAWYERS: AN ECONOMIC THEORY OF LEGAL DISPUTES*

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Abstract

Financial constraints reduce the lawyer's ability to file lawsuits and bring cases to trial. As a result, access to justice for true victims, bargaining impasse, and potential injurers' precaution might be affected. This paper studies civil litigation using a strategic model that allows for asymmetric information, financially-constrained lawyers, third-party lawyer lending, and a continuum of plaintiff's types. We provide methodological contributions to the law and economics literature by generalizing seminal models of legal disputes (Katz, 1990; Bebchuk, 1988). We present formal analysis of the three mutually-exclusive perfect Bayesian equilibrium classes: Mixed-strategy, pure-strategy, and boundary equilibria. We identify necessary conditions for the existence of each class. In particular, the mixed-strategy class arises in a state of the world characterized by lawyers facing strong financial constraints or defendants facing a high threat of frivolous lawsuits. Across equilibrium classes, accidents do occur and bargaining impasse is observed. Access to justice is denied to some true victims under the mixed-strategy and boundary equilibria. We then extend our tractable model to study the social welfare effects of policies aimed at relaxing lawyers' financial constraints. We establish sufficient conditions for a welfare-reducing effect: When the positive impact on access to justice is weak and the potential injurers are overdeterred, these policies are welfare reducing.

KEYWORDS: Civil Litigation; Asymmetric Information; Lawsuits; Settlement; Litigation; Frivolous Lawsuits; Access to Justice; Deterrence; Social Welfare; Financially-Constrained Lawyers; Third-Party Lawyer Lending Industry; Third-Party Litigation Funding

JEL Categories: K41, C70, D82

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1 Introduction

The U.S. tort system provides \$172 billion in gross compensation to plaintiffs each year. Litigation expenses, which are generally covered by personal injury attorneys on behalf of their clients, represent \$5.2 billion of this compensation (Engstrom, 2014). The average cost of taking a medical malpractice claim to trial is \$97,000 (Shepherd, 2014). Expenses on expert witnesses in the \$50,000-\$100,000 range are not uncommon (Trautner, 2009). As cases become more complex and hence, more expensive, attorneys might experience financial constraints. Financial constraints weaken the attorneys' ability to file lawsuits and bring cases to trial. As a result, access to justice for true victims is compromised. In a recent survey (Shepherd, 2014), seasoned medical malpractice lawyers were asked whether they would accept a medical malpractice case with less than \$50,000 in certain damages.[1] Only 1.18 percent of the attorneys responded positively. Moreover, 50 percent of the attorneys stated that they would not accept to represent a victim with damages lower than \$250,000. Over 75 percent of the attorneys indicated that they rejected more than 90 percent of cases due to insufficient damages and/or high litigation expenses.[2]

By affecting the pool of filed cases, lawyers' financial constraints might influence bargaining impasse and potential injurers' precaution, in addition to impacting access to justice. Hence, a comprehensive analysis of civil litigation should consider the financial constraints that lawyers face. Policy debate has been centered only on the effects of lawyers' financial constraints on access to justice. Previous theoretical work on legal disputes has simply abstracted from lawyers' financial constraints. Our paper aims to fill these gaps. We present the first strategic model of civil litigation in an environment characterized by asymmetric information, financially-constrained lawyers, and a continuum of plaintiff's types. Our framework generalizes seminal models of civil litigation (Katz, 1990; Bebchuk, 1988).

Traditionally, financing of litigation has involved attorneys' own funding, fellow attorneys' contributions, and bank loans. In the late 1990s, lawyer lenders such as Counsel Financial, among others, started funding activities (Engstrom, 2014).[3] These lawyer lending institutions

[1]Specifically, the survey question involves a 95 percent likelihood of succeeding at trial.

[2]See also Bell and O'Connell (1997).

[3]More recently, a new type of lawyer lending institutions, specialized on *non-recourse* loans (i.e., loans with

specialize on providing recourse loans (non-contingent loans) to cover the expenses associated with particular legal cases. According to legal commentators, "[R]ecourse lawyer lending ... is making a significant mark ... [and has] remarkable potential for future growth" (Engstrom, 2014; p. 397).[4] In contrast to traditional banks, these lenders do not require lawyers' personal assets as collaterals. Instead, the loans are secured by the law firm's assets, including future fees.[5] The loans involve significantly larger sums and the interest charged is higher than the traditional bank's interest (around 15-20 percent per year). Our theoretical framework also captures the role of the lawyer lending industry on legal disputes.

We model the interaction between a defendant, a plaintiff, and a plaintiff's attorney as a sequential game of incomplete information. Our framework allows for asymmetric information, financially-constrained lawyers, third-party lawyer lending, and a continuum of plaintiff's types. The source of information asymmetry is the damage level of the plaintiff's case, which is unknown by the defendant. We model the lawyers' financial constraints by incorporating real-world characteristics of the third-party lawyer lending industry. Formal definition of the concept of "No-Access to Justice" is presented. Our original model depicts legal disputes from cradle to grave. Specifically, our model allows for endogenous care-taking (precaution), filing, and out-of-court settlement decisions. We present formal analysis of the three mutually-exclusive perfect Bayesian equilibrium (PBE) classes: Mixed- and pure-strategy equilibria with interior and corner solutions, and boundary equilibria with interior and corner solutions. In the mixed-strategy equilibria, the defendant mixes between making a zero offer and a strictly positive offer; an attorney with a high-damage case always files a lawsuit; and, an attorney with a low-damage case mixes between

repayment contingent on case success), has emerged. This segment of the lawyer lending industry has not experienced significant growth (Engstrom, 2014). See also Garber (2010).

[4] Due to the absence of a central repository of data, it is impossible to precise the exact amount of loans associated with the lawyer lending industry (Engstrom, 2014). An important lawyer lender, "*Counsel Financial*, apparently had 'more than $200 million' in loans outstanding as of 2010 (Engstrom, 2014; p. 397). Lawyer lenders operate in almost all U.S. states. For instance, *Advocate Capital* funds law firms in forty states. Public records for the state of New York indicate that 250 law firms borrowed from lawyer lending providers during the period 2000–2010.

[5] Loans are secured by the estimated value of a firm's total portfolio of cases. Lenders generally require access to the firm's entire docket of cases and assets (Engstrom, 2014).

accepting the case and filing a lawsuit and not accepting the case. In the pure-strategy equilibria, a strictly positive offer is made by the defendant; and, attorneys with all types of cases cases file lawsuits. In the boundary equilibria, the defendant might mix between a zero offer and a strictly positive offer or might make a unique strictly positive offer; and attorneys with all types of cases file lawsuits. Across equilibrium classes, accidents and bargaining impasse are observed. Access to justice is denied to some true victims under the mixed-strategy and boundary equilibria.

We identify necessary conditions for the existence of each PBE class. In particular, our analysis demonstrates that the mixed-strategy equilibria arise in a state of the world characterized by lawyers facing strong financial constraints or defendants facing a high threat of frivolous lawsuits (non-meritorious lawsuits).[6] The intuition is as follows. When the level of lawyers' financial constraints is high or the threat of frivolous lawsuits is high, the defendant will have a strong incentive to mix between a zero offer and a strictly positive offer, instead of making a unique strictly positive offer. A unique strictly positive offer will be accepted by most types of plaintiffs, and will encourage filing of frivolous and low-damage cases. By mixing between a zero offer and a strictly positive offer, the defendant will reduce his expected litigation loss: Frivolous and low-damage plaintiffs who receive a zero offer will drop their cases; only high-damage cases will reject a zero offer and proceed to trial. In addition, filing of frivolous and low-damage cases will be discouraged.

We then use our model to study the effects of policies aimed at lowering the costs associated with legal disputes, and provide social welfare analysis. The interest charged to lawyers by third party lenders and the costs associated with expert witnesses' fees are examples of such costs.[7] We focus our policy analysis on the mixed-strategy equilibrium class, which occurs under the empirically-relevant assumption of high level of lawyers' financial constraints. Our findings suggest that cost-reducing policies relax the lawyers' financial constraints. As a result, more low-damage cases are filed. The uninformed defendant reacts by reducing his out-of-court settlement offer, and the likelihood of trial increases. Higher expected litigation costs for the defendant

[6]We use the terms "non-meritorious," "frivolous," and "no-damage" interchangeably.

[7]Policies devoted to strengthening competition in the lawyer lending industry might reduce lawyers' financial costs. Similarly, policies designed to increase efficiency of legal procedures and to reduce unpredictability of the legal system might lower the costs associated with litigation (Landeo et al., 2007a, 2007b).

are observed, which increase his care-taking incentives, and lower the probability of an accident. Access to justice for true victims is improved. Our results also indicate that cost-reducing policies do not generally benefit true victims or their lawyers: Only low-damage victims whose cases now can proceed to trial are better off; the effect on the attorneys is unambiguously positive only in low-damage cases. We demonstrate that a relaxation of the lawyers' financial constraints might reduce social welfare if the positive effect on access to justice by true victims is weak and the defendant is overdeterred.[8] The intuition is as follows. As a result of relaxing the lawyer's financial constraints, only few additional true victims get access to justice. In contrast, too many cases proceed to costly trial, and too many resources are spent on accident prevention to avoid costly litigation.

Finally, we extend our tractable model to conduct social welfare analysis of cost-shifting policies. Several U.S. states have enacted policies that allow attorneys to calculate their contingency fee from the net client's recovery (i.e., after deducting the litigation costs).[9] Then, attorneys effectively shift a portion of the litigation costs to their clients. We show that that these policies also relax the lawyers' financial constraints, and hence, exhibit the same potential negative welfare effects observed in cost-reducing policies.

Our work provides important methodological contributions to the theoretical literature in law and economics. Significant policy implications are also derived from our study. A summary of the main insights are presented below (see Section 2 for details).

(1) Our paper extends previous theoretical work on deterrence and litigation (Landeo et al., 2007a, 2007b; Hylton, 2002) by incorporating the role of lawyers and third-party lawyer lending to the analysis of legal disputes; and, by allowing for endogenous filing decisions in an environment characterized by a continuum of plaintiff's types.[10]

[8]See the discussion presented in Section 5.

[9]U.S. states generally allow lawyers to deduct their contingency fees from the plaintiffs' gross or net recovery, requiring only that the clients be informed "whether ... expenses are to be deducted before or after the contingent fee is calculated" (*Model Rules of Professional Conduct*, R. 1.5 (c)). New York, Kansas, and New Jersey explicitly require that litigation costs be deducted before the contingency fee is calculated.

[10]See Spier (1992), Png (1987), Reinganum and Wilde (1986), Bebchuk (1984), and Shavell (1982) for seminal theoretical work on litigation. See Landeo (forthcoming) and Daughety and Reinganum (2012) for recent surveys

(2) Our article contributes to the theoretical literature on lawsuit filing and litigation by generalizing Katz's (1990) and Bebchuk's (1988) seminal environments.[11] Although the sequence of moves in the continuum-type model analyzed in Katz (1990) is similar to the sequence of moves of the filing and litigation stages in our model, the mixed-strategy equilibria discussed in our paper is neither identified nor analyzed in Katz (1990). Our paper also refines the characterization and analysis of the pure-strategy equilibrium presented in Katz (1990). Finally, our work improves the accuracy of the analysis of lawsuit filing, presents a formal definition of the concept of "No-Access to Justice," and incorporates this component to the welfare analysis of public policies. Hence, our article provides methodological contributions to law and economics by presenting the first formal analysis of civil litigation in an environment that allow for a continuum of plaintiff's types.

(3) Our work is related to the theoretical literature on third-party financing of litigation (Deffains and Desrieux, 2015; Spier and Prescott, 2016; Avraham and Wickelgren, 2014; Daughety and Reinganum, 2014; Demougin and Maultzsch, 2014; Hylton, 2012). Previous literature has been focused on third-party *plaintiff* lending. We contribute to this literature by presenting the first formal study of legal disputes in an environment that allows for third-party *lawyer* lending. In contrast to previous work, we analyze the effects of the third-party institution on access to justice for true victims, care-taking incentives for potential injurers, filing incentives for lawyers, and social welfare, in addition to bargaining impasse.

(4) Our study provides important policy implications. Legal commentators are currently proposing the extension of cost-shifting policies by allowing lawyers to shift the financial costs of loans to their clients, in addition to the litigation costs (Engstrom, 2014). They argue that these policies will be welfare-enhancing. We contribute to this debate by underscoring the importance of assessing cost-shifting policies in terms of their effects on access to justice for true victims and their effects on care-taking incentives for potential injurers. In particular, our analysis, which also applies to this type of cost shifting policies, suggests that these reforms might reduce social welfare.

of theoretical and experimental work on settlement and litigation.

[11] See Rosenberg and Shavell (1985) for additional seminal work on frivolous lawsuits.

The rest of the article is organized as follows. Section Two outlines related literature and provides a detailed discussion of our contributions to this literature. Section Three presents the setup of the benchmark model. Section Four outlines the equilibrium analysis. Section Five discusses the effects of a cost-reducing policy on equilibrium strategies and payoffs. Section Six provides a social welfare analysis of a cost-reducing policy. Section Seven extends our benchmark model to study the social welfare effects of a cost-shifting policy. Section Eight presents concluding remarks. Appendix A includes formal proofs of main results associated with the benchmark model. Appendices B and C, available online, present additional technical material associated with the benchmark model and a formal analysis of the cost-shifting model, respectively.

2 Related Literature

Our work is related to the theoretical literature on deterrence and litigation. Landeo et al. (2007a, b) and Hylton (2002) theoretically study the effects of court errors and tort reform on litigation and deterrence using games of incomplete information between a plaintiff and a defendant. Their frameworks allow for endogenous decisions regarding care-taking, filing, and litigation.[12] Frivolous lawsuits and social welfare are not studied in these papers. We extend this theoretical literature in several ways. First, we incorporate the role of lawyers to the analysis of legal disputes. This extension permits the assessment of the effects of lawyers' financial constraints and policies aimed at reducing these constraints on the likelihood of out-of-court settlement, filing, deterrence, and social welfare. Second, our framework allows for endogenous filing decisions in an environment with a continuum of plaintiff's types. This extension permits us to identify the effects of frivolous lawsuits on the decisions of the plaintiff and the defendant regarding settlement and litigation, and the defendant's care-taking decisions.[13]

Our paper is also connected with the theoretical literature on lawsuit filing and litigation. Katz (1990) studies filing and litigation lawsuits using a game of incomplete information between

[12]See also Hylton (1993).

[13]See the next paragraph for a detailed discussion of our contributions to the theoretical literature on lawsuit filing and litigation.

a plaintiff and a defendant.[14] His framework extends Bebchuk (1988) by endogeneizing the filing decision. Binary-type (meritorious and frivolous plaintiff's types) and continuum-type models are discussed. We provide significant contributions to this literature. First, our model generalizes Katz (1990) by allowing for endogenous care-taking decisions, by introducing the plaintiff's attorney as a third player,[15] and by allowing for lawyer's financial constraints and third-party lawyer lending institutions. Second, although the sequence of moves of the continuum-type model analyzed in Katz (1990) is similar to the sequence of moves of the filing and litigation stages in our model, the mixed-strategy equilibrium class discussed in our paper is neither identified nor analyzed in Katz (1990). Third, our paper refines the characterization and analysis of the pure-strategy equilibrium presented in Katz (1990). Fourth, we improve the accuracy of the analysis of lawsuit filing by constructing a framework that permits the identification of the share of low-damage and no-damage (frivolous) cases that are filed. As a result, we are able to present formal definition of the concept of "No-Access to Justice" by true victims, and incorporate the assessment of access to justice to the welfare analysis of public policies. Hence, our article provides methodological contribution to the law and economics literature by presenting a complete formal analysis of a strategic model of civil litigation in an environment that allows for a continuum of plaintiff's types.

Finally, our article is related to the theoretical literature on third-party litigation funding. As discussed in Garber (2010), third-party litigation funding (also known as alternative litigation finance – ALF) includes three types of financing: Non-recourse loans to individual plaintiffs, loans to plaintiffs' lawyers, and investments in commercial lawsuits (business against business lawsuits). Previous work on third-party litigation funding has been focused on *plaintiff* lending only. Daughety and Reinganum (2014) study the design of third-party loans to plaintiffs using dynamic incomplete information models with the plaintiff as the first mover.[16] Their findings

[14] See Rosenberg and Shavell (1985) for additional seminal contributions.

[15] Several theoretical papers have studied specific aspects of the relationship between the litigants and their attorneys such as agency problems and contractual agreements established between the attorneys and their clients. See Emons (2007), Choi (2003), Miceli (1994), Dana and Spier (1990) and Miller (1987). Ours is the first paper to consider an environment with financially-constrained lawyers.

[16] See also Deffains and Desrieux (2015), Spier and Prescott (2016), Avraham and Wickelgren (2014), Demougin

suggest that the third-party institution affects only bargaining impasse.[17] Analysis of the effects of the third-party institution on filing is not included. We provide several contributions to the literature on third-party litigation funding. First, our work contributes to a better understanding of the third-party litigation funding institution by presenting the first formal analysis of legal disputes in an environment that allows for third-party *lawyer* lending, and by studying the effects of policies aimed at reducing lawyers' financial constrains. Second, our work incorporates filing into the analysis, and demonstrates that changes in the features of the third-party litigation institution might affect not only settlement but also care-taking incentives and filing decisions. In particular, we show that a reduction in the interest rate charged on third-party loans induces more no-damage (frivolous) and low-damage cases to be filed, reduces the likelihood of out-of-court settlement, increases the defendant's care-taking incentives, and might reduce social welfare.

3 Model Setup

This section describes the game stages, the "Lawyer's Financial Constraint" component, and the "No-Access to Justice" component. It also introduces the notation.

3.1 Game Stages

We model the interaction between a potential defendant,[18] a potential plaintiff, and a potential plaintiff's attorney as a sequential game of incomplete information. The source of information asymmetry is the damage level of the potential plaintiff's case A, which is unknown by the defendant. The stages of the game are as follows.

and Maultzsch (2014) and Hylton (2012). These papers are focused on the analysis of litigation. Care-taking incentives and filing decisions are not studied.

[17] The defendant's care taking incentives are not affected by the third-party institution.

[18] We use the terms "potential defendant," "potential injurer," and "defendant" interchangeably.

3.1.1 Care-Taking Stage

In the first stage, the potential defendant decides his level of care, which determines the probability of accident λ. The cost of care is denoted by $K(\lambda)$ with $\lim_{\lambda \to 0^+} K(\lambda) = +\infty$ and $K(1) = 0$. We assume that all potential defendants have the same cost of care, common knowledge. We also assume that $K(\lambda)$ is a continuous and differentiable function defined on the interval $(0, 1]$ with $\frac{\partial K(\lambda)}{\partial \lambda} < 0$, $\lim_{\lambda \to 0^+} \frac{\partial K(\lambda)}{\partial \lambda} = -\infty$, $\lim_{\lambda \to 1^-} \frac{\partial K(\lambda)}{\partial \lambda} = 0$; and, that $\frac{\partial K(\lambda)}{\partial \lambda}$ is a continuous and differentiable function with $\frac{\partial K^2(\lambda)}{\partial \lambda^2} > 0$. The potential injurer's optimal level of care, i.e., the optimal λ, is the one that minimizes the defendant's expected total loss $L_D(\lambda) = K(\lambda) + \lambda l_D$, where l_D is the expected litigation loss. We take the expected litigation loss as parametric in order to describe L_D, but ultimately l_D will be derived as the continuation value of the litigation stage, and hence, it will reflect the outcomes at the litigation stage. We assume that accident occurrence is common knowledge.

If an accident occurs, Nature first determines the merit of the potential plaintiff's case and informs this to the potential plaintiff only. A mass $\mu \geq 0$ of potential plaintiffs learn that their cases are non-meritorious (damage $A = 0$), and a mass 1 of potential plaintiffs learn that they have meritorious cases (damage $A > 0$).[19] Then, the mass of potential plaintiffs is equal to $1 + \mu$. The information about the mass of non-meritorious and meritorious cases is common knowledge. Second, if the potential plaintiff has a meritorious case ($A > 0$), Nature determines the damage level and informs this to the potential plaintiff only. We assume that the damage levels, conditional on $A > 0$, are distributed according to the probability density function $g(A)$ and the cumulative distribution function $G(A)$, with support $(0, \bar{A}]$. We also assume that $g(A)$ is a continuous and differentiable function. The distributions and $\bar{A}$ are common knowledge.

3.1.2 Filing Stage

If an accident occurs, the second stage starts. We assume that the mass of potential attorneys is greater than or equal to $1 + \mu$, i.e., it is sufficiently high to serve all potential plaintiffs with meritorious and non-meritorious cases. The potential plaintiff and his potential attorney meet.[20]

[19]Our results hold when $\mu = 0$.

[20]For simplicity, our framework abstracts from searching costs.

The attorney, who perfectly observes the potential plaintiff's type (damage level), decides whether to take the case and file a lawsuit. We denote the mass of filed cases as ζ. The attorney is hired under a contingency-fee compensation.[21] Under this scheme, the attorney receives gross payment equal to a share γ of the plaintiff's gross recovery (award at trial or out-of-court settlement amount).[22] The attorney's share γ is an exogenous constant, known by all parties.

The filing costs for meritorious and non-meritorious cases (frivolous cases) are f_M and f_F, respectively. Note that the filing costs encompass the administrative costs associated with filing, which are equal for meritorious and non-meritorious cases. In addition, the filing costs for non-meritorious cases f_F include the expected monetary costs associated with the sanctions imposed on the attorney for pursuing non-meritorious cases under the *Model Rule of Professional Conduct 3.1.* and the *Federal Rule of Civil Procedure 11.*[23] Then, $f_F > f_M$.[24] The filing costs are observed only by the plaintiffs and their attorneys but the magnitudes are common knowledge. Following empirical regularities, we assume that the plaintiff is financially constrained. Then, the plaintiff's attorney pays the filing cost.

3.1.3 Litigation Stage

If a lawsuit is filed, the third stage starts. The uninformed defendant makes a take-it-or-leave-it out-of-court settlement offer to the plaintiff, a strictly positive offer $S > 0$ or a zero offer. β denotes the probability that a defendant makes a zero offer. The plaintiff then decides whether to accept or reject the defendant's offer. If an offer $S > 0$ is accepted by the plaintiff, then the defendant transfers the settlement amount to the plaintiff, and the game ends. The plaintiff gets $(1 - \gamma)S$ and his attorney gets a net payoff of $\gamma A - f_i$, $i = F, M$. Acceptance of a zero offer implies that the plaintiff drops the case. If an out-of-court settlement offer is rejected, the case proceeds to costly trial. We denote the probability of trial as ρ. Both litigants incur litigation costs: C_P denotes the plaintiff's litigation cost, which is paid by his attorney; and, C_D denotes

[21] See Miceli (1994) for seminal work on contingency fees.

[22] Our main qualitative findings hold in an environment that allows for different values of γ in case of trial and out-of-court settlement. See Emons (2007).

[23] For a comprehensive discussion of these sanctions, see Faughnan et al. (2011).

[24] Our main results hold when $f_F = f_M$.

the defendant's litigation cost. We assume that the court perfectly observes the plaintiff's type. Then, non-meritorious cases never succeed at trial (they get a zero recovery). When a meritorious case goes to trial, the court orders the defendant to pay $A > 0$ to the plaintiff.[25] The plaintiff gets $(1-\gamma)A$ at trial and his attorney gets a net payoff of $\gamma A - C_P - f_M$.

3.2 Lawyer's Financial Constraint Component

This section describes the lawyer's financial constraint component of our model. The approach we follow to incorporate financially-constrained lawyers into our model is aligned with empirical regularities. In particular, Garber (2010) states: "Plaintiffs' lawyers pursuing personal-injury claims typically work on a contingent-fee basis, may have insufficient hourly work to provide steady streams of revenue, and incur out-of-pocket expenses to pursue their clients' claims" (p. 23). Our framework captures these empirically-relevant features.

We denote the amount of the lawyer's own funds as $x > f_i$, $i = F, M$. We assume that the lawyer is financially constrained. His own funds x are insufficient to bring a case to trial, i.e., $x < f_i + C_P$, $i = F, M$. We also assume that there are available third-party lawyer lenders that can lend money to the lawyer to allow him to bring a case to trial, and that the third-party lawyer lending industry is not perfectly competitive.[26] Lawyers with non-meritorious cases know that their cases will never succeed at trial, and hence, do not request loans. In order to be able to bring a meritorious case to trial, the financially-constrained attorney needs to borrow $C_P + f_M - x$ at a net interest rate r. We denote $\tilde{A}$ as the damage threshold at which proceeding and not proceeding to trial provide the same expected payoff for the lawyer, $\gamma\tilde{A} - C_P - f_M - (C_P + f_M - x)r = -f_M$. In other words, cases $A < \tilde{A}$ will not proceed to trial. Hence, $\tilde{A}$ represents the lawyer's financial constraint.

[25] We assume that the court applies a strict liability rule. Under this rule, the injurer has to bear the costs of the accident regardless of the extent of his precaution. Strict liability is common in tort law cases. Then, this assumption is empirically relevant. Our tractable model can be easily extended to accommodate the court's application of a negligence rule in an environment where the defendant's level of care is common knowledge.

[26] This assumption is also empirically relevant. The specialized nature of the service provided by these lenders might act as a barrier to entry. As a result, lenders might have market power.

Definition 1. *The lawyer's financial constraint $\tilde{A}$ is defined as follows.*

$$\tilde{A} \equiv \frac{C_P + (C_P + f_M - x)r}{\gamma}.$$

Potential plaintiffs with $A \geq \tilde{A}$ are called "high-damage cases," and potential plaintiffs with $0 < A < \tilde{A}$ are called "low-damage cases." Remember that a measure 1 represents the meritorious potential plaintiffs. It encompasses high- and low-damage potential plaintiffs. Then, $G(\tilde{A})$ represents the mass of low-damage potential plaintiffs, and $1 - G(\tilde{A})$ represents the mass of high-damage potential plaintiffs. Remember also that μ denotes the mass of no-merit potential plaintiffs ($A = 0$). Then, $1 + \mu$ represents the mass of high-, low-, and no-damage potential plaintiffs. We denote the mass of low-damage and no-damage cases that are filed as ν.

We assume that the lawyer's financial constraint $\tilde{A}$ is common knowledge. In particular, the plaintiff knows that the lawyer's financial constraint allows only high-damage cases ($A \geq \tilde{A}$) to proceed to trial, and takes this information into consideration when deciding whether to accept a settlement offer. This empirically-relevant assumption might be interpreted as a partial delegation of settlement authority to the lawyer.[27] According to the *Restatement (Third) of Law Governing Lawyers* (1988, Sec. 33.1), the plaintiff can validly make partial or full delegation to his lawyer as long as this decision is revocable.[28] Importantly, delegation of settlement authority is commonly observed in real-world settings (Miller, 1987). It is simple to show that the rational plaintiff with $A \geq 0$ is at least equally off by accepting to condition his litigation stage decision to the lawyer's financial constraint. Hence, the plaintiff will never revert his decision. In other words, revocability will not occur in equilibrium.[29]

[27]We refer to this delegation as *partial* delegation because the plaintiff still holds the settlement decision authority but her decision is constrained by her lawyer's financial constraints.

[28]See also the *Restatement (Second) of Agency* (1958, Sec. 1).

[29]See Dana and Spier (1990) for a litigation model involving full delegation of authority to the lawyer regarding the decision to drop the case. See Choi (2003) for a litigation model involving plaintiff's endogenous decision of delegation of settlement authority to the lawyer. See Parness and Bartlett (1999) for a discussion of delegation of settlement authority based on apparent authority.

3.3 No-Access to Justice Component

This section formally defines the "No-Access to Justice" component of our model. The "No-Access to Justice" component η represents the inability of meritorious (potential) plaintiffs to get access to justice. To the best of our knowledge, ours represents the first formal definition of "No-Access to Justice."

Definition 2. *No-Access to Justice η is defined as the sum of two terms.*

(1) The mass of meritorious cases that are not filed.

(2) The mass of meritorious cases that receive a zero offer and cannot proceed to trial.

Intuitively, the first term represents the inability of lawyers with meritorious cases to file a lawsuit. The second term represents the inability of meritorious plaintiffs to get compensation for the inflicted injury through a strictly positive out-of-court settlement transfer or an award at trial.[30]

4 Equilibrium Analysis

Our model encompasses three mutually-exclusive perfect Bayesian equilibrium (PBE) classes: Mixed- and pure-strategy PBE, and boundary PBE. Each class includes two mutually-exclusive PBE: PBE with an interior solution and PBE with a corner solution. For exposition, this section presents formal analysis of the existence of the mixed- and pure-strategy PBE, and boundary PBE with interior solutions only. Characterization and formal proofs of the mixed- and pure-strategy PBE, and boundary PBE with corner solutions are presented in Appendix B.

The mixed-strategy PBE with an interior solution relies on conditions (1)-(4):

$$f_F < \gamma \tilde{A}. \tag{1}$$

$$\min_{\tau \in [\tilde{A}, \bar{A}]} \left\{ [\mu + G(\tau)]\tau - \int_{\tilde{A}}^{\tau} (A + C_D) g(A) dA \right\} > 0 \tag{2}$$

[30] The specific elements included in η depend on the equilibrium outcomes. See the analysis of Case 1 in Section 5.1, and the analysis of Cases 2 and 3 in Section 2.2.4 in Appendix B.

For any $A \in [\tilde{A}, \bar{A}]$,

$$g(A) - C_D \frac{\partial g(A)}{\partial A} > 0. \tag{3}$$

$$\int_{\tilde{A}}^{\bar{A}} A g(A) dA + C_D [1 - G(\tilde{A}) - \bar{A} g(\bar{A})] > 0 \tag{4}$$

Condition (1) guarantees that non-meritorious cases will be filed when the settlement offer is greater than or equal to $\tilde{A}$. Condition (2), which implies that for any $\tau \in [\tilde{A}, \bar{A}]$, $\mu + G(\tau)]\tau > \int_{\tilde{A}}^{\tau} (A + C_D) g(A) dA$, is a necessary condition for the existence of the mixed-strategy PBE class. It guarantees that a zero offer is made in equilibrium. Condition (3) guarantees the strict convexity of the defendant's expected loss function in the interval $[\tilde{A}, \bar{A}]$, and hence, the existence and uniqueness of the equilibrium positive settlement offer. Condition (4) is a necessary condition for the existence of the mixed-strategy PBE with an interior solution. It guarantees that an *interior* strictly positive offer in the interval $(\tilde{A}, \bar{A})$ is made in equilibrium.

The pure-strategy PBE with an interior solution relies on conditions (2A) and (4A), in addition to conditions (1) and (3):

$$\min_{\tau \in [\tilde{A}, \bar{A}]} \left\{ [\mu + G(\tau)]\tau - \int_{\tilde{A}}^{\tau} (A + C_D) g(A) dA \right\} < 0 \tag{2A}$$

$$1 + \mu - C_D g(\bar{A}) > 0. \tag{4A}$$

Condition (2A), which implies that there exists $\tau \in [\tilde{A}, \bar{A}]$ such that, $\mu + G(\tau)]\tau < \int_{\tilde{A}}^{\tau} (A + C_D) g(A) dA$, is a necessary condition for the existence of the pure-strategy PBE class. It guarantees that a zero offer is never made in equilibrium. Condition (4A) is a necessary condition for the existence of the pure-strategy PBE with an interior solution. It guarantees that an *interior* strictly positive offer in the interval $(\tilde{A}, \bar{A})$ is made in equilibrium.

It is important to note that conditions (2) and (2A) characterize the state of the world where either the mixed- or pure-strategy PBE class occurs. Specifically, the mixed-strategy PBE class occurs in a state of the world characterized by high level of lawyers' financial constraints (high $\tilde{A}$, right-hand side of condition (2)) or high threat of non-meritorious cases (high μ, left-hand side of condition (2)). Conversely, the pure-strategy PBE class occurs in a state of the world characterized by low level of lawyers' financial constraints (low $\tilde{A}$, right-hand side of condition (2A)) or low threat of non-meritorious cases (low μ, left-hand side of condition (2A)).

The boundary PBE with an interior solution relies on conditions (2B), in addition to conditions (1), (3), (4):

$$\min_{\tau\in[\tilde{A},\bar{A}]}\left\{[\mu+G(\tau)]\tau-\int_{\tilde{A}}^{\tau}(A+C_D)g(A)dA\right\}=0 \tag{2B}$$

Condition (2B) is a necessary condition for the existence of the boundary PBE class. It guarantees that a zero offer might be made in equilibrium.

4.1 Mixed-Strategy PBE with Interior Solution

In equilibrium, the lawyers' financial constraints permeate the decisions of all the parties involved in a legal dispute. We will demonstrate that the magnitude of the prevalent lawyers' financial constraints (the state of the world) determines the damage composition of the equilibrium mass of filed cases. One of three mutually-exclusive scenarios arise in equilibrium: Case 1, under "Strong Financial Constraints;" Case 2, under "Medium Financial Constraints;" and, Case 3, under "Mild Financial Constraints." The composition of the equilibrium mass of filed cases is as follows: All high-damage and some low-damage cases are filed in Case 1; all high- and low-damage cases are filed in Case 2; in addition to all high- and low-damage cases, some no-damage cases are filed in Case 3. Across cases, accidents and bargaining impasse occur in equilibrium. Specifically, the uninformed defendants randomize between making a zero offer and a strictly positive offer. Due to asymmetric information, some high-damage plaintiffs receive an insufficiently high offer and proceed to costly trial, some low- and no-damage plaintiffs receive a generous offer and settle out-of-court, and some no-damage and low-damage plaintiffs receive a zero offer and need to drop their cases.

We will show that access to justice for true victims is compromised across cases. In Case 1, access to justice is affected by two sources. First, some low-damage cases are not filed. Second, among the low-damage cases filed, some plaintiffs receive a zero offer and are forced to drop their cases. Then, some low-damage plaintiffs do not get access to justice. In Cases 2 and 3, access to justice is compromised by only one source. Although all low-damage cases are filed, some low-damage plaintiffs receive a zero offer and are forced to drop their cases.[31] Hence, access to

[31] In other words, in Cases 2 and 3, the first term stated in Definition 2 is an empty set. See Section 2.2.4 in Appendix B.

justice is still denied to some true victims.

The existence of the mixed-strategy PBE with an interior solution is formally analyzed below. We assume that conditions (1)–(4) hold. Backward induction is applied. Several steps are included in the analysis.

4.1.1 Potential Composition of the Set of Equilibrium Offers

We will first demonstrate that the set of equilibrium offers should include a zero offer and at least one strictly positive offer $S \in [\tilde{A}, \bar{A}]$. Lemma 1 states this result.

Lemma 1. *The set of equilibrium offers must include a zero offer and at least one strictly positive offer $S \in [\tilde{A}, \bar{A}]$.*

Proof. First, it is simple to show that offers greater than $\bar{A}$ are strictly dominated by an offer equal to $\bar{A}$. Second,we will demonstrate that offers $S \in (0, \tilde{A})$ are not in the set of equilibrium offers.[32] Suppose not. An offer $S \in (0, \tilde{A})$ is an equilibrium offer. Let $\hat{A} = \frac{C_P + f_M + (C_P + f_M - x)r}{\gamma}$ be the damage threshold at which the lawyer's expected payoff is zero when a meritorious case is solved at trial. Hence, when the lawyer expects to receive a unique offer equal to zero from the defendant, only cases with $A \geq \hat{A}$ will be filed.[33] Let the mass of low- and no-damage cases that are filed be $\nu \in [0, G(\tilde{A}) + \mu]$. Let $n(A) \in [0, 1]$ be the probability that a type A will be filed, for $A \in [\tilde{A}, \bar{A}]$.[34] Let $\epsilon > 0$ denote a small number. The defendant's expected litigation loss function is $l_D(S) = \nu S + \int_{\tilde{A}}^{\hat{A}} (A + C_D) n(A) g(A) dA + \int_{\hat{A}}^{\bar{A}} (A + C_D) g(A) dA$. Consider the case when $\nu \in (0, G(\tilde{A}) + \mu]$. $l_D(S)$ achieves its minimum at a zero offer. Then, the defendant is better off by deviating to a zero offer. Contradiction follows. Consider now the case when $\nu = 0$. Let $\check{A} \equiv \inf\{A_{filed}\}$, where A_{filed} is the set of values of A that are filed and $\hat{A} \geq \check{A} \geq \tilde{A}$. Two

[32] S might be non-unique, i.e., multiple S might be made in equilibrium with strictly positive probabilities.

[33] Note that $\hat{A} = \tilde{A} + \frac{f_M}{\gamma}$. Of course, when the lawyer expects that the defendant will mix between offering zero and making a strictly positive offer (which occurs in equilibrium due to asymmetric information), then the lawyer has an incentive to file cases with $A < \hat{A}$. See next sections for details.

[34] The use of $n(A)$ allows us to provide a general formulation of the defendant's litigation loss that accounts for environments in which the probability of filing is not known and might be equal to zero. Claim 1 demonstrates that, in the environments studied in Lemma 1, Lemma 2, and Proposition 5, $n(A) = 1$ for $A > \check{A}$.

options are possible: (1) $\check{A} = \hat{A}$ and (2) $\check{A} < \hat{A}$.[35] Under option (1), when facing a plaintiff of type $\hat{A} \leq A \leq \hat{A}+\epsilon$, the defendant's expected litigation loss from offering $S \in (0, \tilde{A})$ and offering $\hat{A}+\epsilon$ will be $\int_{\hat{A}}^{\hat{A}+\epsilon}(\hat{A}+C_D)g(A)dA$ and $\int_{\hat{A}}^{\hat{A}+\epsilon}(\hat{A}+\epsilon)g(A)dA$, respectively. The defendant will be better off by deviating and offering $\hat{A}+\epsilon$: $\int_{\hat{A}}^{\hat{A}+\epsilon}(\hat{A}+\epsilon)g(A)dA < \int_{\hat{A}}^{\hat{A}+\epsilon}(A+C_D)g(A)dA$, when $C_D > \epsilon$. Contradiction follows. Under option (2), when facing a plaintiff of type $\check{A} \leq A \leq \check{A}+\epsilon$, the defendant's expected litigation loss from offering $S \in (0, \tilde{A})$ will be $\int_{\check{A}}^{\check{A}+\epsilon}(A+C_D)n(A)g(A)dA$. His expected litigation loss from offering $\check{A}+\epsilon$ will be $\int_{\check{A}}^{\check{A}+\epsilon}(\check{A}+\epsilon)n(A)g(A)dA$. By Claim 1 in Appendix A, $n(A) = 1$, for $A > \check{A}$. The defendant will be better off by deviating and offering $\check{A}+\epsilon < \hat{A}$: $\int_{\check{A}}^{\check{A}+\epsilon}(\check{A}+\epsilon)g(A)dA < \int_{\check{A}}^{\check{A}+\epsilon}(A+C_D)g(A)dA$, when $C_D > \epsilon$. Contradiction follows. Hence, an offer $S \in (0, \tilde{A})$ cannot be in the set of equilibrium offers.

Third, we will demonstrate that a zero offer is in the set of equilibrium offers. Suppose not. There is not a zero offer in equilibrium. Then the defendant offers $S \in [\tilde{A}, \bar{A}]$.[36] By condition (1), all no-damage and low-damage cases will be filed. The defendant's expected litigation loss from offering S will be $[\mu + G(S)]S + \int_S^{\bar{A}}(A+C_D)g(A)dA$. By condition (2), $[\mu + G(S)]S + \int_S^{\bar{A}}(A+C_D)g(A)dA > \int_{\hat{A}}^{\bar{A}}(A+C_D)g(A)dA$, where the right-hand side of the inequality represents the defendant's expected litigation loss from making a zero offer. Then, the defendant's is better off by deviating to a zero offer. Contradiction follows. Hence, a zero offer must be in the set of equilibrium offers. As a result, the probability that the defendant makes a zero offer $\beta > 0$. Fourth, we will show that a zero offer cannot be the only equilibrium offer. Suppose not. The defendant always makes a zero offer. Then, only cases with types $A \geq \hat{A}$ will be filed. These plaintiffs will always reject a zero offer. When facing a plaintiff of a type $\hat{A} \leq A \leq \hat{A}+\epsilon$, the defendant will be better off by deviating and offering $\hat{A}+\epsilon$: $\int_{\hat{A}}^{\hat{A}+\epsilon}(\hat{A}+\epsilon)g(A)dA < \int_{\hat{A}}^{\hat{A}+\epsilon}(A+C_D)g(A)dA$. Contradiction follows. Hence, in addition to the zero offer, there must be at least one strictly positive offer $S \in [\tilde{A}, \bar{A}]$ in the set of equilibrium offers. ■

[35] In words, at least for some $A \in [\tilde{A}, \hat{A})$ are filed, $n(A) > 0$.

[36] S might be non-unique, i.e. multiple S might be made in equilibrium with strictly positive probabilities.

4.1.2 Potential Composition of Filed Cases

In this section, we will show that the equilibrium mass of filed cases should include all high-damage cases and at least some low-damage cases. Then, the equilibrium mass of filed cases $\zeta = \nu + \int_{\tilde{A}}^{\bar{A}} g(A)dA$, where $\nu > 0$. Lemma 2 states these results.

Lemma 2. *There must be at least some low-damage cases that are filed in equilibrium. All high-damage cases are filed in equilibrium.*

Proof. First, we will demonstrate that there must be at least some low damage cases that are filed in equilibrium, $\nu > 0$. Suppose not. No-damage or low-damage cases are never filed. By definition of $\hat{A}$, $A \geq \hat{A}$ always files. By assumption, $\hat{A} \geq \check{A} \geq \tilde{A}$. Then, there are two possible options: (1) $\check{A} = \hat{A}$, and (2) $\check{A} < \hat{A}$. Consider option 1. When facing a plaintiff of a type $\hat{A} \leq A \leq \hat{A} + \epsilon$, the defendant will be better off by deviating from the mixed-strategy involving a zero offer and a strictly positive offer $S \in [\tilde{A}, \bar{A}]$ to a pure-strategy involving an offer $\hat{A} + \epsilon$: $\int_{\hat{A}}^{\hat{A}+\epsilon}(\hat{A} + \epsilon)g(A)dA < \int_{\hat{A}}^{\hat{A}+\epsilon}(A + C_D)g(A)dA$, when $C_D > \epsilon$. Consider option 2. When facing a plaintiff of a type $\check{A} \leq A \leq \check{A}+\epsilon$, the defendant's expected litigation loss from the mixed-strategy involving a zero offer and a strictly positive offer $S \in [\tilde{A}, \bar{A}]$ will be $\int_{\check{A}}^{\check{A}+\epsilon}(A + C_D)n(A)g(A)dA$, when $C_D > \epsilon$. His expected litigation loss from offering $\check{A} + \epsilon$ will be $\int_{\check{A}}^{\check{A}+\epsilon}(\check{A} + \epsilon)n(A)g(A)dA$, respectively. By Claim 1 in Appendix A, $n(A) = 1$, for $A > \check{A}$. The defendant will be better off by deviating and offering $\check{A} + \epsilon$: $\int_{\check{A}}^{\check{A}+\epsilon}(\check{A} + \epsilon)g(A)dA < \int_{\check{A}}^{\check{A}+\epsilon}(A + C_D)g(A)dA$, when $C_D > \epsilon$. Then, a mixed-strategy with a zero offer and a strictly positive offer $S \in [\tilde{A}, \hat{A}]$ is not in the set of equilibrium offers. Contradiction follows. Hence, $v > 0$.

Second, we will show that all high-damage cases are filed. We just demonstrated that at least some low-damage cases are filed in equilibrium. Then, it must be the case that at least some attorneys with low-damage cases will get non-negative expected payoffs: $\gamma[\beta \bullet 0+(1-\beta)S)]-f_M \geq 0$, where S and β represent a strictly positive offer and the probability of getting a zero offer, respectively.[37] We also showed that $\beta > 0$ in equilibrium. Consider now the case of an attorney with $A \geq \tilde{A}$. The expected payoff for the attorney is $\beta[\gamma A - C_P - (C_P + f_M - x)r] + (1-\beta)\gamma S - f_M$. This expression is non-negative for $A = \tilde{A}$ and strictly positive for $A > \tilde{A}$. As a consequence,

[37]The mixed-strategy equilibrium might involve a zero offer and multiple strictly positive offers.

all high-damage cases will be filed. Hence, the equilibrium mass of cases that are filed $\zeta = \nu + \int_{\tilde{A}}^{\bar{A}} g(A)dA$, where $\nu > 0$. ■

4.1.3 Equilibrium S and ν

In this section, we will demonstrate the uniqueness of the equilibrium mass of no- and low-damage cases that are filed ν. We will also show the uniqueness of the equilibrium strictly positive offer $S \in (\tilde{A}, \bar{A})$.[38] Proposition 1 states these results.

Proposition 1. *The equilibrium positive settlement offer $S \in (\tilde{A}, \bar{A})$ and the equilibrium mass of no- and low-damage cases that are filed ν, which are implicitly defined by equations (5) and (6), exist and are unique.*

Proof. We have established that a zero offer and at least one strictly positive offer are made in equilibrium. This implies that the positive equilibrium offer S must minimize the expected litigation loss of the defendant, and the defendant must be indifferent between offering the optimal strictly positive offer S and a zero offer. The indifference condition is given by

$$\nu S + \int_{\tilde{A}}^{S} Sg(A)dA + \int_{S}^{\bar{A}} (A + C_D)g(A)dA = \int_{\tilde{A}}^{\bar{A}} (A + C_D)g(A)dA. \tag{5}$$

The first-order optimality condition is

$$\frac{\partial}{\partial S}\left[\nu S + \int_{\tilde{A}}^{S} Sg(A)dA + \int_{S}^{\bar{A}} (A + C_D)g(A)dA\right] = 0.$$

This last equation simplifies to

$$\nu + G(S) - G(\tilde{A}) = C_D g(S). \tag{6}$$

Lemma 3 in Appendix A demonstrates that the system of equations (5)–(6) has a unique solution, S and ν. By condition (3), the second-order optimality condition $g(A) > C_D \frac{\partial g(A)}{\partial A}$ is satisfied for all $A \in [\tilde{A}, \bar{A}]$. By Claim 2 in Appendix A, $\nu < \mu + G(\tilde{A})$. ■

[38] To simplify notation, we also refer to the *equilibrium* strictly positive offer and mass of no- and low-damage cases that are filed as S and ν, respectively, in this section and the rest of the paper.

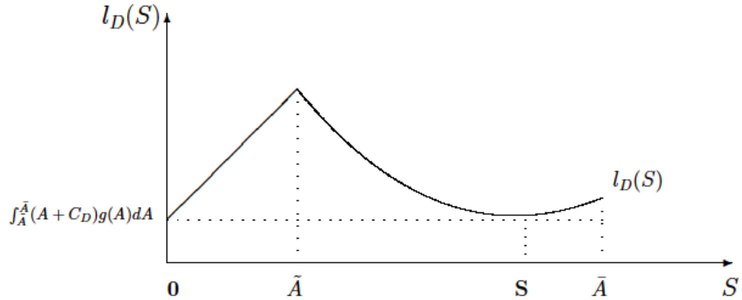

Figure 1: $\mathbf{l_D(S)}$ for Mixed-Strategy PBE with Interior Solution

Intuitively, at the equilibrium mass of no- and low-damage cases that are filed ν and the equilibrium strictly positive out-of-court settlement S: The marginal cost of raising S, represented by the mass of plaintiffs who accept S (left-hand side of equation (6)) should be equal to the marginal benefit of raising S, represented by the savings in litigation cost C_D as fewer cases go to trial (right-hand side of equation (6)).

Corollary 1. In equilibrium, the defendant's expected litigation loss l_D is

$$l_D = \int_{\tilde{A}}^{\bar{A}} (A + C_D)g(A)dA \tag{7}$$

Next, we present a graphical representation of the optimal decision of the defendant at the litigation stage. Figure 1 depicts the defendant's expected litigation loss function $l_D(S)$ for $S \in [0, \bar{A}]$. We construct this function by keeping the equilibrium mass of filed cases $\zeta = \nu + \int_{\tilde{A}}^{\bar{A}} g(A)dA$ constant.

$$l_D(S) = \begin{cases} \nu S + \int_{\tilde{A}}^{\bar{A}}(A + C_D)g(A)dA & \text{if } S \in [0, \tilde{A}) \\ \nu S + \int_{\tilde{A}}^{S} Sg(A)dA + \int_{S}^{\bar{A}}(A + C_D)g(A)dA & \text{if } S \in [\tilde{A}, \bar{A}] \end{cases}$$

When $S \in [0, \tilde{A})$, $l_D(S)$ is linear and upward-sloping, with a corner minimum at the zero offer. When $S \in [\tilde{A}, \bar{A}]$, $l_D(S)$ is strictly convex and achieves a unique interior minimum (by condition 4 and Lemma 3 in Appendix A). The defendant's expected loss function $l_D(S)$ attains the same value at a zero offer and at the optimal strictly positive offer S. Hence, in equilibrium, the defendant mixes between a zero offer and a strictly positive (interior) offer $S \in (\tilde{A}, \bar{A})$.

4.1.4 Composition of Equilibrium ν

By Lemma 2 and Claim 2 in Appendix A, $0 < \nu < \mu + G(\tilde{A})$. The prevalent magnitude of the lawyers' financial constraints $\tilde{A}$ (the state of the world) determines one of four mutually-exclusive cases: Case 1, where $G(\tilde{A}) - \nu > 0$; Case 2, where $G(\tilde{A}) - \nu = 0$; and, Case 3, where $(G(\tilde{A}) - \nu < 0$ and $\nu < \mu + G(\tilde{A})$. Lemma 4 demonstrates that a relaxation of the lawyers' financial constraints lowers $[G(\tilde{A}) - \nu]$. Then, Cases 1, 2 and 3 occur under "Strong," "Medium," and "Mild" lawyers' financial constraints, respectively.

Lemma 4. *The difference between the total mass of low-damage cases and the mass of low- and no-damage cases that are filed,* $[G(\tilde{A}) - \nu]$ *is increasing in* $\tilde{A}$.

Proof. See Appendix A

Cases 1, 2 and 3 involve different compositions of equilibrium ν, and hence, different compositions of the equilibrium mass of filed cases ζ. In Case 1, the total mass of low-damage cases $G(\tilde{A})$ is greater than the equilibrium mass of low-damage and no-damage cases that are filed ν. Given that $f_F > f_M$, the equilibrium ν must include some low-damage cases only. Hence, the equilibrium mass of filed cases ζ includes some low-damage cases, in addition to all high-damage cases. In Case 2, the total mass of low-damage cases $G(\tilde{A})$ is equal to the equilibrium mass of low- and no-damage cases that are filed ν. Then, the equilibrium ν must include all low-damage cases. Hence, the equilibrium mass of filed cases ζ includes all low-damage cases, in addition to all high-damage cases. In Case 3, the total mass of low-damage cases $G(\tilde{A})$ is lower than the equilibrium mass of low- and no-damage cases that are filed ν, and ν is lower than the total mass of low- and no-damage cases $\mu + G(\tilde{A})$. Then, the equilibrium ν must include all low-damage cases and some no-damage case. Hence, the equilibrium mass of filed cases ζ includes all low-damage and some no-damage cases, in addition to all high-damage cases.

4.1.5 Equilibrium β

Next, we will show how the composition of ν determines the equilibrium probability that the defendant makes a zero offer β in each of the three cases.[39] Proposition 2 summarizes the equilibrium β for Cases 1–3.

Proposition 2. *The equilibrium probability that the defendant makes a zero offer are* $\beta = 1-\frac{f_M}{\gamma S}$, $\beta \in \left(1-\frac{f_F}{\gamma S}, 1-\frac{f_M}{\gamma S}\right)$, *and* $\beta = 1-\frac{f_F}{\gamma S}$, *in Cases 1, 2, and 3, respectively.*

Proof. In Case 1, an attorney with an average low-damage client mixes between filing and not filing.[40] Then, he must be indifferent between these two strategies: $f_M = \gamma[\beta \bullet 0 + (1-\beta)S]$.[41] This indifference condition allows us to compute the equilibrium β: $\beta = 1-\frac{f_M}{\gamma S}$. An attorney with a no-damage client never files a lawsuit because his expected payoff is negative: $\gamma[\beta \bullet 0 + (1-\beta)S] - f_F = \gamma[(1-\frac{f_M}{\gamma S}) \bullet 0 + \frac{f_M}{\gamma S} S] - f_F = f_M - f_F < 0$.[42] In Case 2, an attorney with a low-damage plaintiff must receive a strictly positive expected payoff but an attorney with a no-damage offer must receive a negative expected payoff. Hence, the following condition must hold $f_F > \gamma[\beta \bullet 0 + (1-\beta)S] > f_M$. This condition yields a range of equilibrium values $\beta \in \left(1-\frac{f_F}{\gamma S}, 1-\frac{f_M}{\gamma S}\right)$. In Case 3, an attorney with a no-damage case will mix between filing and not filing. Hence, he must be indifferent between these two strategies. The indifference condition $\gamma[\beta \bullet 0 + (1-\beta)S] - f_F = 0$ allows us to compute the equilibrium β: $\beta = 1-\frac{f_F}{\gamma S}$. The expected payoff for an attorney with a low-damage client must be strictly positive: $\gamma[\beta \bullet 0 + (1-\beta)S] - f_M = \gamma[(1-\frac{f_F}{\gamma S}) \bullet 0 + \frac{f_F}{\gamma S} S] - f_M = f_F - f_M > 0$.
■

[39] To simplify notation, we also refer to the *equilibrium* probability that the defendant makes a zero offer as β, in this section and the rest of the paper.

[40] In principle, the probability of filing for a low-damage plaintiff may depend on the specific A. Then, the expression "average "low-damage client" is used here.

[41] Intuitively, although low-damage cases cannot proceed to trial, they might still receive a positive out-of-court settlement offer due to asymmetric information.

[42] Intuitively, although asymmetry of information might allow the no-damage plaintiff to receive a positive settlement offer, the probability of getting this offer $(1-\beta)$ is too low to cover the lawyer's costs of filing a non-meritorious case $f_F > f_M$.

4.1.6 Equilibrium λ_D

We now consider the defendant's decision at the care-taking stage. Given the equilibrium strategies at the litigation and filing stages, the defendant chooses his optimal probability of an accident $\lambda_D = \arg\min L_D(\lambda)$. By definition, $L_D(\lambda) = K(\lambda) + \lambda l_D$. By Corollary 1, $l_D = \int_{\tilde{A}}^{\bar{A}}(A + C_D)g(A)dA$ in equilibrium. Proposition 3 demonstrates that, for any positive value of l_D, λ_D exists, is unique, and is decreasing in l_D.

Proposition 3. *For any positive value of l_D, the function $L_D(\lambda) = K(\lambda) + \lambda l_D$ has a unique interior minimum, $\lambda_D \in (0, 1)$, which is decreasing in l_D.*

Proof. See Appendix A.

4.1.7 Equilibrium Posterior Beliefs

Proposition 4 states the defendant's posterior beliefs in equilibrium.

Proposition 4. *In equilibrium, the defendant's posterior beliefs are as follow. (1) Case 1: $P(A = 0|Filing) = 0$, $P(0 < A < \tilde{A}|Filing) = \frac{\nu}{\nu+1-G(\tilde{A})}$, $P(\tilde{A} \leq A \leq y|Filing) = \frac{G(y)-G(\tilde{A})}{\nu+1-G(\tilde{A})}$ for any $y \in [\tilde{A}, \bar{A}]$. Case 2: $P(A = 0|Filing) = 0$, $P(0 < A \leq y|Filing) = G(y)$ for any $y \in (0, \bar{A}]$. Case 3: $P(A = 0|Filing) = \frac{\nu-G(\tilde{A})}{\nu+1-G(\tilde{A})}$, $P(0 < A \leq y|Filing) = \frac{G(y)}{\nu+1-G(\tilde{A})}$ for any $y \in (0, \bar{A}]$.*

Proof. See Appendix A.

Result 1 summarizes the mixed-strategy PBE with an interior solution.

Result 1. *Assume that conditions (1)–(4) hold. The following strategy profile, together with the defendant's beliefs, characterize the mixed-strategy perfect Bayesian equilibrium with an interior solution.*

Case 1: $G(\tilde{A}) - \nu > 0$

(1) The defendant chooses a probability of accident $\lambda_D = \arg\min \left\{K(\lambda)+\lambda \int_{\tilde{A}}^{\bar{A}}(A+C_D)g(A)dA\right\}$. If a lawsuit is filed, the defendant mixes between proposing a zero offer with probability $\beta = 1 - \frac{f_M}{\gamma S}$; and, proposing an offer $S \in (\tilde{A}, \bar{A})$, implicitly defined by equations (5) and (6), with the complementary probability.

(2) A high-damage case is always filed by the plaintiff's attorney; an average low-damage case is filed with probability $\frac{\nu}{G(\tilde{A})}$; a no-damage case is never filed.

(3) A high-damage plaintiff always rejects a zero offer and accepts an offer $S > 0$ only if $A \leq S$; a low-damage plaintiff always accepts a non-negative offer; a no-damage plaintiff always accepts a non-negative offer.

(4) The defendant's equilibrium beliefs are as follows. When the defendant observes a lawsuit, he believes that $P(A = 0) = 0$, $P(0 < A < \tilde{A}) = \frac{\nu}{\nu+1-G(\tilde{A})}$, $P(\tilde{A} \leq A \leq y) = \frac{G(y)-G(\tilde{A})}{\nu+1-G(\tilde{A})}$ for any $y \in [\tilde{A}, \bar{A}]$.

Case 2: $G(\tilde{A}) - \nu = 0$

(1) The defendant chooses a probability of accident $\lambda_D = \arg\min \Big\{K(\lambda) + \lambda \int_{\tilde{A}}^{\bar{A}} (A + C_D) g(A) dA\Big\}$. If a lawsuit is filed, the defendant mixes between proposing a zero offer with probability $\beta \in \big(1 - \frac{f_F}{\gamma S}, 1 - \frac{f_M}{\gamma S}\big)$; and, proposing an offer $S \in (\tilde{A}, \bar{A})$, implicitly defined by equations (5) and (6), with the complementary probability.

(2) A high-damage case is always filed by the plaintiff's attorney; a low-damage case is always filed; a no-damage case is never filed.

(3) A high-damage plaintiff always rejects a zero offer and accepts an offer $S > 0$ only if $A \leq S$; a low-damage plaintiff always accepts a non-negative offer; a no-damage plaintiff always accepts a non-negative offer.

(4) The defendant's equilibrium beliefs are as follows. When the defendant observes a lawsuit, he believes that $P(A = 0) = 0$, $P(0 < A \leq y) = G(y)$ for any $y \in (0, \bar{A}]$.

Case 3: $G(\tilde{A}) - \nu < 0$ *and* $\nu < \mu + G(\tilde{A})$

(1) The defendant chooses a probability of accident $\lambda_D = \arg\min \Big\{K(\lambda) + \lambda \int_{\tilde{A}}^{\bar{A}} (A + C_D) g(A) dA\Big\}$. If the plaintiff files a lawsuit, the defendant mixes between proposing a zero offer with probability $\beta = 1 - \frac{f_F}{\gamma S}$; and, proposing an offer $S \in (\tilde{A}, \bar{A})$, implicitly defined by equations (5) and (6), with the complementary probability.

(2) A high-damage case is always filed by the plaintiff's attorney; a low-damage case is always filed; a no-damage case is filed with probability $\frac{\nu - G(\tilde{A})}{\mu}$.

(3) A high-damage plaintiff always rejects a zero offer and accepts an offer $S > 0$ only if $A \leq S$; a low-damage case plaintiff always accepts a non-negative offer; a no-damage plaintiff always

Table 1: Equilibrium Outcomes and Payoffs for Mixed-Strategy PBE with Interior Solution

Probability of Accident	$\lambda_D = \arg\min\{K(\lambda) + \lambda l_D\}$
Mass of Filed Cases	$\zeta = \nu + \int_{\tilde{A}}^{\bar{A}} g(A)dA$
Probability of a Zero Offer[(a)]	$\beta = \left(1 - \frac{f_M}{\gamma S}\right)$, $\beta \in \left(1 - \frac{f_F}{\gamma S}, 1 - \frac{f_M}{\gamma S}\right)$, $\beta = \left(1 - \frac{f_F}{\gamma S}\right)$
Probability of Trial	$\rho = \beta[1 - G(\tilde{A})] + (1 - \beta)[1 - G(S)]$
Defendant's Expected Litigation Loss	$l_D = \int_{\tilde{A}}^{\bar{A}} (A + C_D)g(A)dA$
Plaintiff's Expected Payoff	
- No-Damage ($A = 0$)[(b)]	$\Pi_P = (1 - \gamma)[\beta \bullet 0 + (1 - \beta)S]$
- Low-Damage ($0 < A < \tilde{A}$)	$\Pi_P = (1 - \gamma)[\beta \bullet 0 + (1 - \beta)S]$
- High-Damage with $A \in [\tilde{A}, S)$	$\Pi_P = (1 - \gamma)[\beta A + (1 - \beta)S]$
- High-Damage with $A \in [S, \bar{A}]$	$\Pi_P = (1 - \gamma)A$
Attorney's Expected Payoff	
- No-Damage ($A = 0$)[(b)]	$\Pi_{PA} = \gamma[\beta \bullet 0 + (1 - \beta)S] - f_F$
- Low-Damage ($0 < A < \tilde{A}$)	$\Pi_{PA} = \gamma[\beta \bullet 0 + (1 - \beta)S] - f_M$
- High-Damage with $A \in [\tilde{A}, S)$	$\Pi_{PA} = \gamma[\beta A + (1 - \beta)S] - \beta[C_P + (C_P + f_M - x)r] - f_M$
- High-Damage with $A \in [S, \bar{A}]$	$\Pi_{PA} = \gamma A - [C_P + (C_P + f_M - x)r] - f_M$

Notes: Mass of filed cases conditional on accident occurrence, and other outcomes conditional on accident occurrence and filing; Π_A and Π_{PA} denote the expected payoff for the plaintiff and his attorney, respectively; [(a)]probability of a zero offer for Cases 1, 2, and 3, respectively; [(b)]applies to Case 3 only.

accepts a non-negative offer.

(4) The defendant's equilibrium beliefs are as follows. When the defendant observes a lawsuit, he believes that $P(A = 0) = \frac{\nu - G(\tilde{A})}{\nu + 1 - G(\tilde{A})}$, $P(0 < A \leq y) = \frac{G(y)}{\nu + 1 - G(\tilde{A})}$ *for any* $y \in (0, \bar{A}]$.

Table 1 outlines the equilibrium outcomes and payoffs. See Section 2.2 in Appendix B for details.

4.2 Pure-Strategy PBE with Interior Solution

Accidents and bargaining impasse occur in equilibrium. Due to asymmetric information, some high-damage plaintiffs receive an insufficiently high offer and proceed to costly trial, and some low- and no-damage plaintiffs receive a generous offer and settle out-of-court. Although attorneys with low- and no-damage cases cannot proceed to trial due to their financial constraints, their expectations about a strictly positive out-of-court settlement offer induce them to file a lawsuit. Then, in addition to all high-damages, all low- and no-damage cases are filed; and all filed cases receive a strictly positive offer. Hence, access to justice for true victims is not compromised by the lawyers' financial constraints. The existence of the pure-strategy PBE with an interior solution is formally analyzed in Appendix A (Propositions 5–8, Corollary 2, and proofs). Result 2 summarizes the equilibrium.

Result 2. *Assume that conditions (1), (2A), (3) and (4A) hold. Then, the following strategy profile, together with the defendant's beliefs, characterize the pure-strategy perfect Bayesian equilibrium with an interior solution.*

(1) The defendant chooses a probability of accident $\lambda_D = \arg\min \Big\{K(\lambda) + \lambda l_D(S)\Big\}$*, where* $l_D(S) = [\mu + G(S)]S + \int_S^{\bar{A}} (A + C_D) g(A) dA$*. If a lawsuit is filed, the defendant always proposes an offer* $S \in (\tilde{A}, \bar{A})$*, implicitly defined by* $\mu + G(S) = C_D g(S)$*.*

(2) All cases are filed by the plaintiff's attorney.

(3) A high-damage plaintiff rejects an offer $S \in (\tilde{A}, \bar{A})$ *only if* $A \geq S$*; a low-damage plaintiff always accepts* $S \in (\tilde{A}, \bar{A})$*; a no-damage plaintiff always accepts* $S \in (\tilde{A}, \bar{A})$*.*

(4) The defendant's equilibrium beliefs are as follows. When the defendant observes a lawsuit, he believes that $P(A = 0) = \frac{\mu}{1+\mu}$*,* $P(0 < A \leq y) = \frac{G(y)}{1+\mu}$*.*

4.3 Boundary PBE with Interior Solution

Accidents and bargaining impasse occur in equilibrium. In addition to all high-damages, all low- and no-damage cases are filed. The defendant might mix between a zero offer and a strictly positive offer, or might make a unique strictly positive offer. Access to justice is compromised in the former case only. The existence of the boundary PBE with an interior solution is formally analyzed in Appendix A (Lemma 5, Propositions 9–11, Corollary 3, and proofs). Result 3 summarizes the equilibrium.

Result 3. *Assume that conditions (1), (2B), (3), and (4) hold. Then, the following strategy profile, together with the defendant's beliefs, characterize the boundary perfect Bayesian equilibrium with an interior solution.*

(1) The defendant chooses a probability of accident $\lambda_D = \arg\min\left\{K(\lambda) + \lambda l_D(S)\right\}$, *where* $l_D(S) = [\mu + G(S)]S + \int_S^{\bar{A}}(A + C_D)g(A)dA$. *If a lawsuit is filed, the defendant mixes between proposing a zero offer with probability* $\beta \in [0, 1 - \frac{f_F}{\gamma S})$*; and, proposing an offer* $S \in (\tilde{A}, \bar{A})$*, implicitly defined by* $\mu + G(S) = C_D g(S)$*, with the complementary probability.*

(2) All cases are filed by the plaintiff's attorney.

(3) A high-damage plaintiff always rejects a zero offer and accepts an offer $S > 0$ *only if* $A \leq S$*; a low-damage plaintiff always accepts a non-negative offer; a no-damage plaintiff always accepts a non-negative offer.*

(4) The defendant's equilibrium beliefs are as follows. When the defendant observes a lawsuit, he believes that $P(A = 0) = \frac{\mu}{1+\mu}$, $P(0 < A \leq y) = \frac{G(y)}{1+\mu}$.

4.4 Discussion

Our previous analysis demonstrates that the mixed-strategy PBE class arises in a state of the world characterized by high level of lawyers' financial constraints or high threat of non-meritorious lawsuits (frivolous lawsuits). Conversely, the pure-strategy PBE class occurs in a state of the world characterized by condition (2A): Low level of lawyers' financial constraints and low threat of non-meritorious lawsuits (frivolous lawsuits). Intuition is provided below.

In the mixed-strategy PBE class, the defendant mixes between a zero offer and a strictly positive offer $S \in (\tilde{A}, \bar{A}]$.[43] His expected litigation loss under both offers is the same and corresponds to equation (5): $\nu S + \int_{\tilde{A}}^{S} Sg(A)dA + \int_S^{\bar{A}}(A + C_D)g(A)dA = \int_{\tilde{A}}^{\bar{A}}(A + C_D)g(A)dA$,

[43] The strictly positive offer is $S \in (\tilde{A}, \bar{A})$ and $S = \bar{A}$, under the mixed-strategy PBE with an interior and corner solution, respectively. See Appendix B for formal analysis of the mixed-strategy PBE with a corner solution.

where the left- and right-hand sides indicate the defendant's expected litigation loss when he makes an offer $S \in [\tilde{A}, \bar{A}]$ and a zero offer, respectively. By condition (2), for any $S \in [\tilde{A}, \bar{A}]$, $[\mu + G(S)]S > \int_{\tilde{A}}^{S} (A + C_D)g(A)dA$. Then, $[\mu + G(\tilde{A})]S + \int_{\tilde{A}}^{S} Sg(A)dA + \int_{S}^{\bar{A}} (A + C_D)g(A)dA > \int_{\tilde{A}}^{S} (A + C_D)g(A)dA + \int_{S}^{\bar{A}} (A + C_D)g(A)dA$, for $S \in [\tilde{A}, \bar{A}]$. Hence,

$$[\mu + G(\tilde{A})]S + \int_{\tilde{A}}^{S} Sg(A)dA + \int_{S}^{\bar{A}} (A + C_D)g(A)dA > \int_{\tilde{A}}^{\bar{A}} (A + C_D)g(A)dA, \tag{8}$$

for any $S \in (\tilde{A}, \bar{A}]$. The left-hand side of the inequality indicates the defendant's expected litigation loss when he chooses a pure strategy involving a strictly positive offer $S \in (\tilde{A}, \bar{A}]$.[44] The right-hand side of the inequality indicates the defendant's expected litigation loss when he chooses a mixed strategy involving a zero offer and a strictly positive offer $S \in (\tilde{A}, \bar{A}]$.

Inequality (8) outlines the mechanisms through which the level of lawyers' financial constraints, represented by $\tilde{A}$, and the threat of frivolous lawsuits, represented by the mass of no-meritorious cases μ, influence the defendant's choice between a mixed and a pure strategy. First, the influence of the level of lawyers' financial constraints $\tilde{A}$ operates through the right-hand side of the inequality.[45] When the level of lawyers' financial constraints is high (for a given threat of frivolous lawsuits), the threat of a trial, represented by the mass of high-damage cases $1 - G(\tilde{A})$, will be low. The defendant will have a strong incentive to mix between a zero offer and an offer $S \in (\tilde{A}, \bar{A}]$. A unique strictly positive offer $S \in (\tilde{A}, \bar{A}]$ will be accepted by all low- and no-damage plaintiffs, and will encourage filing of frivolous and low-damage cases. The defendant will reduce his expected litigation loss by mixing between a zero offer and an offer $S \in (\tilde{A}, \bar{A}]$: Frivolous and low-damage plaintiffs who receive a zero offer will drop their cases; only high-damage cases will reject a zero offer and proceed to trial. In addition, filing of frivolous and low-damage cases will be discouraged.

[44] The strictly positive offer is $S \in (\tilde{A}, \bar{A})$ and $S = \hat{A}$, under the pure-strategy PBE with an interior and corner solution, respectively. See Appendix B for formal analysis of the pure-strategy PBE with a corner solution.

[45] Although the first two terms of the left-hand side of the inequality also include $\tilde{A}$, the level of lawyers' financial constraints will not influence the defendant's expected litigation loss associated with a pure-strategy involving $S \in (\tilde{A}, \bar{A}]$. Any change in $\tilde{A}$ will simply generate a reallocation from the first term to the second term of the inequality. Some initially low-damage cases will now become high-damage cases. Both groups accept an offer $S \in (\tilde{A}, \bar{A}]$.

Second, the influence of the threat of frivolous lawsuits μ operates through the left-hand side of the inequality. When the threat of frivolous lawsuits is high (for a given level of lawyers' financial constraints), the defendant will have a strong incentive to mix between a zero offer and an offer $S \in (\tilde{A}, \bar{A}]$. A unique strictly positive offer $S \in (\tilde{A}, \bar{A}]$ will be accepted by all low- and no-damage plaintiffs, and encourage filing of frivolous and low-damage cases. By mixing between a zero offer and an offer $S \in (\tilde{A}, \bar{A}]$, the defendant will reduce his expected litigation loss because only high-damage cases can proceed to trial.

5 Effects of a Cost-Reducing Policy on Equilibrium Outcomes and Payoffs

This section studies the effects of a cost-reducing policy on the equilibrium outcomes and payoffs. We focus our policy analysis on the mixed-strategy equilibrium with an interior solution, which occurs under the empirically-relevant assumption of strong lawyers' financial constraints. For exposition, the rest of the paper will be focused on the mixed-strategy PBE – Case 1. The formal analysis of Cases 2 and 3 is presented in Appendix B.

Consider, for instance, a policy aimed at reducing the lawyer's financial cost of loans r. It is simple to show that a reduction in r lowers $\tilde{A} = \frac{C_P + (C_P + f_M - x)r}{\gamma}$.[46]

5.1 Effects on Equilibrium Outcomes

Proposition 12 summarizes the comparative statics results of a reduction in $\tilde{A}$. Our analysis is focused on Case 1.

Proposition 12. *A reduction in $\tilde{A}$: (1) increases the expected litigation loss of the defendant l_D; (2) reduces the probability of an accident λ_D; (3) reduces the (strictly) positive out-of-court*

[46] More generally, a decrease in $\tilde{A}$ might be also generated by a reduction in the plaintiff's litigation costs C_P, a reduction in the filing cost f_M, an increase in the lawyer's share of the plaintiff's gross recovery γ, or an increase in the lawyer's own funds x.

settlement offer S; (4) reduces the probability of a zero offer β; (5) increases the mass of filed cases ζ; and (6) increases the probability of trial ρ if $C_D < \tilde{A}$.[47]

Proof. See Appendix B.

Intuitively, a relaxation of the lawyer's financial constraint (i.e., a reduction in $\tilde{A}$), increases access to justice for true victims by inducing more cases with low A to be filed and less low-damage cases to be dropped (by reducing the likelihood of a zero offer associated with dropping of low-damage cases).[48] Given the asymmetry of information between the plaintiff and the defendant, the higher likelihood of confronting plaintiffs with low A induces the defendant to lower the positive settlement offer, and hence, increases the likelihood of trial and the litigation costs. As a consequence of the negative impact of the higher likelihoods of filing and trial (and higher litigation costs), which are not offset by the positive effect of the lower settlement offer, the defendant's expected loss increases and hence, his expenses on care also increase. This latter effect reduces the likelihood of accident occurrence. These results also hold in Case 3 and across cases.[49]

Figure 2 graphically represents the effects of a change in $\tilde{A}$. The left-hand side graph shows the defendant's expected litigation loss functions $l_D(S)$ and $l'_D(S)$, which correspond to $\tilde{A}$ and $\tilde{A}' < \tilde{A}$, respectively. The right-hand side graph shows the defendant's expected total loss functions L_D and L'_D, which correspond to $\tilde{A}$ and $\tilde{A}' < \tilde{A}$, respectively.

[47]Intuitively, if the defendant's litigation costs are low enough, then a reduction in $\tilde{A}$ increases the probability of trial. This is a sufficient (but not necessary) condition. See the proof in Appendix B for details.

[48]Given that a reduction in $\tilde{A}$ lowers the settlement offer $S > 0$, and given the inverse relationship between a settlement offer $S > 0$ and the probability of making that offer $(1 - \beta)$, the probability of making a zero offer β will decrease.

[49]The analysis also applies to Case 3 and across cases because the algebraic expressions for the equilibrium outcomes are similar across cases. Result (6) may be violated if a shift between cases occurs. This violation becomes immaterial when f_M is infinitely close to f_F because β_1 will converge to β_3. Case 2 is a borderline case. Any change in $\tilde{A}$ will shift the equilibrium from Case 2 to Case 1 or to Case 3.

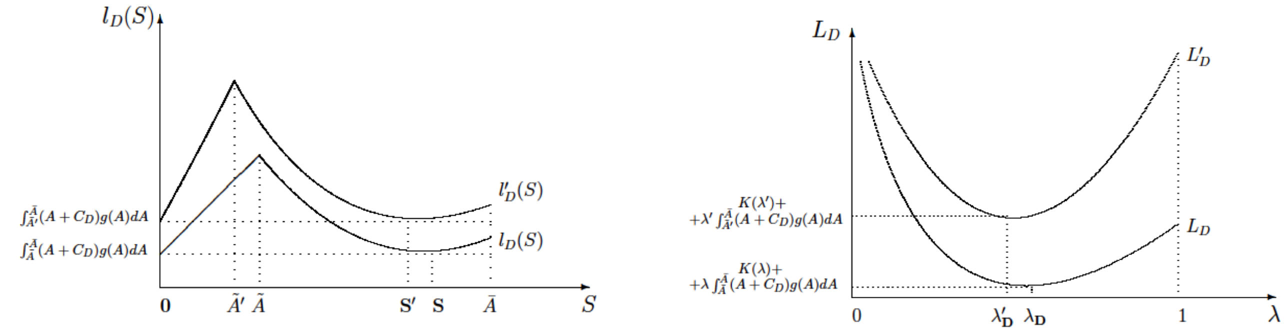

Figure 2: Effects of a Change in $\tilde{A}$ on $l_D(S)$ and L_D

5.2 Effects on Plaintiff's and Attorney's Payoffs

The effects of a cost-reducing policy on the average expected payoffs for the plaintiff and his attorney are generally ambiguous. They depend on the value of A relative to the old and new thresholds and the old and new equilibrium positive offers.[50]

Let $\tilde{A}' < \tilde{A}$ and $S' < S$ denote the new threshold and the new equilibrium offer, respectively. Table 2 summarizes the five possible cases. For each case, the first and second column refer to the old and new position of A, respectively.

5.2.1 Effects on Plaintiff's Payoff

Our discussion will be focused on the cases in which the plaintiff's expected payoff is affected by a cost-reducing policy. Appendix B presents the discussion of all cases. Some initially low-damage plaintiffs are better off. Specifically, in the second case ($0 < A < \tilde{A}$ and $A > \tilde{A}'$), the plaintiff can now proceed to trial and get a strictly positive payoff. Before the policy, the case was dropped (a zero offer was accepted). However, some high-damage plaintiffs are worse off. In the third case ($\tilde{A} < A < S$ and $\tilde{A}' < A < S'$), the positive effect of an increase in the probability of a strictly positive offer less than offsets the negative effect of a reduction in the strictly positive offer. As a result, the plaintiff's expected payoff is reduced. Similarly, in the fourth case ($\tilde{A} < A < S$ and $A > S'$), the plaintiff is worse off. He now proceeds to trial with certainty and gets an award equal to A. Then, a generous expected payoff (due to a settlement offer greater than A) is now

[50]See Section 2.2.1 in Appendix B for details.

Table 2: Effects of a Cost-Reducing Policy on Plaintiff's and Attorney's Payoffs

Plaintiff's Type Position		Payoff Effect	
Before Policy	After Policy	Π_P	Π_{PA}
$0 < A < \tilde{A}$	$0 < A < \tilde{A}'$	0	0
$0 < A < \tilde{A}$	$A > \tilde{A}'$	+	+
$\tilde{A} < A < S$	$\tilde{A}' < A < S'$	−	+/−/0
$\tilde{A} < A < S$	$A > S'$	−	+/−/0
$A > S$	$A > S'$	0	+

Notes: Π_A and Π_{PA} denote the expected payoff for the plaintiff and his attorney; +, −, and 0 denote positive change, negative change, and no effect, respectively.

replaced with a lower payoff.

5.2.2 Effects on Attorney's Payoff

The attorney's expected payoff depends directly on C_P, f_M, and r, which also affect $\tilde{A}$. Then, only an evaluation of the effects of individual factors can be implemented. Consider the effect of a reduction in the lawyer's financial cost r. Our discussion will be focused on the cases in which the attorney is unequivocally better off. Appendix B presents the discussion of all cases. Our analysis suggests that only in the second and fifth cases, the attorney is unequivocally better off. Consider the second case ($0 < A < \tilde{A}$ and $A > \tilde{A}'$). The initially low-damage case can now proceed to trial. Then, a zero offer is replaced with a strictly positive offer. This effect is aligned with the effect of a cost-reducing policy on the plaintiff's payoff. Consider now the fifth case ($A > S$ and $A > S'$). The high-damage case proceeds to trial, before and after the reduction in r. Due to the reduction in the financial cost r, the attorney's expected payoff increases.

Corollary 3. *If a cost-reducing policy allows initially low-damage plaintiffs to proceed to trial (Table 2, second case), then both the plaintiff and his attorney are unambiguously better off. Access to justice for true victims is also enhanced.*

6 Welfare Analysis: Effects of a Cost-Reducing Policy

This section presents the welfare analysis of a cost-reducing policy for the mixed-strategy PBE with an interior solution – Case 1. The main qualitative findings also hold for Case 3. This analysis is presented in Appendix B (Section 2.2.4).[51]

6.1 Definitions

Formal definitions of the social welfare components follow.

Consider the "No-Access to Justice" component η in Case 1. Given Definition 2,

$$\eta = \left[\int_0^{\tilde{A}} g(A)dA - \nu \right] + \nu\beta. \tag{9}$$

Intuitively, η represents the inability of true victims to get access to justice. It takes into account (1) the mass of low-damage potential plaintiffs who cannot file a lawsuit, $\int_0^{\tilde{A}} g(A)dA - \nu$;[52] and, (2) the mass of low-damage plaintiffs who file a lawsuit but receive a zero offer, and hence, need to drop their cases, $\nu\beta$.

Let $\theta \geq 0$ be the coefficient of conversion of the "No Access to Justice" term η into social welfare loss. In Appendix B (Section 2.2.3), we show that when $\theta = 0$, the social welfare function encompasses the sum of the net expected payoffs for all players.[53] When $\theta > 0$, the social welfare function also accounts for the social value of preserving the citizens' right of access to justice.[54] In Appendix B (Section 2.2.3), we also demonstrate that the minimization of the social welfare loss function is equivalent to the maximization of the social welfare function, across θ values.

[51] Case 2 is a borderline case. Any change in $\tilde{A}$ will shift the equilibrium from Case 2 to Case 1 or to Case 3.

[52] Remember that $\int_0^{\tilde{A}} g(A)dA - \nu = 1 - \zeta = 1 - \left[\int_{\tilde{A}}^{\bar{A}} g(A)dA + \nu \right]$, where ζ is the mass of filed cases.

[53] See Kaplow and Shavell (2002, 2001, 1999) for discussion on social welfare analysis of public policies.

[54] Preserving the right of access to justice is an increasing concern for the U.S. and the international community. The U.S. Department of Justice established the *Access to Justice Initiative* (ATJ) in March 2010. Similarly, the United Nations considered for the first time including Access to Justice as part of its *Sustainable Development Goals* (Goal 16) in 2015. See Kornhauser (2015, 2003) for discussion on economic analysis of law and welfare analysis of public policies. See also Chang (2000). For more general discussion on welfare economics, see Deb et al. (1997), Gibbard (1974), Hillinger and Lapham (1971), Sen (1971, 1970), and Diamond (1967).

Our social welfare analysis will be focused on the minimization of the social welfare loss function under $\theta > 0$.

Definition 3. *The social loss from litigation l_W is defined as follows.*

$$l_W = H + \zeta \bullet f_M + \rho \bullet (C_P + C_D) + \theta\eta =$$

$$= \int_0^{\bar{A}} Ag(A)dA + \left[\int_{\tilde{A}}^{\bar{A}} g(A)dA + \nu\right] f_M + \left[\beta \int_{\tilde{A}}^{\bar{A}} g(A)dA + (1-\beta)\int_S^{\bar{A}} g(A)dA\right](C_P + C_D) +$$
$$+\theta\left[\int_0^{\tilde{A}} g(A)dA - \nu + \nu\beta\right]. \tag{10}$$

The social loss from litigation l_W encompasses four main components: (1) total harm from an accident H; (2) total filing cost, term in f_M; (3) total legal costs incurred in case of trial, term in $(C_P + C_D)$; and, (4) social cost associated with the infringement of some citizens' right of access to justice, represented by the "No Access to Justice" component, term in η.[55]

Definition 4. *The social welfare loss function SWL, evaluated at λ_D, is defined as follows.*

$$SWL(\lambda_D) = K(\lambda_D) + \lambda_D l_W, \tag{11}$$

where l_W is given by equation (10).

The social welfare loss function SWL, evaluated at the privately-optimal probability of an accident λ_D, encompasses two main components: (1) Resources devoted to accident prevention $K(\lambda_D)$; (2) (unconditional) social loss from litigation $\lambda_D l_w$.

Let $\lambda_W = \arg\min\left\{K(\lambda) + \lambda l_W\right\}$ represent the socially-optimal probability of an accident.

Definition 5. *The potential injurer's deterrence level is defined as follows.*

(1) Under-Deterred Potential Injurer: $\lambda_D > \lambda_W$.

(2) Over-Deterred Potential Injurer: $\lambda_D < \lambda_W$.

[55]Note that in equilibrium, some meritorious plaintiffs receive settlement transfers that are greater than the actual damages. These excessive transfers represent payoff redistributions between plaintiffs and defendants. Hence, they should not be included in the definition of social welfare loss from litigation.

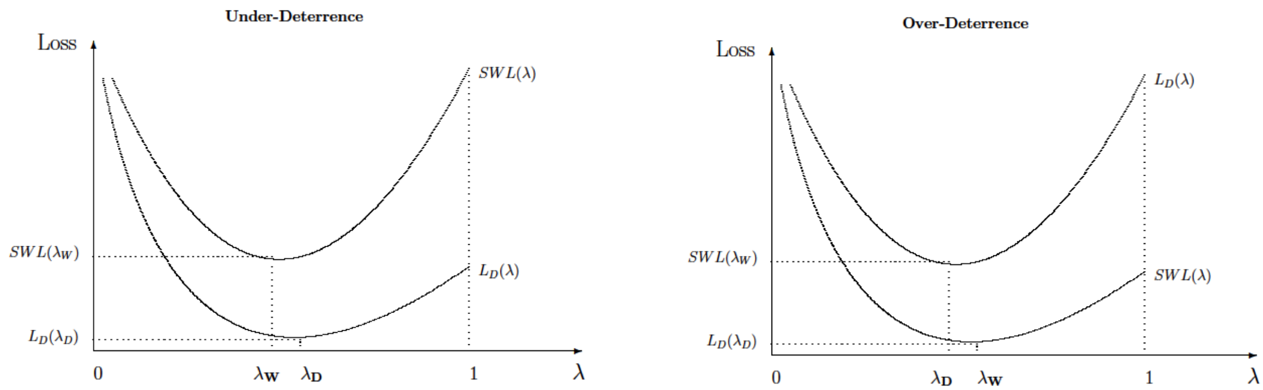

Figure 3: Deterrence

By Proposition 3, $l_D < l_W$ implies under-deterrence, and $l_D > l_W$ implies over-deterrence. Figure 3 depicts the case of over-deterrence and under-deterrence, left- and right-hand sides, respectively.

6.2 Social Welfare Analysis

We analyze the social welfare effect of a cost-reducing policy (i.e., the effect of a reduction in $\tilde{A}$). We will demonstrate that the overall effect of a cost-reducing policy is generally ambiguous. If the positive effect on access to justice for true victims is weak and the potential injurers are overdeterred, then this policy is welfare reducing.[56]

We start our analysis by decomposing the overall welfare effect into two components, indirect and direct effects. The indirect and direct effects capture the impact of a cost-reducing policy on the potential injurer's care-taking incentives, and on the social welfare loss from litigation, respectively. Then, the indirect and direct effects are computed for a given l_W and a given λ_D, respectively.

The overall welfare effect of a reduction in $\tilde{A}$ is given by:

$$\frac{dSWL(\lambda_D)}{d\tilde{A}} = \frac{\partial SWL(\lambda_D)}{\partial \lambda_D}\frac{\partial \lambda_D}{\partial \tilde{A}} + \frac{\partial SWL(\lambda_D)}{\partial \tilde{A}}.$$

The first term in the right-hand side of the equation represents the indirect effect while the second

[56] When $\theta = 0$, a cost-reducing policy will be welfare reducing if the potential injurer is overdeterred. If the potential injurer is underdeterred and the positive effect on deterrence is strong enough, then this policy will be welfare improving.

term represents the direct effect. The direct effect can be computed by explicit differentiation:

$$\frac{\partial SWL(\lambda_D)}{\partial \tilde{A}} = -\lambda_D \frac{(\tilde{A} + C_D)G(\tilde{A})}{S} f_M + \lambda_D (C_P + C_D) \frac{\partial \rho}{\partial \tilde{A}} + \lambda_D \theta \left[\frac{\partial \eta}{\partial \tilde{A}} \right]. \tag{12}$$

To compute the indirect effect, we take into account that at the point of the defendant's optimum, λ_D, the first-order optimality condition implies:

$$\frac{\partial K(\lambda_D)}{\partial \lambda_D} = -l_D.$$

Differentiating the first-order optimality condition with respect to $\tilde{A}$ yields:

$$\frac{\partial \lambda_D}{\partial \tilde{A}} = -\frac{\frac{\partial l_D}{\partial \tilde{A}}}{\frac{\partial^2 K(\lambda_D)}{\partial \lambda_D^2}} = \frac{(\tilde{A} + C_D)G(\tilde{A})}{\frac{\partial^2 K(\lambda_D)}{\partial \lambda_D^2}}.$$

Then, the indirect effect can be written as:

$$\frac{\partial SWL(\lambda_D)}{\partial \lambda_D} \frac{\partial \lambda_D}{\partial \tilde{A}} = \left[\frac{\partial K(\lambda_D)}{\partial \lambda_D} + l_W \right] \frac{(\tilde{A} + C_D)G(\tilde{A})}{\frac{\partial^2 K(\lambda_D)}{\partial \lambda_D^2}} = (l_W - l_D) \frac{(\tilde{A} + C_D)G(\tilde{A})}{\frac{\partial^2 K(\lambda_D)}{\partial \lambda_D^2}}. \tag{13}$$

Hence, the overall welfare effect of a cost-reducing policy can be expressed as:

$$\frac{dSWL(\lambda_D)}{d\tilde{A}} = \left[(l_w - l_D) \frac{(\tilde{A} + C_D)G(\tilde{A})}{\frac{\partial^2 K(\lambda_D)}{\partial \lambda_D^2}} \right] +$$

$$+ \left[-\lambda_D \frac{(\tilde{A} + C_D)G(\tilde{A})}{S} f_M + \lambda_D (C_P + C_D) \frac{\partial \rho}{\partial \tilde{A}} + \lambda_D \theta \left(\frac{\partial \eta}{\partial \tilde{A}} \right) \right]. \tag{14}$$

The first and second terms in brackets represent the indirect and direct effects of a cost-reducing policy, respectively. A detailed analysis of these two effects follows.

Indirect Welfare Effect

The indirect effect, $\left[(l_W - l_D) \frac{(\tilde{A}+C_D)G(\tilde{A})}{\frac{\partial^2 K(\lambda_D)}{\partial \lambda_D^2}} \right]$, is generally ambiguous. It depends on the sign of the term $(l_W - l_D)$, i.e., on the relationship between the social loss from litigation and the defendant's private litigation loss.[57] Intuitively, the indirect welfare effect depends on the potential injurer's deterrence level. The welfare effect will be positive if the potential injurer is under-deterred $l_W > l_D$;[58] otherwise, it will be negative.

[57]Remember that, by assumption, $\frac{\partial^2 K(\lambda_D)}{\partial \lambda_D^2} > 0$.

[58]In this case, a reduction in $\tilde{A}$ will reduce the social welfare loss, and hence, will increase social welfare.

More specifically, the social loss from litigation l_W is given by equation (10), and the defendant's private expected loss from litigation l_D is given by equation (7). Then, the term $(l_W - l_D)$ can be expressed as follows.

$$l_W - l_D = \left[\int_0^{\bar{A}} Ag(A)dA - \int_{\tilde{A}}^{\bar{A}} Ag(A)dA\right] +$$
$$+ \left\{(C_P + C_D)\left[\beta \int_{\tilde{A}}^{\bar{A}} g(A)dA + (1-\beta)\int_S^{\bar{A}} g(A)dA)\right] - C_D \int_{\tilde{A}}^{\bar{A}} g(A)dA\right\} +$$
$$+ \left\{\left[\int_{\tilde{A}}^{\bar{A}} g(A)dA + \nu\right] f_M + \theta\left[\int_0^{\tilde{A}} g(A)dA - \nu + \nu\beta\right]\right\}. \tag{15}$$

The first term in brackets is positive. The third term in curly brackets is also positive.[59] The second term in curly brackets will be positive if f_M is sufficiently lower than γS.[60] In this case, the sign of the term $(l_W - l_D)$ will be unambiguously positive, and hence, the indirect effect of a cost-reducing policy will be welfare enhancing. Otherwise, the indirect effect might be welfare reducing.[61]

Direct Welfare Effect

The direct effect of a cost-reducing policy on social welfare, $\left[-\lambda_D \frac{(\tilde{A}+C_D)G(\tilde{A})}{S} f_M + \lambda_D (C_P + C_D)\frac{\partial\rho}{\partial\tilde{A}} + \lambda_D\theta\left(\frac{\partial\eta}{\partial\tilde{A}}\right)\right]$, is also ambiguous. It depends on the sign of the expression in brackets. Specifically, the direct effect includes two negative welfare effects, the effect of larger case-taking costs (first term in f_M), and the effect of larger litigation costs (second term in $C_P + C_D$; $\frac{\partial\rho}{\partial\tilde{A}} < 0$, by Proposition 9). It also includes a positive welfare effect, the effect on the No-Access to Justice component η. By Lemma 6, the No-Access to Justice component η is increasing in $\tilde{A}$.[62]

Lemma 6. *The No-Access to Justice component η is increasing in $\tilde{A}$.*

Proof. See Appendix A.

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[59] Note that $\eta = \int_0^{\tilde{A}} g(A)dA - \nu + \nu\beta$, which is positive. The third term is also positive when $\theta = 0$.

[60] If $f_M < \gamma S$, then $\beta = 1 - \frac{f_M}{\gamma S}$ will be quite close to unity. Then, $\rho = \beta \int_{\tilde{A}}^{\bar{A}} g(A)dA + (1-\beta)\int_S^{\bar{A}} g(A)dA$ should be sufficiently close to $\int_{\tilde{A}}^{\bar{A}} g(A)dA$. Hence, adding C_P to C_D ensures that the second term will be positive.

[61] These results also hold when $\theta = 0$.

[62] Lemma 7 in Appendix B shows that this result also holds for Case 3.

This positive effect will offset the negative effects if the value of θ (the coefficient of conversion of the No-Access to Justice term η into social welfare loss) is large enough. In this case, the sign of the expression in brackets will be positive, and hence, the direct effect of a cost-shifting policy will be welfare improving. Otherwise, the indirect effect will be welfare reducing.[63]

Overall Welfare Effect

Proposition 13 summarizes the main welfare results.

Define $\underline{\theta}$ as

$$\underline{\theta} \equiv \frac{\lambda_D \frac{(\tilde{A}+C_D)G(\tilde{A})}{S} f_M - \lambda_D (C_P + C_D) \frac{\partial \rho}{\partial \tilde{A}}}{\lambda_D \frac{\partial \eta}{\partial \tilde{A}}}. \tag{16}$$

Proposition 13. *If the defendant is under-deterred ($l_W > l_D$) and $\theta > \underline{\theta}$, then the welfare effect of a cost-reducing policy is positive; if the defendant is over-deterred ($l_W < l_D$) and $\theta < \underline{\theta}$, then the welfare effect of a cost-reducing policy is negative.*[64]

Proof. See Appendix B.

Figure 4 provides graphical representation. The left-hand side graph depicts the effects of a change in social welfare loss when the defendant is originally over-deterred and the effect on NAJ is not strong enough. The right-hand side graph depicts the effects of a change in social welfare loss when the defendant is originally under-deterred and the effect on NAJ is strong enough.

Our analysis demonstrates that cost-reducing policies might be welfare reducing, and underscores the importance of the potential injurer's deterrence level and the No-Access to Justice component in the assessment of public policies associated with civil litigation.

[63] When $\theta = 0$, the direct effect will be unambiguously welfare reducing. Hence, a cost-reducing policy will be welfare reducing if the potential injurer is overdeterred (i.e., if the indirect effect is also welfare reducing). If the potential injurer is undeterred (i.e., if the indirect effect is welfare improving) and this indirect effect is strong enough, then a cost-reducing policy will be welfare improving.

[64] A sufficiently large (small) value of θ does not necessarily mean that θ should be large (small) in absolute sense. It can be just relatively large (small) compared to $(C_P + C_D)$ and f_M, and still satisfy the condition stated in Proposition 13. For instance, if $(C_P + C_D)$ and f_M become small (large) enough, then $\underline{\theta}$ becomes smaller (larger). As a result, the inequalities described in Proposition 13 will be satisfied for lower (higher) values of θ.

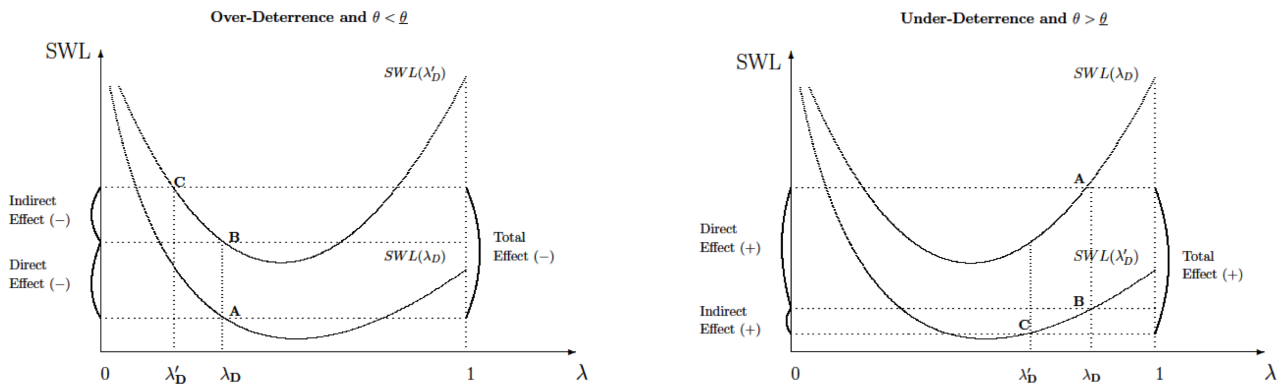

Figure 4: Effects of a Change in $\tilde{\mathrm{A}}$ on SWL

7 Extension: A Cost-Shifting Model

We extend our tractable model to study the welfare effects of a policy that allows attorneys to shift part of the litigation and case-taking costs to their clients. In the benchmark model, the attorney calculates his fee from the client's *gross recovery*, and then deducts expenses out of his own share. In the cost-shifting model, the attorney calculates his fee from the client's *net recovery*. Hence, the attorney effectively shifts a $(1-\gamma)$ portion of the case-related expenses to the plaintiff.

We assume that the plaintiff's litigation costs $C_P = C_P^1 + C_P^2$, where C_P^1 represents case-related litigation expenses that can be shifted to the client.[65] We also assume that the filing cost f_M can be shifted to the client. We denote $\tilde{A}''$ as the damage level at which proceeding and not proceeding to trial provide the same expected payoff for the lawyer, $\gamma(\tilde{A}'' - C_P^1 - f_M) - C_P^2 - (C_P + f_M - x)r = -f_M$. Hence, $\tilde{A}''$ represents the lawyer's financial constraint.

Definition 6. *The lawyer's financial constraint $\tilde{A}''$ is defined as follows.*

$$\tilde{A}'' = C_P^1 + f_M + \frac{C_P^2 + (C_P + f_M - x)r - f_M}{\gamma}.$$

Finally, we assume that the lawyer's financial constraint is common knowledge. In particular, the plaintiff knows that the attorney's financial constraint allows only high-damage cases ($A \geq \tilde{A}''$) to proceed to trial. It is straightforward to verify that $\tilde{A}'' < \tilde{A}$, where $\tilde{A}$ corresponds to the

[65]In the benchmark model, $C_P^1 = 0$, and $C_P = C_P^2$.

threshold value of A under the benchmark model. In other words, a cost-shifting policy reduces the threshold $\tilde{A}$, i.e., relaxes the lawyer's financial constraint. The structure of the equilibrium and comparative statics resemble the benchmark model.[66] The formal analysis is presented in Appendix C (Lemmas 8–9, Propositions 14–15, and proofs).

The rest of the section will be focused on the social welfare analysis for the mixed-strategy PBE with an interior solution – Case 1. We assess the effects of a cost-shifting policy on social welfare by comparing the social welfare loss functions associated with the cost-shifting model and the benchmark model.

Let the terms with and without superscript ($''$) correspond to the equilibrium outcomes for the cost-shifting and the benchmark models, respectively. Let $\Delta = (SWL'' - SWL)$ represent the total welfare effect of a cost-shifting policy. A positive welfare effect will be indicated by $\Delta < 0$. The total welfare effect Δ can be decomposed into direct and indirect effects.

$$\Delta = \{[K(\lambda_D'') + \lambda_D'' l_W''] - [K(\lambda_D) + \lambda_D l_W'']\} + \{[K(\lambda_D) + \lambda_D l_W''] - [K(\lambda_D) + \lambda_D l_W]\} =$$

$$= \{[K(\lambda_D'') + \lambda_D'' l_W''] - [K(\lambda_D) + \lambda_D l_W'']\} + \{\lambda_D (l_W'' - l_W)\}. \tag{17}$$

The first expression in curly brackets, $\{[K(\lambda_D'')+\lambda_D'' l_W'']-[K(\lambda_D)+\lambda_D l_W'']\}$, represents the indirect effect, which operates through changes in the potential injurer's care-taking incentives. The second expression in curly brackets, $\{\lambda_D(l_W'' - l_W)\}$, represents the direct effect, which operates through changes in the social loss from litigation. A detailed analysis of these two effects follows.

Indirect Welfare Effect

The indirect effect of a cost-shifting policy on social welfare, $\{[K(\lambda_D'')+\lambda_D'' l_W'']-[K(\lambda_D)+\lambda_D l_W'']\}$, is generally ambiguous. It depends on the sign of the expression in curly brackets. Intuitively, the indirect welfare effect depends on the potential injurer's deterrence level. By Proposition 15 in Appendix C, $\lambda_D'' < \lambda_D$. Given the assumptions about the function $K(\lambda)$, it is straightforward to show that $K(\lambda) + \lambda l_W''$ is decreasing on the interval $(0, \lambda_W'')$ and increasing on the interval $(\lambda_W'', 1)$. The sign of the expression in curly brackets will be negative when $\lambda_D'' > \lambda_W''$, and hence,

[66] In particular, a cost-shifting policy increases the probability of trial and the mass of filed cases. In addition, this policy increases the expected loss of the defendant, and hence, reduces the probability of an accident.

the indirect effect will be welfare improving. The sign of the expression in curly brackets will be positive when $\lambda''_D < \lambda_D \leq \lambda''_W$, and hence, the indirect effect will be welfare reducing.

The intuition is as follows. Consider first the case where the defendant was initially underdeterred ($\lambda_D > \lambda''_W$) and is still underdeterred under the cost-shifting policy ($\lambda_D > \lambda''_D > \lambda''_W$). The defendant's expected litigation loss conditional on accident occurrence l''_D is lower than the socially optimal litigation loss l''_W. Although the higher private expected litigation loss under the cost-shifting policy forces the potential defendant to increase his spending on care, his level of care is not above the socially optimal. Hence, the indirect effect is welfare improving. Second, consider the case where the defendant was initially overdeterred ($\lambda_D \leq \lambda''_W$). Then, he will be still overdeterred under the cost-shifting policy ($\lambda''_D < \lambda_D \leq \lambda''_W$). Too many resources were initially spent on care, and the situation is aggravated by the cost-shifting policy. Hence, the indirect effect of a cost-shifting policy is welfare reducing.[67]

Direct Welfare Effect

The direct effect of the cost-shifting policy on social welfare, $\lambda_D(l''_W - l_W)$, is also ambiguous. It depends on the sign of the term $(l''_W - l_W)$. This term can be expressed as

$$\begin{aligned} l''_W - l_W = &\left[\int_0^{\bar{A}} Ag(A)dA + \zeta'' \bullet f_M + \rho'' \bullet (C_P + C_D) + \theta\eta''\right] - \\ &-\left[\int_0^{\bar{A}} Ag(A)dA + \zeta \bullet f_M + \rho \bullet (C_P + C_D) + \theta\eta\right] = \\ &= (\zeta'' - \zeta)f_M + (\rho'' - \rho)(C_P + C_D) + \theta(\eta'' - \eta). \end{aligned} \tag{18}$$

The previous equation indicates that a cost-shifting policy affects $(l''_W - l_W)$ in three ways. There are two negative welfare effects that operate through the larger filing cost (due to higher number of true victims filing a lawsuit) and the larger litigation costs (due to the higher conditional probability of trial). A third welfare effect operates through the change in the No-Access to Justice term η.

The effect of a cost-shifting policy on the No-Access to Justice term η is generally ambiguous. On the one hand, η will be lower because of the higher filing and the higher share of true victims

[67]These results also hold when $\theta = 0$.

that can now proceed to trial (higher share of plaintiffs with $A \geq \tilde{A}''$). On the other hand, η might be higher or lower due to the change in the probability of a zero offer β, which is generally ambiguous (by Proposition 15 in Appendix C). The following sufficient condition ensures that a cost-shifting policy decreases β, and hence, decreases η.

$$-\gamma(S'' - S) > (1 - \gamma) f_M. \tag{19}$$

As a result, a cost-shifting policy will unambiguously reduce η. Hence, access to justice for true victims will be enhanced. If the effect on the No-Access to Justice term η offsets the effects on filing and litigation costs, then the sign of the term $l''_W - l_W$ will be negative, and hence, the direct effect of a cost-shifting policy will be welfare enhancing. Otherwise, it will be welfare reducing.[68]

Overall Welfare Effect

If the direct welfare effect of a cost-shifting policy is positive and the defendant is under-deterred, then a cost-shifting policy will be welfare improving. If the positive effect on access to justice is weak and the defendant is overdeterred, then this policy will reduce social welfare. Our analysis suggests that cost-shifting policies should be used with caution.

8 Summary and Conclusions

This article presents a comprehensive economic analysis of legal disputes. Our work provides important methodological contributions to law and economics by generalizing seminal economic models of civil litigation (Katz, 1990; Bebchuk, 1988). Our tractable framework is characterized by asymmetric information, financially-constrained lawyers, third-party lawyer lending, and a continuum of plaintiff's types. The decisions at all the stages associated with a legal dispute are endogeneized. We provide the first formal definition of access to justice and incorporate this concept to the welfare analysis of public policies.

[68] When $\theta = 0$, the direct effect will be unambiguously welfare reducing. Hence, a cost-shifting policy will be welfare reducing if the potential injurer is overdeterred (i.e., if the indirect effect is also welfare reducing). If the potential injurer is undeterred (i.e., if the indirect effect is welfare improving) and this indirect effect is strong enough, then a cost-shifting policy will be welfare improving.

We characterize the two perfect Bayesian equilibrium classes: Mixed- and pure-strategy classes with interior and corner solutions. The existence of one equilibrium class or the other reflects the state of the world regarding the magnitude of financial constraints faced by lawyers and the threat of frivolous lawsuits faced by defendants. In particular, the existence of the mixed-strategy equilibria require either high level of lawyers' financial constraints or high threat of frivolous lawsuits. Our analysis demonstrates that the lawyers' financial constraints permeate every decision made by the parties involved in a legal dispute. Across equilibrium classes, accidents and bargaining impasse are observed. Access to justice is denied to some true victims only under the mixed-strategy equilibria. We provide a formal analysis of two policies: Cost-reducing and cost-shifting policies. We show that these policies might be welfare reducing if their positive effects on access to justice are weak and the potential injurers are overdeterred.

Our paper provides important policy implications. First, our work points to the significance of lawyers' financial constraints for the analysis of legal disputes. Second, our analysis underscores the importance of incorporating access to justice for true victims and deterrence to the overall social welfare analysis of policies associated with legal disputes. In particular, our work informs current policy debate regarding the extension of cost-shifting policies by allowing lawyers to shift the financial costs of loans to their clients. Proponents of this reform have focused on the effects of these policies on access to justice. Our results suggest that a comprehensive assessment of these policies should also consider their effects on care-taking incentives for potential injurers. Given their possible welfare-reducing effects, the implementation of these policies should be carefully evaluated.

In future work, we will extend our tractable model to study the optimal design of contracts between the plaintiff's lawyer and the third-party lender. The new framework will include the third-party lender as a fourth player, and will allow for uncertainty about the outcome at trial in the form of court errors. Recourse and non-recourse loans, as well as other contract terms, will be evaluated. Access to justice for true victims, bargaining impasse, and care-taking incentives for potential injurers will be assessed in this environment. These, and other extensions, remain fruitful areas for future research.

Appendix A

A1. Technical Claims

Claim 1. *Let* $\check{A} \equiv \inf\{A_{filed}\}$*,* $\hat{A} > \check{A} \geq \tilde{A}$*, and that defendant makes a zero offer or an offer* $S \in (0, \tilde{A})$*. Then,* $n(A) = 1$ *for* $A > \check{A}$*.*

Proof. By definition of $\hat{A}$, a case with $A \geq \hat{A}$ is always filed. By assumption, $\hat{A} > \check{A} \geq \tilde{A}$. Then, there are two possible options: (1) Type $\check{A}$ is filed, and (2) type $\check{A}$ is not filed. Let b be the probability that a zero offer or an offer $S_1 \in (0, \check{A})$ is made by the defendant; and $(1 - b)$ be the probability that an offer $S_2 \in [\check{A}, \bar{A}]$ is made by the defendant.[69] By assumption, the defendant makes a zero offer or an offer $S \in (0, \tilde{A})$; then, $b > 0$. A zero offer or an offer $S_1 \in (0, \check{A})$ will be always rejected by a plaintiff with type $\check{A}$. Consider option (1). Given that an attorney with a case $\check{A}$ files a lawsuit by assumption, then it must be the case that his expected payoff is non-negative: $b[\gamma\check{A} - C_P - (C_P + f_M - x)r] + (1 - b)\gamma S_2 - f_M \geq 0$. Then, the expected payoff for an attorney with a case $A > \check{A}$: $b[\gamma A - C_P - (C_P + f_M - x)r] + (1 - b)\gamma S_2 - f_M > 0$. An attorney with a case $A > \check{A}$ will always file a lawsuit. Hence, $n(A) = 1$. Now consider option (2). Given that $\check{A} \equiv \inf\{A_{filed}\}$, in any neighborhood of $\check{A}$, there exists $A_1 > \check{A}$ such that A_1 is filed. Then, all $A > A_1$ are also filed. The neighborhood of $\check{A}$ can be infinitely small. Then, all $A > \check{A}$ are filed. Hence, $n(A) = 1$. ■

Claim 2. *Suppose that condition (2) holds. Suppose that the defendant mixes between a zero offer and a strictly positive offer* $S \in [\tilde{A}, \bar{A}]$*. Then,* $\mu + G(\tilde{A}) > \nu$*.*

Proof. By assumption, the defendant mixes between a zero offer and a strictly positive offer $S \in [\tilde{A}, \bar{A}]$. Then, he must be indifferent between these two offers: $\int_{\tilde{A}}^{\bar{A}} (A + C_D) g(A) dA = \nu S + \int_{\tilde{A}}^{S} S g(A) dA + \int_{S}^{\bar{A}} (A + C_D) g(A) dA$, where the left- and right-hand sides correspond to the defendant's expected litigation loss when he makes a zero offer and an offer $S \in [\tilde{A}, \bar{A}]$, respectively. By condition (2), for any $S \in [\tilde{A}, \bar{A}]$, including the strictly positive offer that satisfies the indifference condition above: $[\mu + G(S)]S > \int_{\tilde{A}}^{S} (A + C_D) g(A) dA$. Then, $[\mu +$

[69] An offer $S_2 \in [\check{A}, \bar{A}]$ must be considered to ensure that an attorney with type $A < \hat{A}$ will file.

$G(\tilde{A})]S + \int_{\tilde{A}}^{S} Sg(A)dA + \int_{S}^{\bar{A}} (A + C_D)g(A)dA > \nu S + \int_{\tilde{A}}^{S} Sg(A)dA + \int_{S}^{\bar{A}} (A + C_D)g(A)dA$, for the strictly positive offer that satisfies the indifference condition above. Hence, $\mu + G(\tilde{A}) > \nu$. ■

A2. Mixed-Strategy PBE with Interior Solution – Additional Proofs

This section assumes that conditions (1)–(4) hold.

Lemma 3. *The system of equations (5)–(6) has a unique solution (S, ν), where $S \in (\tilde{A}, \bar{A})$.*

Proof. Inserting equation (6) into (5) yields $\int_{\tilde{A}}^{S} (A + C_D - S)g(A)dA - S[C_D g(S) - G(S) + G(\tilde{A})] = 0$. After simplification, $\int_{\tilde{A}}^{S} (A + C_D - S)g(A)dA - S[C_D g(S) - G(S) + G(\tilde{A})] = \int_{\tilde{A}}^{S} Ag(A)dA + C_D[G(S) - G(\tilde{A}) - Sg(S)]$. Denote $\Phi(S) \equiv \int_{\tilde{A}}^{S} Ag(A)dA + C_D[G(S) - G(\tilde{A}) - Sg(S)]$. The proof proceeds in several steps: (1) $\Phi(S)$ is continuous on the interval $[\tilde{A}, \bar{A}]$; (2) $\frac{\partial \Phi(S)}{\partial S} > 0$; (3) $\Phi(\tilde{A}) < 0$; (4) $\Phi(\bar{A}) > 0$; (5) $\Phi(S) = 0$ has exactly one solution.

(1) Continuity of $\Phi(S)$ follows from the assumptions about $G(A)$ and $g(A)$ functions. (2) Differentiation and further algebraic transformations yield $\frac{\partial \Phi(S)}{\partial S} = S\left[g(S) - C_D \frac{\partial g(S)}{\partial S}\right] > 0$. The last inequality follows from condition (3). (3) $\Phi(\tilde{A}) = -\tilde{A} C_D g(\tilde{A}) < 0$. (4) By condition (4), $\Phi(\bar{A}) = \int_{\tilde{A}}^{\bar{A}} Ag(A)dA + C_D[1 - G(\tilde{A}) - \bar{A}g(\bar{A})] > 0$. (5) We have showed that $\Phi(S)$ is a strictly increasing and continuous function with $\Phi(\tilde{A}) < 0$ and $\Phi(\bar{A}) > 0$. Hence, there exists a unique $S \in (\tilde{A}, \bar{A})$ such that $\Phi(S) = 0$. By equation (6), existence and uniqueness of S implies existence and uniqueness of ν. ■

Lemma 4. *The difference between the total mass of low- and no-damage cases and the mass of low- and no-damage cases that are filed, $[G(\tilde{A}) - \nu]$, is increasing in $\tilde{A}$.*

Proof. Totally differentiating equation (5) and using equation (6) yield:

$$\frac{\partial \nu}{\partial \tilde{A}} = \frac{(S - \tilde{A} - C_D)g(\tilde{A})}{S}.$$

Hence,

$$\frac{\partial[G(\tilde{A})-\nu]}{\partial\tilde{A}} = g(\tilde{A}) - \frac{\partial\nu}{\partial\tilde{A}} = \frac{(\tilde{A}+C_D)g(\tilde{A})}{S} > 0.$$

■

Proposition 3. *For any positive value of l_D, the function $L_D(\lambda) = K(\lambda) + \lambda l_D$ has a unique interior minimum, $\lambda_D \in (0,1)$, which is decreasing in l_D.*

Proof. By the assumptions on $K(\lambda)$, the first derivative of $L_D(\lambda)$ is continuous and strictly increasing, negative when λ approaches zero, and positive when λ approaches 1. Hence, $L_D(\lambda)$ has a unique interior minimum, λ_D. Totally differentiating the first derivative of $L_D(\lambda)$, $\frac{\partial^2 K(\lambda)}{\partial\lambda^2}d\lambda + dl_D = 0$. Hence, $\frac{\partial\lambda}{\partial l_D} = -\frac{1}{\frac{\partial^2 K(\lambda)}{\partial\lambda^2}} < 0$. ■

Proposition 4. *In equilibrium, the defendant's posterior beliefs are as follow. (1) Case 1: $P(A=0|Filing) = 0$, $P(0 < A < \tilde{A}|Filing) = \frac{\nu}{\nu+1-G(\tilde{A})}$, $P(\tilde{A} \leq A \leq y|Filing) = \frac{G(y)-G(\tilde{A})}{\nu+1-G(\tilde{A})}$ for any $y \in [\tilde{A}, \bar{A}]$. Case 2: $P(A=0|Filing) = 0$, $P(0 < A \leq y|Filing) = G(y)$ for any $y \in (0, \bar{A}]$. Case 3: $P(A=0|Filing) = \frac{\nu-G(\tilde{A})}{\nu+1-G(\tilde{A})}$, $P(0 < A \leq y|Filing) = \frac{G(y)}{\nu+1-G(\tilde{A})}$ for any $y \in (0, \bar{A}]$.*

Proof. In Case 1, all high-damage cases and a subset of low-damage cases are filed, and no-damage cases are not filed. The mass of high-damage cases that are filed is equal to the total mass of high-damage cases, $1 - G(\tilde{A})$. ν includes only the subset of low-damage cases that are filed. Therefore, the total mass of filed cases is $1 - G(\tilde{A}) + \nu$. As no-damage cases are not filed, the posterior (conditional on filing) probability of a no-damage case is 0, the posterior probability of an average low-damage case is $\frac{\nu}{1-G(\tilde{A})+\nu}$, while the posterior probability of an average high-damage case is $\frac{1-G(\tilde{A})}{1-G(\tilde{A})+\nu}$. Given that all high-damage cases are filed and the distribution $G(A)$ is known by the defendant, he computes the posterior probability for any range of high-damage cases as the product of conditional probability for this particular range (conditional on a case being a high-damage case) and the posterior probability of a high-damage case. Hence, for any $y \in (\tilde{A}, \bar{A}]$, $P(\tilde{A} < A \leq y|Filing) = \frac{G(y)-G(\tilde{A})}{1-G(\tilde{A})}\frac{1-G(\tilde{A})}{1-G(\tilde{A})+\nu} = \frac{G(y)-G(\tilde{A})}{1-G(\tilde{A})+\nu}$. In Case 2, all high- and low-damage cases are filed, and no-damage cases are not filed. The mass of filed cases (low-damage and high-damage cases) equals 1. Therefore, the posterior (conditional on filing) distribution of types is described by the cdf $G(A)$. Hence, for any $y \in (0, \bar{A}]$, $P(0 < A \leq y|Filing) = G(y)$. In Case 3, all high- and low-damage cases are filed, and $\nu - G(\tilde{A})$ of no-damage cases are filed. This is why the total mass of filed cases is $1 - G(\tilde{A}) + \nu$. Therefore, the posterior probability of a no-damage case is $\frac{\nu - G(\tilde{A})}{1-G(\tilde{A})+\nu}$, and the posterior probability of a meritorious case (high-damage or low-damage case) is $\frac{1}{1-G(\tilde{A})+\nu}$. Given that all meritorious cases are filed and the distribution $G(A)$ is known by the defendant, he computes the posterior probability for any range of meritorious cases as the product of conditional probability for this particular range (conditional on a case being a meritorious case) and the posterior probability of a meritorious case. Hence, for any $y \in (0, \bar{A}]$, $P(0 < A \leq y|Filing) = G(y)\frac{1}{1-G(\tilde{A})+\nu} = \frac{G(y)}{1-G(\tilde{A})+\nu}$. In Case 4, given that all cases are filed, the defendant cannot update his beliefs upon observing filing. Hence, his posterior and prior beliefs are the same. The defendant's equilibrium beliefs are as follows. $P(A = 0|Filing) = \frac{\mu}{1+\mu}$; for any $y \in (\tilde{A}, \bar{A}]$, $P(0 < A \leq y|Filing) = \frac{G(y)}{1+\mu}$. ■

A3. Pure-Strategy PBE with Interior Solution – Proofs

This section assumes that conditions (1), (2A), (3) and (4A) hold.

Proposition 5. *The equilibrium settlement offer $S \in (\tilde{A}, \bar{A})$, implicitly defined by $\mu + G(S) = C_D g(S)$, exists and is unique.*

Proof: First, it is simple to show that offers greater than $\bar{A}$ are strictly dominated by an offer equal to $\bar{A}$. Similarly, offers $S \in (0, \tilde{A})$ are not in the set of equilibrium offers. These proofs follow the logic applied in Lemma 1. Second, we will demonstrate that a zero offer cannot be an equilibrium offer in pure strategy. Suppose not. The defendant always makes a zero offer in equilibrium. Then, only cases with types $A \geq \hat{A}$ will be filed. When facing a plaintiff of a type $\hat{A} \leq A \leq \hat{A} + \epsilon$, the defendant's expected litigation loss will be lower by offering $\hat{A} + \epsilon$, where $\epsilon > 0$ (small number): $\int_{\hat{A}}^{\hat{A}+\epsilon}(\hat{A}+\epsilon)g(A)dA < \int_{\hat{A}}^{\hat{A}+\epsilon}(A+C_D)g(A)dA$, when $C_D > \epsilon$. Contradiction follows. Hence, a zero offer cannot be an equilibrium offer in pure strategy.

Third, we will show that a mixed-strategy with a zero offer and an offer $S \in [\tilde{A}, \bar{A}]$ is not in the set of equilibrium offers.[70] Suppose not. The defendant mixes between a zero offer and

[70] S might be non-unique, i.e., multiple S might be made in equilibrium with positive probabilities.

a strictly positive offer $S \in [\tilde{A}, \bar{A}]$ in equilibrium. Following the logic applied in the proof of Lemma 2, we can establish that all cases with $A \geq \tilde{A}$ and some low-damage cases must be filed. Then, the defendant's expected litigation loss, which is the same under both offers, is: $\nu S + \int_{\tilde{A}}^{S} Sg(A)dA + \int_{S}^{\bar{A}}(A+C_D)g(A)dA = \int_{\tilde{A}}^{\bar{A}}(A+C_D)g(A)dA$. When the defendant offers a unique $S_1 \in [\tilde{A}, \bar{A}]$, all cases are filed. His expected litigation loss is $[\mu + G(S_1)]S_1 + \int_{S_1}^{\bar{A}}(A+C_D)g(A)dA$. By condition (2A), there exists $S_1 \in [\tilde{A}, \bar{A}]$ such that, $[\mu + G(S_1)]S_1 < \int_{\tilde{A}}^{S_1}(A+C_D)g(A)dA$. Then, $[\mu + G(S_1)]S_1 + \int_{S_1}^{\bar{A}}(A+C_D)g(A)dA < \int_{\tilde{A}}^{\bar{A}}(A+C_D)g(A)dA$, where the left- and right-hand sides represent the defendant's expected litigation loss when he makes an offer $S_1 \in [\tilde{A}, \bar{A}]$ and when he mixed between a zero offer and a strictly positive offer $S \in [\tilde{A}, \bar{A}]$, respectively. The defendant is better off, and then, will always deviate to offer $S_1 \in [\tilde{A}, \bar{A}]$. Contradiction follows. Hence, a mixed strategy with a zero offer and a strictly positive offer $S \in [\tilde{A}, \bar{A}]$ cannot be in set of equilibrium offers.

From the previous analysis, we conclude that the set of equilibrium offers might only involve a pure strategy with an offer $S \in [\tilde{A}, \bar{A}]$ or a mixed strategy with multiple offers $S \in [\tilde{A}, \bar{A}]$. Fourth, we will show that the equilibrium offer $S \in [\tilde{A}, \bar{A}]$ exists and is unique. Under both, the pure and mixed strategies, the defendant's expected litigation loss $l_D(S) = [\mu + G(S)]S + \int_{S}^{\bar{A}}(A+C_D)g(A)dA$, by condition (1). Minimization of $l_D(S)$ yields the first-order condition: $\mu + G(S) = C_D g(S)$. By condition (3), the second derivative $g(S) - C_D \frac{\partial g(S)}{\partial S} > 0$, for all $S \in [\tilde{A}, \bar{A}]$. Then, the function is strictly convex, and has a unique minimum. Hence, the set of equilibrium offers must involve a unique offer $S \in [\tilde{A}, \bar{A}]$. Fifth, we will demonstrate that the equilibrium offer is interior, $S \in (\tilde{A}, \bar{A})$. There are three possible options for a unique minimum of the function $l_D(S) = [\mu + G(S)]S + \int_{S}^{\bar{A}}(A+C_D)g(A)dA$. (1) The function $l_D(S)$ is strictly increasing on the interval $[\tilde{A}, \bar{A}]$; it achieves a unique corner minimum at $S = \tilde{A}$. (2) The function $l_D(S)$ is strictly decreasing on the interval $[\tilde{A}, \bar{A}]$; it achieves a corner minimum at $S = \bar{A}$. (3) The function $l_D(S)$ achieves a unique interior minimum on the interval $[\tilde{A}, \bar{A}]$; the value of S is implicitly defined by the first-order condition. Consider option (1). When $S = \tilde{A}$, all cases are filed, by condition (1). Then, the defendant is better off by making a zero offer: $[\mu + G(\tilde{A})]\tilde{A} + \int_{\tilde{A}}^{\bar{A}}(A+C_D)g(A)dA > \int_{\tilde{A}}^{\bar{A}}(A+C_D)g(A)dA$, where the right-hand side term corresponds to the defendant's expected litigation loss from making a zero offer. Contradiction follows. Hence, an offer $S = \tilde{A}$ cannot be an equilibrium offer. Consider options (2) and (3). The necessary and sufficient conditions for options (2) and (3) to occur are $\lim_{S\to\bar{A}^-} \frac{\partial l_D(S)}{\partial S} = 1+\mu - C_D g(\bar{A}) \leq 0$, and $\lim_{S\to\bar{A}^-} \frac{\partial l_D(S)}{\partial S} = 1+\mu - C_D g(\bar{A}) > 0$, respectively. By condition (4A), $\lim_{S\to\bar{A}^-} \frac{\partial l_D(S)}{\partial S} = 1+\mu - C_D g(\bar{A}) > 0$. Hence, the function has an interior minimum $S \in (\tilde{A}, \bar{A})$. ■

Proposition 6. *In equilibrium, all cases are filed. Then,* $\zeta = \mu + 1$.

Proof. We demonstrated that the equilibrium settlement offer is $S \in (\tilde{A}, \bar{A})$. By condition (1), attorneys with high-, low- and no-damage cases will get strictly positive expected payoffs. Then, all cases will be filed. Hence, $\nu = \mu + G(\tilde{A})$ and the total filed cases $\zeta = \mu + 1$, in equilibrium. ■

Corollary 2. *In equilibrium, the defendant's expected litigation loss* l_D *is* $l_D(S) = [\mu + G(S)]S + \int_S^{\bar{A}} (A + C_D) g(A) dA$.

Proposition 7. *The defendant's equilibrium probability of an accident* $\lambda_D = \arg\min L_D$ *exists, is unique, and is decreasing in* l_D.

Proof. Apply the logic used in the proof of Proposition 3. ■

Proposition 8. *In equilibrium, the defendant's prior and posterior beliefs are the same.*

Proof. Given that all cases are filed, the defendant cannot update his beliefs upon observing filing. Hence, his posterior and prior beliefs are the same. The defendant's equilibrium beliefs are as follows. $P(A = 0|Filing) = \frac{\mu}{1+\mu}$; for any $y \in (\tilde{A}, \bar{A}]$, $P(0 < A \leq y|Filing) = \frac{G(y)}{1+\mu}$. ■

Figure 5. Figure 5 presents a graphical representation of the optimal decision of the defendant at the litigation stage. It depicts the defendant's expected litigation loss function $l_D(S)$ for $S \in [0, \bar{A}]$. We construct this function by keeping he equilibrium mass of filing cases $\zeta = [\mu + G(\tilde{A})] + \int_{\tilde{A}}^{\bar{A}} g(A) dA$ constant.

$$l_D(S) = \begin{cases} [\mu + G(\tilde{A})]S + \int_{\tilde{A}}^{\bar{A}} (A + C_D) g(A) dA & \text{if } S \in [0, \tilde{A}) \\ [\mu + G(\tilde{A})]S + \int_{\tilde{A}}^{S} S g(A) dA + \int_S^{\bar{A}} (A + C_D) g(A) dA & \text{if } S \in [\tilde{A}, \bar{A}] \end{cases}$$

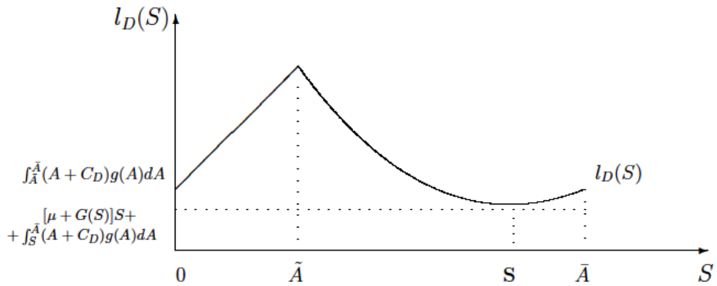

Figure 5: $\mathbf{l_D(S)}$ for Pure-Strategy PBE with Interior Solution

When $S \in [0, \tilde{A})$, the function is linear and upward-sloping, with a corner minimum at the zero offer. When $S \in [\tilde{A}, \bar{A}]$, $l_D(S)$ is strictly convex and achieves a unique interior minimum (by conditions (3) and (4A)). The defendant's expected litigation loss at the optimal strictly positive offer S is lower than the value of the function at a zero offer. Hence, in equilibrium, the defendant makes a unique strictly positive (interior) offer $S \in (\tilde{A}, \bar{A})$.

A4. Boundary PBE with Interior Solution – Proofs

This section assumes that conditions (1), (2B), (3) and (4) hold.

Lemma 5. *Assume that all cases are filed and that $S \in [\tilde{A}, \bar{A}]$. Then, condition (4) implies condition (4A).*

Proof. Suppose not. Condition (4) does not imply condition (4A). Assume that condition (4) holds and $1 + \mu - C_D g(\bar{A}) \leq 0$. Assume also that all cases are filed and $S \in [\tilde{A}, \bar{A}]$. The defendant's expected litigation loss is $l_D(S) = [\mu + G(S)]S + \int_S^{\bar{A}}(A + C_D)g(A)dA$. Given the strict convexity of the defendant's expected litigation loss function, ensured by condition (3), and that $1 + \mu - C_D g(\bar{A}) \leq 0$, then the defendant's expected litigation loss function achieves a corner minimum $S = \bar{A}$ on the interval $[\tilde{A}, \bar{A}]$. By condition (2B), $\int_{\tilde{A}}^{\bar{A}}(A + C_D)g(A)dA = (1 + \mu)\bar{A}$. Therefore, $(1 + \mu)\bar{A} - C_D\bar{A}g(\bar{A}) = \int_{\tilde{A}}^{\bar{A}}(A + C_D)g(A)dA - C_D\bar{A}g(\bar{A}) = \int_{\tilde{A}}^{\bar{A}} Ag(A)dA + C_D[1 - G(\tilde{A}) - \bar{A}g(\bar{A})] \leq 0$, which contradicts the assumption that condition (4) holds. Hence, condition (4) implies condition (4A). ■

Proposition 9. *In equilibrium, the defendant mixes between proposing a zero offer with proba-*

bility $\beta \in [0, 1 - \frac{f_F}{\gamma S})$ and proposing an offer $S \in (\tilde{A}, \bar{A})$, implicitly defined by $\mu + G(S) = C_D g(S)$, with the complementary probability; and, all cases are filed by the plaintiff's attorney.

Proof: First, it is simple to show that offers greater than $\bar{A}$ are strictly dominated by an offer equal to $\bar{A}$. Second, following the logic applied in the proof of Lemma 1, we can demonstrate that offers $S \in (0, \tilde{A})$ are not in the set of equilibrium offers. Third, we will show that a zero offer cannot be the only equilibrium offer. Suppose not. The defendant always makes a zero offer in equilibrium. Then, only cases with types $A \geq \hat{A}$ will be filed. When facing a plaintiff of a type $\hat{A} \leq A \leq \hat{A} + \epsilon$, the defendant's expected litigation loss will be lower by offering $\hat{A} + \epsilon$: $\int_{\hat{A}}^{\hat{A}+\epsilon}(\hat{A}+\epsilon)g(A)dA < \int_{\hat{A}}^{\hat{A}+\epsilon}(A+C_D)g(A)dA$, when $C_D > \epsilon$. Contradiction follows. Hence, a zero offer cannot be the only equilibrium offer. From the previous analysis, we conclude that the set of equilibrium offers might only involve three possible options: (1) a mixed strategy with multiple offers $S \in [\tilde{A}, \bar{A}]$; (2) a mixed strategy with a zero offer and a strictly positive offer $S \in [\tilde{A}, \bar{A}]$; or, (3) a pure strategy with a strictly positive offer $S \in [\tilde{A}, \bar{A}]$. Fifth, we will show that only options (2) or (3) might occur in equilibrium, and that the strictly positive offer involves an interior solution. Option (1) is ruled out by condition (3). Options (2) and (3) are aligned with condition (2B). Hence, either option 2 or option 3 might occur in equilibrium.

Sixth, we will show that, in equilibrium, $\nu = \mu + G(\tilde{A})$. Consider the pure-strategy equilibrium with a unique strictly positive offer $S \in [\tilde{A}, \bar{A}]$. Following the logic applied in the proof of Proposition 6, we conclude that in the pure-strategy equilibrium, all low- and no-damage cases must be filed. Consider now the mixed-strategy equilibrium with a zero offer and a strictly positive offer $S \in [\tilde{A}, \bar{A}]$. Suppose that $\nu < \mu + G(\tilde{A})$. Using the logic applied in the proof of Lemma 2, we can show that all high-damage cases and at least some low-damage cases must be filed. The indifference condition implies $\nu S + \int_{\tilde{A}}^{S} Sg(A)dA + \int_{S}^{\bar{A}}(A + C_D)g(A)dA = \int_{\tilde{A}}^{\bar{A}}(A + C_D)g(A)dA$, at the strictly positive offer S that minimizes the expected litigation loss of the defendant, $l_D(S) = \nu S + \int_{\tilde{A}}^{S} Sg(A)dA + \int_{S}^{\bar{A}}(A+C_D)g(A)dA$. By assumption $\nu < \mu + G(\tilde{A})$. Then, for any $S \in [\tilde{A}, \bar{A}]$, $\nu S + \int_{\tilde{A}}^{S} Sg(A)dA + \int_{S}^{\bar{A}}(A+C_D)g(A)dA < \mu S + G(\tilde{A})S + \int_{\tilde{A}}^{S} Sg(A)dA + \int_{S}^{\bar{A}}(A + C_D)g(A)dA$. Therefore, for any $S \in [\tilde{A}, \bar{A}]$, $\mu S + G(\tilde{A})S + \int_{\tilde{A}}^{S} Sg(A)dA + \int_{S}^{\bar{A}}(A + C_D)g(A)dA > \int_{\tilde{A}}^{\bar{A}}(A+C_D)g(A)dA$, or, $[\mu + G(\tilde{A})]S - \int_{\tilde{A}}^{S}(A+C_D)g(A)dA > 0$, which contradicts condition (2B). Then, in the mixed-strategy equilibrium, all low- and no-damage cases must be filed. Seventh, we will demonstrate that all high-damage cases must be filed in equilibrium. Following the logic used in the proofs of Lemma 2 and Proposition 6, it is simple to show that the expected payoff for an attorney with a high-damage case $\beta[\gamma A - C_P - (C_P + f_M - x)r] + (1-\beta)\gamma S - f_M$ is non-negative when $\beta > 0$ and $A = \tilde{A}$; and, strictly positive when $\beta > 0$ and $A > \tilde{A}$, and when $\beta = 0$. Then, all high-damage cases are filed in equilibrium. Hence, in equilibrium, $\zeta = \mu + 1$.

Eighth, by Lemma 5, condition (4) implies condition (4A). Hence, by condition (4), $S \in (\tilde{A}, \bar{A})$, in the mixed- and the pure-strategy equilibria. The proof follows the logic applied in the proofs of Lemma 3 and Proposition 5.

Ninth, we will demonstrate that, in equilibrium, $\beta \in [0, 1 - \frac{f_F}{\gamma S})$. We just showed that in equilibrium, all low- and no-damage cases are filed. Then, the expected payoff for an attorney with low- or no-damage client should be strictly positive. The expected payoff for an attorney with a no-damage client will allow us to compute the equilibrium β: $\beta \bullet 0 + (1-\beta)\gamma S - f_F > 0$. Then, the probability of a strictly positive offer, $1 - \beta > \frac{f_F}{\gamma S}$, and the probability of a zero offer $\beta \in [0, 1 - \frac{f_F}{\gamma S})$. Given that $f_F > f_M$, then, the expected payoff for an attorney with a low-damage client $\beta \bullet 0 + (1-\beta)\gamma S - f_M > 0$. ■

Corollary 3. In equilibrium, the defendant's expected litigation loss l_D is $l_D(S) = [\mu + G(S)]S + \int_S^{\bar{A}} (A + C_D) g(A) dA$.

Proposition 10. *The defendant's equilibrium probability of an accident* $\lambda_D = \arg\min\{K(\lambda) + \lambda l_D(S)\}$ *exists, is unique, and is decreasing in* l_D.

Proof. Apply the logic used in the proof of Proposition 3. ■

Proposition 11. *In equilibrium, the defendant's prior and posterior beliefs are the same.*

Proof. Apply the logic used in the proof of Proposition 8. ■

A5. Welfare Analysis: Effects of a Cost-Reducing Policy – Additional Proof

This section assumes that conditions (1)–(4) hold.

Lemma 6. *The No-Access to Justice component* η *is increasing in* $\tilde{A}$.

Proof. $\eta = \left[\int_0^{\tilde{A}} g(A)dA - \nu\right] + \nu\beta.$

$$\frac{\partial \eta}{\partial \tilde{A}} = g(\tilde{A}) - \frac{\partial \nu}{\partial \tilde{A}} + \frac{\partial \nu}{\partial \tilde{A}}\beta + \frac{\partial \beta}{\partial \tilde{A}}\nu = g(\tilde{A}) - \frac{(S - \tilde{A} - C_D)}{S} g(\tilde{A}) \frac{f_M}{\gamma S} + \frac{\partial \beta}{\partial \tilde{A}}\nu >$$

$$> g(\tilde{A}) - g(\tilde{A}) \left[1 - \frac{(\tilde{A} + C_D)}{S}\right] + \frac{\partial \beta}{\partial \tilde{A}}\nu > 0.$$

■

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[FOR ONLINE PUBLICATION]

FINANCIALLY-CONSTRAINED LAWYERS: AN ECONOMIC THEORY OF LEGAL DISPUTES

SUPPLEMENTARY MATERIAL: APPENDICES B AND C

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1 Introduction

This document presents the supplementary material for our paper "Financially-Constrained Lawyers: An Economic Theory of Legal Disputes." Two appendices are included: Appendix B and Appendix C. The specific material included in each appendix is outlined below.

Appendix B: Benchmark Model – Supplementary Material

- Main Material
  - Propositions $1'$, $5'$, $9'$, 12, and 13, and Lemma $5'$ and Proofs
- Additional Material
  - Equilibrium Outcomes and Payoffs
  - Effects of a Cost-Reducing Policy on Plaintiff's and Attorneys' Payoffs.
  - Social Welfare Function
  - Welfare Effects of a Cost-Reducing Policy
  - Lemma 7 and Proof

Appendix C: Cost-Shifting Model – Supplementary Material

- Main Material
  - Technical Conditions.
  - Lemmas 8–9 and Proofs
  - Propositions 14–15 and Proofs
- Additional Material
  - Equilibrium Outcomes and Payoffs
  - Effects of a Cost-Shifting Policy on Equilibrium Plaintiff's and Attorney's Payoffs

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2 Appendix B: Benchmark Model – Supplementary Material

This appendix presents supplementary material related to the benchmark model.

2.1 Main Material

This section includes the technical conditions associated with the mixed- and pure-strategy PBE with corner solutions, and the proofs of Propositions 1′, 5′, 9′, 12, and 13, and Lemmas 5′ and 6.

2.1.1 Technical Conditions and Propositions

Technical Conditions

The mixed-strategy PBE with a corner solution relies on conditions (1)-(3) and (4′):

$$f_F < \gamma\tilde{A}. \tag{1}$$

$$\min_{\tau\in[\tilde{A},\bar{A}]}\left\{[\mu+G(\tau)]\tau-\int_{\tilde{A}}^{\tau}(A+C_D)g(A)dA\right\}>0 \tag{2}$$

For any $A\in[\tilde{A},\bar{A}]$,

$$g(A)-C_D\frac{\partial g(A)}{\partial A}>0. \tag{3}$$

$$\int_{\tilde{A}}^{\bar{A}}Ag(A)dA+C_D[1-G(\tilde{A})-\bar{A}g(\bar{A})]\leq 0 \tag{4′}$$

The pure-strategy PBE with a corner solution relies on conditions (2A) and (4A), in addition to conditions (1) and (3):

$$\min_{\tau\in[\tilde{A},\bar{A}]}\left\{[\mu+G(\tau)]\tau-\int_{\tilde{A}}^{\tau}(A+C_D)g(A)dA\right\}<0 \tag{2A}$$

$$1+\mu-C_Dg(\bar{A})\leq 0. \tag{4A′}$$

The boundary PBE with a corner solution relies on conditions (2B), in addition to conditions (1), (3), (4′) and (4A′):

$$\min_{\tau\in[\tilde{A},\bar{A}]}\left\{[\mu+G(\tau)]\tau-\int_{\tilde{A}}^{\tau}(A+C_D)g(A)dA\right\}=0 \tag{2B}$$

Propositions and Proofs

Mixed-Strategy PBE with Corner Solution

Proposition 1′. *Assume that conditions (1)–(3) and (4′) hold. Then, the following strategy profile, together with the defendant's beliefs, characterize the mixed-strategy perfect Bayesian equilibrium with a corner solution.*

Case 1: $G(\tilde{A})-\nu>0$

(1) The defendant chooses a probability of accident $\lambda_D=\arg\min\left\{K(\lambda)+\lambda\int_{\tilde{A}}^{\bar{A}}(A+C_D)g(A)dA\right\}$. *If a lawsuit is filed, the defendant mixes between proposing a zero offer with probability* $\beta=1-\frac{f_M}{\gamma S}$ *and proposing an offer* $S=\bar{A}$ *with the complementary probability.*

(2) A high-damage case is always filed by the plaintiff's attorney; an average low-damage case is filed with probability $\frac{\nu}{G(\tilde{A})}$; *a no-damage case is never filed.*

(3) A high-damage plaintiff always rejects a zero offer and accepts an offer $S=\bar{A}$ *only if* $A\leq\bar{A}$; *a low-damage plaintiff always accepts an offer* $S=\bar{A}$; *a no-damage plaintiff always accepts an offer* $S=\bar{A}$.

(4) The defendant's equilibrium beliefs are as follows. When the defendant observes a lawsuit, he believes that $P(A=0)=0$, $P(0<A<\tilde{A})=\frac{\nu}{\nu+1-G(\tilde{A})}$, $P(\tilde{A}\leq A\leq y)=\frac{G(y)-G(\tilde{A})}{\nu+1-G(\tilde{A})}$ for any $y\in[\tilde{A},\bar{A}]$.

Case 2: $G(\tilde{A})-\nu=0$

(1) The defendant chooses a probability of accident $\lambda_D=\arg\min\left\{K(\lambda)+\lambda\int_{\tilde{A}}^{\bar{A}}(A+C_D)g(A)dA\right\}$. If a lawsuit is filed, the defendant mixes between proposing a zero offer with probability $\beta\in(1-\frac{f_F}{\gamma S},1-\frac{f_M}{\gamma S})$ and proposing an offer $S=\bar{A}$ with the complementary probability.

(2) A high-damage case is always filed by the plaintiff's attorney; a low-damage case is always filed; a no-damage case is never filed.

(3) A high-damage plaintiff always rejects a zero offer and accepts an offer $S=\bar{A}$ only if $A\leq\bar{A}$; a low-damage plaintiff always accepts an offer $S=\bar{A}$; a no-damage plaintiff always accepts an offer $S=\bar{A}$.

(4) The defendant's equilibrium beliefs are as follows. When the defendant observes a lawsuit, he believes that $P(A=0)=0$, $P(0<A\leq y)=G(y)$ for any $y\in(0,\bar{A}]$.

Case 3: $G(\tilde{A})-\nu<0$ *and* $\nu<\mu+G(\tilde{A})$

(1) The defendant chooses a probability of accident $\lambda_D=\arg\min\left\{K(\lambda)+\lambda\int_{\tilde{A}}^{\bar{A}}(A+C_D)g(A)dA\right\}$. If the plaintiff files a lawsuit, the defendant mixes between proposing a zero offer with probability $\beta=1-\frac{f_F}{\gamma S}$ and proposing an offer $S=\bar{A}$ with the complementary probability.

(2) A high-damage case is always filed by the plaintiff's attorney; a low-damage case is always filed; a no-damage case is filed with probability $\frac{\nu-G(\tilde{A})}{\mu}$.

(3) A high-damage plaintiff always rejects a zero offer and accepts an offer $S=\bar{A}$ only if $A\leq\bar{A}$; a low-damage case plaintiff always accepts an offer $S=\bar{A}$; a no-damage plaintiff always accepts an offer $S=\bar{A}$.

(4) The defendant's equilibrium beliefs are as follows. When the defendant observes a lawsuit, he believes that $P(A=0)=\frac{\nu-G(\tilde{A})}{\nu+1-G(\tilde{A})}$, $P(0<A\leq y)=\frac{G(y)}{\nu+1-G(\tilde{A})}$ for any $y\in(0,\bar{A}]$.

Proof. The proof consists of several steps.

Step 1. We will first demonstrate that that offers greater than $\bar{A}$ and offer $S\in(0,\tilde{A})$ are not in the set of equilibrium offers. Second, we will show that a zero offer must be in the set of equilibrium offers. Third, we will demonstrate that a zero offer cannot be the only equilibrium offer: At least one strictly positive offer $S\in[\tilde{A},\bar{A}]$ must be in the set of equilibrium offers, in addition to a zero offer. The proofs follow the logic applied in the proof of Lemma 1.

Step 2. We will show that there must be some low-damage cases that are filed ($\nu>0$), and that all high-damage cases are filed. The proofs follow the logic applied in the proof of Lemma 2.

Step 3. We will demonstrate that the strictly positive equilibrium offer is $\bar{A}$. By condition (4′), the system (5)-(6) does not have a solution. By condition (3), the second derivative of $l_D(S)$

$$g(S)-C_D\frac{\partial g(S)}{\partial S}>0,$$

which is satisfied for all $S\in[\tilde{A},\bar{A}]$. Then, there is a unique minimum. There are two potential options. (1) $l_D(S)$ is strictly increasing and the optimal strictly positive offer is $\tilde{A}$; (2) $l_D(S)$ is strictly decreasing and the optimal strictly positive offer is $\bar{A}$. Consider Option 1. Suppose that Option 1 holds. The defendant is indifferent between a zero offer and $\tilde{A}$. The indifference condition implies:

$$\int_{\tilde{A}}^{\bar{A}}(A+C_D)g(A)dA=\nu\tilde{A}+\int_{\tilde{A}}^{\bar{A}}(A+C_D)g(A)dA.$$

This condition holds only if $\nu = 0$. Contradiction follows. Consider Option 2 now. The defendant is indifferent between a zero offer and $\bar{A}$. The indifference condition implies:

$$[\nu + 1 - G(\tilde{A})]\bar{A} = \int_{\tilde{A}}^{\bar{A}} (A + C_D)g(A)dA.$$

Solving for ν yields:

$$\nu = \frac{\int_{\tilde{A}}^{\bar{A}}(A + C_D)g(A)dA}{\bar{A}} - [1 - G(\tilde{A})].$$

By Claim 2 in Appendix A, $\nu < \mu + G(\tilde{A})$. Hence, $S = \bar{A}$ and $\nu = \frac{\int_{\tilde{A}}^{\bar{A}}(A+C_D)g(A)dA}{\bar{A}} - [1 - G(\tilde{A})]$ are the equilibrium strictly positive offer and the equilibrium mass of low- and no-damage cases that are filed.

Step 4. By Claim 2 in Appendix A, $\nu < \mu + G(\tilde{A})$. The prevalent magnitude of the lawyers' financial constraints $\tilde{A}$ (the state of the world) determines one of four mutually-exclusive cases: Case 1, where $G(\tilde{A}) - \nu > 0$; Case 2, where $G(\tilde{A}) - \nu = 0$; Case 3, where $G(\tilde{A}) - \nu < 0$ and $\nu < \mu + G(\tilde{A})$; and Case 4, where $G(\tilde{A}) - \nu < 0$ and $\nu = \mu + G(\tilde{A})$. Lemma 4 demonstrates that a relaxation of the lawyers' financial constraints lowers $[G(\tilde{A}) - \nu]$. The four cases involve different compositions of equilibrium ν and different equilibrium β. The proofs follow the logic applied in the proof of Lemma 4 and Proposition 2.

Step 5. The defendant's optimal probability of an accident $\lambda_D = \arg\min\{K(\lambda) + \lambda l_D\} = \arg\min\{K(\lambda) + \lambda \int_{\tilde{A}}^{\bar{A}}(A + C_D)g(A)dA\}$. The proof follows the logic applied in the proof of Proposition 3.

Step 6. The equilibrium strategies of the average plaintiff and his attorney and the equilibrium mass of filed cases determine the beliefs of the defendant. The proof follows the logic applied in Proposition 4.

■

Graphical Representation of l_D – Mixed-Strategy PBE with Corner Solution

We illustrate the equilibrium behavior of the defendant at the litigation stage by graphically representing the defendant's expected litigation loss function $l_D(S)$ for $S \in [0, \bar{A}]$. To construct this function, we keep the equilibrium mass of filed cases $\zeta = \nu + \int_{\tilde{A}}^{\bar{A}} g(A)dA$ constant.

$$l_D(S) = \begin{cases} \nu S + \int_{\tilde{A}}^{\bar{A}}(A + C_D)g(A)dA & \text{if } S \in [0, \tilde{A}) \\ \nu S + \int_{\tilde{A}}^{S} Sg(A)dA + \int_{S}^{\bar{A}}(A + C_D)g(A)dA & \text{if } S \in [\tilde{A}, \bar{A}] \end{cases}$$

Figure 1 provides the graphical representation of $l_D(S)$. When $S \in [0, \tilde{A})$, $l_D(S)$ is linear and upward-sloping, with a corner minimum at the zero offer. When $S \in [\tilde{A}, \bar{A}]$, $l_D(S)$ is strictly decreasing and achieves a unique corner minimum at $S = \bar{A}$ (by condition (4)). The defendant's expected loss function $l_D(S)$ attains the same value at a zero offer and at the optimal strictly positive offer $S = \bar{A}$. Hence, the defendant mixes between a zero offer and a strictly positive offer $S = \bar{A}$.

Pure-Strategy PBE with Corner Solution

Proposition 5′. *Assume that conditions (1), (2A), (3), and (4A′) hold. Then, the following strategy profile, together with the defendant's beliefs, characterize the pure-strategy perfect Bayesian equilibrium with a corner solution.*

(1) The defendant chooses a probability of accident $\lambda_D = \arg\min\Big\{K(\lambda) + \lambda l_D(S)\Big\}$, *where* $l_D(S) = [\mu + G(S)]S + \int_{S}^{\bar{A}}(A + C_D)g(A)dA$. *If a lawsuit is filed, the defendant proposes an offer* $S = \bar{A}$ *with certainty.*

(2) All cases are filed by the plaintiff's attorney.

(3) A plaintiff always accepts an offer $S = \bar{A}$.

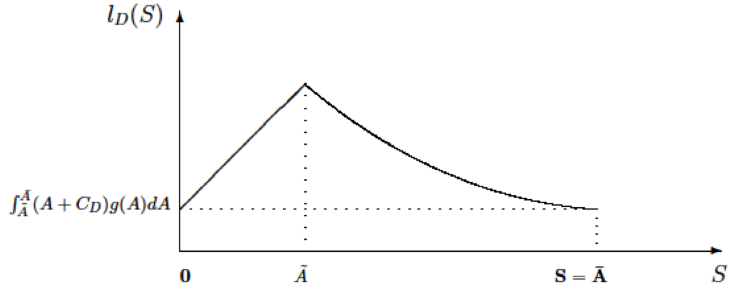

Figure 1: $\mathbf{l_D(S)}$ for Mixed-Strategy PBE with Corner Solution

(4) The defendant's equilibrium beliefs are as follows. When the defendant observes a lawsuit, he believes that $P(A=0) = \frac{\mu}{1+\mu}$, $P(0 < A \leq y) = \frac{G(y)}{1+\mu}$.

Proof. The proof consists of several steps.

Step 1. We will first demonstrate that offers greater than $\bar{A}$ and offer $S \in (0, \tilde{A})$ are not in the set of equilibrium offers. Second, we will show that a zero offer cannot be an equilibrium offer. Third, we will demonstrate that a mixed-strategy with a zero offer and $S \in [\tilde{A}, \hat{A}]$ cannot be in the set of equilibrium offers. The proofs follow the logic applied in the proof of Lemma 1 and Proposition 5.

Step 2. From the previous analysis, we conclude that the set of equilibrium offers might only involve a pure strategy with a unique offer $S \in [\tilde{A}, \bar{A}]$ or a mixed strategy with multiple offers $S \in [\tilde{A}, \bar{A}]$. We will first show that the equilibrium offer $S \in [\tilde{A}, \bar{A}]$ exists and is unique. Under both, the pure and the mixed strategies, the defendant's expected litigation loss $l_D(S) = [\mu + G(S)]S + \int_S^{\bar{A}}(A+C_D)g(A)dA$, by condition (1). Minimization of $l_D(S)$ yields the first-order condition: $\mu + G(S) = C_D g(S)$. By condition (3), the second derivative $g(S) - C_D\frac{\partial g(S)}{\partial S} > 0$, for all $S \in [\tilde{A}, \bar{A}]$. Then, the function is strictly convex and has a unique minimum. Hence, the set of equilibrium offers must involve a unique offer $S \in [\tilde{A}, \bar{A}]$. Second, we will demonstrate that the equilibrium offer is corner, $S = \bar{A}$. There are three possible options for a unique minimum of the function $l_D(S)$. (1) The function $l_D(S)$ is stricity increasing on the interval $[\tilde{A}, \bar{A}]$; it achieves a unique corner minimum at $S = \tilde{A}$. (2) The function $l_D(S)$ is strictly decreasing on the interval $[\tilde{A}, \bar{A}]$; it achieves a corner minimum at $S = \bar{A}$. (3) The function $l_D(S)$ achieves a unique interior minimum on the interval $(\tilde{A}, \bar{A})$; the value of S is implicitly defined by the first-order condition. Consider option (1). When $S = \tilde{A}$, all cases are filed, by condition (1). Then, the defendant is better off by making a zero offer: $[\mu + G(\tilde{A})]\tilde{A} + \int_{\tilde{A}}^{\bar{A}}(A+C_D)g(A)dA > \int_{\tilde{A}}^{\bar{A}}(A+C_D)g(A)dA$, where the right-hand side term corresponds to the defendant's expected litigation loss from making a zero offer. Contradiction follows. Hence, an offer $S = \tilde{A}$ cannot be an equilibrium offer. Consider options (2) and (3). The necessary and sufficient conditions for options (2) and (3) to occur are $\lim_{S \to \bar{A}^-} \frac{\partial l_D(S)}{\partial S} = 1 + \mu - C_D g(\bar{A}) \leq 0$, and $\lim_{S \to \bar{A}^-} \frac{\partial l_D(S)}{\partial S} = 1 + \mu - C_D g(\bar{A}) > 0$, respectively. By condition (4A$'$), $\lim_{S \to \bar{A}^-} \frac{\partial l_D(S)}{\partial S} = 1 + \mu - C_D g(\bar{A}) \leq 0$. Hence, the function has a corner minimum at $S = \bar{A}$.

Step 3. We will show that all cases are filed in equilibrium. The proof follows the logic applied in Proposition 6.

Step 4. The defendant's optimal probability of an accident $\lambda_D = \arg\min\left\{K(\lambda) + \lambda l_D(S)\right\}$. The proof follows the logic applied in the proof of Proposition 7.

Step 5. We will show that, in equilibrium, the defendant's posterior and prior beliefs are the same. The proof follows the logic applied in the proof of Proposition 8.

■

Figure 2: $\mathbf{l_D(S)}$ for Pure-Strategy PBE with Corner Solution

Graphical Representation of l_D – Pure-Strategy PBE with Corner Solution

We illustrate the equilibrium behavior of the defendant at the litigation stage by graphically representing the defendant's expected litigation loss function $l_D(S)$ for $S \in [0, \bar{A}]$. To construct this function, we keep the equilibrium mass of filed cases $\zeta = [\mu + G(\tilde{A})] + \int_{\tilde{A}}^{\bar{A}} g(A)dA$ constant.

$$l_D(S) = \begin{cases} [\mu + G(\tilde{A})]S + \int_{\tilde{A}}^{\bar{A}}(A + C_D)g(A)dA & \text{if } S \in [0, \tilde{A}) \\ [\mu + G(\tilde{A})]S + \int_{\tilde{A}}^{S} Sg(A)dA + \int_{S}^{\bar{A}}(A + C_D)g(A)dA & \text{if } S \in [\tilde{A}, \bar{A}] \end{cases}$$

Figure 2 provides the graphical representation of $l_D(S)$. When $S \in [0, \tilde{A})$, the function is linear and upward-sloping, with a corner minimum at the zero offer. When $S \in [\tilde{A}, \bar{A}]$, $l_D(S)$ is strictly decreasing and achieves a unique corner minimum at $S = \bar{A}$ (by conditions (4) and (5′)). The defendant's expected litigation loss at the optimal strictly positive offer $S = \bar{A}$ is lower than the value of the function at a zero offer. Hence, the defendant chooses the pure strategy $S = \bar{A}$.

Boundary PBE with Corner Solution

Lemma 5′. *Assume that all cases are filed and that $S \in [\tilde{A}, \bar{A}]$. Then, condition (4A′) implies condition (4′).*

Proof: Suppose not. Condition (4A′) does not imply condition (4′). Assume that condition (4A′) holds and condition (4) holds. By Lemma 5, condition (4) implies condition (4A). Then, condition (4A′) does not hold. Contradiction follows. ■

Proposition 9′. *Assume that conditions (1), (2B), (3) and (4A′) hold. Then, the following strategy profile, together with the defendant's beliefs, characterize the boundary perfect Bayesian equilibrium with an corner solution.*

(1) The defendant chooses a probability of accident $\lambda_D = \arg\min \left\{ K(\lambda) + \lambda l_D(S) \right\}$, where $l_D(S) = [\mu + G(S)]S + \int_{S}^{\bar{A}}(A + C_D)g(A)dA$. If a lawsuit is filed, the defendant proposes a zero offer with probability $\beta \in [0, 1 - \frac{f_F}{\gamma A})$ and an offer $S = \bar{A}$ with the complementary probability.

(2) All cases are filed by the plaintiff's attorney.

(3) A high-damage plaintiff always rejects a zero offer and accepts an offer $S > 0$ only if $A \leq S$; a low-damage plaintiff always accepts a non-negative offer; a no-damage plaintiff always accepts a non-negative offer.

(4) The defendant's equilibrium beliefs are as follows. When the defendant observes a lawsuit, he believes that $P(A = 0) = \frac{\mu}{1+\mu}$, $P(0 < A \leq y) = \frac{G(y)}{1+\mu}$.

Proof. The proof follows all the steps of the proofs of Propositions 9–11 with one exception: By Lemma 5′, condition (4A′) implies condition (4′). Then, condition (4A′) ensures that the strictly positive offer S is corner, in the mixed- and pure-strategy equilibria. Hence, $S = \bar{A}$. ■

Effects of a Cost-Reducing Policy on Equilibrium Outcomes

Proposition 12. *A reduction in $\tilde{A}$: (1) increases the expected litigation loss of the defendant l_D; (2) reduces the probability of an accident λ_D; (3) reduces the (strictly) positive out-of-court settlement offer S; (4) reduces the probability of a zero offer β; (5) increases the mass of filed cases ζ; and (6) increases the probability of trial ρ if $C_D < \tilde{A}$.*[1]

Proof. (1) The defendant's expected litigation loss is $l_D = \int_{\tilde{A}}^{\bar{A}} (A + C_D) g(A) dA$.

$$\frac{\partial l_D}{\partial \tilde{A}} = -(\tilde{A} + C_D) g(\tilde{A}) < 0.$$

This result applies to Cases 1 and 3, and across cases. ■

(2) By Proposition 3, an increase in the defendant's expected litigation loss, l_D, increases the spending on care and, therefore, reduces the probability of an accident. This result applies to Cases 1 and 3, and across cases. ■

(3) Total differentiating equations (5) and (6) yields (after some algebraic transformations):

$$d\nu = dS\left[C_D \frac{\partial g(S)}{\partial S} - g(S)\right]$$

and

$$(S - \tilde{A} - C_D) g(\tilde{A}) d\tilde{A} = S d\nu.$$

From the last equation:

$$\frac{\partial \nu}{\partial \tilde{A}} = \frac{(S - \tilde{A} - C_D) g(\tilde{A})}{S},$$

and

$$\frac{\partial S}{\partial \tilde{A}} = \frac{(\tilde{A} + C_D) g(\tilde{A})}{S\left[g(S) - C_D \frac{\partial g(S)}{\partial S}\right]}.$$

By condition (3), the last expression is greater than zero. This result applies to Cases 1 and 3, and across cases. ■

(4) Consider Case 1. The probability of a zero offer is:

$$\beta = 1 - \frac{f_M}{\gamma S}.$$

Therefore,

$$\frac{\partial \beta}{\partial \tilde{A}} = \frac{f_M}{\gamma S^2} \frac{\partial S}{\partial \tilde{A}} > 0.$$

Intuitively, a reduction in $\tilde{A}$ reduces the probability of a zero offer β. The same logic applies to Case 3. ■

(5) Consider Case 1. Let $\zeta = \int_{\tilde{A}}^{\bar{A}} g(A) dA + \nu = 1 - G(\tilde{A}) + \nu$ represent the aggregate filing. Hence,

$$\frac{\partial \zeta}{\partial \tilde{A}} = -g(\tilde{A}) + \frac{\partial \nu}{\partial \tilde{A}} = -\frac{(\tilde{A} + C_D) g(\tilde{A})}{S} < 0.$$

Intuitively, a reduction in $\tilde{A}$ increases filing. The same logic applies to Case 3, and across cases. ■

(6) Consider Case 1. The probability of trial (conditional on accident occurrence) is:

$$\rho = \beta(1 - G(\tilde{A})) + (1 - \beta)(1 - G(S)) = 1 - G(\tilde{A}) - \frac{f_M (G(S) - G(\tilde{A}))}{\gamma S}.$$

[1] Case 2 is a borderline case. Any change in $\tilde{A}$ will shift the equilibrium from Case 2 to Case 1 or to Case 3.

Differentiating with respect to $\tilde{A}$ yields:

$$\frac{\partial \rho}{\partial \tilde{A}} = -g(\tilde{A}) + \frac{\partial S}{\partial \tilde{A}} \frac{f_M}{\gamma} \frac{[G(S) - G(\tilde{A}) - g(S)S]}{S^2} < 0$$

The last inequality holds because

$$G(S) - G(\tilde{A}) - g(S)S = C_D g(S) - \nu - g(S)S = (C_D - S)g(S) - \nu < (C_D - \tilde{A})g(S) - \nu < 0,$$

when $C_D < \tilde{A}$. The same logic applies to Case 3, and across cases. ■

Welfare Analysis: Effects of a Cost-Reducing Policy

Proposition 13. *If the defendant is under-deterred ($l_W > l_D$) and $\theta > \underline{\theta}$, then the welfare effect of a cost-shifting policy is positive; if the defendant is over-deterred ($l_W < l_D$) and $\theta < \underline{\theta}$, then the welfare effect of a cost-shifting policy is negative.*

Proof. The condition $l_W > l_D$ ensures that the indirect effect on social welfare is positive. The direct effect includes two negative terms $-\lambda_D \frac{(\tilde{A}+C_D)G(\tilde{A})}{S} f_M$ and $\lambda_D(C_P+C_D)\frac{\partial \rho}{\partial \tilde{A}}$ and one positive term $\lambda_D \theta \frac{\partial \eta}{\partial \tilde{A}}$. The condition

$$\theta > \underline{\theta} = \frac{\lambda_D \frac{(\tilde{A}+C_D)G(\tilde{A})}{S} f_M - \lambda_D (C_P + C_D)\frac{\partial \rho}{\partial \tilde{A}}}{\lambda_D \frac{\partial \eta}{\partial \tilde{A}}}$$

ensures that the direct effect on social welfare is positive. Hence the overall effect on social welfare is positive as well. The same logic applies to the second part of the proposition. ■

2.2 Additional Material

This section includes the analysis of equilibrium outcomes and payoffs, the analysis of the effects of a cost-reducing policy on plaintiff's and attorneys' payoffs, and the welfare analysis of a cost-reducing policy.

2.2.1 Equilibrium Outcomes and Payoffs

The equilibrium outcomes and payoffs for Cases 1, 2, and 3 are as follows.

Case 1

The equilibrium outcomes and payoffs are as follows.

(1) Mass of filed cases (conditional on accident occurrence): $\zeta = \int_{\tilde{A}}^{\bar{A}} g(A)dA + \nu$.

(2) Probability of trial (conditional on accident occurrence and filing):

$$\rho = \beta[1 - G(\tilde{A})] + (1-\beta)[1 - G(S)] = 1 - G(\tilde{A}) - \frac{f_M[G(S) - G(\tilde{A})]}{\gamma S}.$$

(3) Defendant's expected litigation loss (conditional on accident occurrence and filing): $l_D = \int_{\tilde{A}}^{\bar{A}} (A + C_D)g(A)dA$.

(4) Plaintiff's expected payoff (conditional on accident occurrence and filing).

(4.1) Low-damage plaintiff ($0 < A < \tilde{A}$):

$$\Pi_P = (1-\beta)S(1-\gamma) + \beta \bullet 0 = \frac{f_M(1-\gamma)}{\gamma}.$$

(4.2) High-damage plaintiff of type $A \in [\tilde{A}, S)$:

$$\Pi_P = \beta(1-\gamma)A + (1-\beta)(1-\gamma)S = [(1 - \frac{f_M}{\gamma S})(1-\gamma)A + \frac{f_M(1-\gamma)}{\gamma}].$$

(4.3) High-damage plaintiff of type $A \in [S, \bar{A}]$:

$$\Pi_P = (1-\gamma)A.$$

(4.4) Average expected payoff (aggregating across plaintiff's types):

$$\frac{\frac{f_M(1-\gamma)}{\gamma}[G(S) - G(\tilde{A}) + \nu] + \int_{\tilde{A}}^{S} \beta(1-\gamma)Ag(A)dA + \int_{S}^{\bar{A}} (1-\gamma)Ag(A)dA}{1 - G(\tilde{A}) + \nu}.$$

(5) Attorney's expected payoff (conditional on accident occurrence and filing).

(5.1) Attorney with low-damage client ($0 < A < \tilde{A}$):

$$\Pi_{PA} = \beta \bullet 0 + (1-\beta)\gamma S - f_M = f_M - f_M = 0.$$

(5.2) Attorney with high-damage client of type $A \in [\tilde{A}, S)$:

$$\Pi_{PA} = \beta[\gamma A - C_P - (C_P + f_M - x)r] + (1-\beta)\gamma S - f_M = \beta[\gamma A - C_P - (C_P + f_M - x)r] - f_M.$$

(5.3) Attorney with high-damage client of type $A \in [S, \bar{A}]$:

$$\Pi_{PA} = [\gamma A - C_P - (C_P + f_M - x)r] - f_M.$$

(5.4) Average expected payoff (aggregating across plaintiff's types):

$$\frac{\int_{\tilde{A}}^{S}(1-\frac{f_M}{\gamma S})[\gamma A - C_P - (C_P + f_M - x)r]g(A)dA}{1-G(\tilde{A})+\nu}+$$

$$+\frac{\int_{S}^{\bar{A}}[\gamma A - C_P - (C_P + f_M - x)r]g(A)dA}{1-G(\tilde{A})+\nu} - f_M.$$

Case 2

The equilibrium outcomes and payoffs are as follows.

(1) Mass of filed cases (conditional on accident occurrence): $\zeta = \int_{\tilde{A}}^{\bar{A}} g(A)dA + \nu$.

(2) Probability of trial (conditional on accident occurrence and filing):

$$\rho = \beta[1 - G(\tilde{A})] + (1-\beta)[1 - G(S)].$$

(3) Defendant's expected litigation loss (conditional on accident occurrence and filing): $l_D = \int_{\tilde{A}}^{\bar{A}}(A + C_D)g(A)dA$.

(4) Plaintiff's expected payoff (conditional on accident occurrence and filing).

(4.1) Low-damage plaintiff ($0 < A < \tilde{A}$):

$$\Pi_P = (1-\beta)S(1-\gamma) + \beta \bullet 0.$$

(4.2) High-damage plaintiff of type $A \in [\tilde{A}, S)$:

$$\Pi_P = \beta(1-\gamma)A + (1-\beta)(1-\gamma)S.$$

(4.3) High-damage plaintiff of type $A \in [S, \bar{A}]$:

$$\Pi_P = (1-\gamma)A.$$

(4.4) Average expected payoff (aggregating across plaintiff's types):

$$(1-\beta)(1-\gamma)SG(S) + \int_{\tilde{A}}^{S} \beta(1-\gamma)Ag(A)dA + \int_{S}^{\bar{A}} (1-\gamma)Ag(A)dA.$$

(5) Attorney's expected payoff (conditional on accident occurrence and filing).

(5.1) Attorney with low-damage client ($0 < A < \tilde{A}$):

$$\Pi_{PA} = \beta \bullet 0 + (1-\beta)\gamma S - f_M = (1-\beta)\gamma S - f_M$$

(5.2) Attorney with high-damage client of type $A \in [\tilde{A}, S)$:

$$\Pi_{PA} = \beta(\gamma A - C_P - (C_P + f_M - x)r) + (1-\beta)\gamma S - f_M$$

(5.3) Attorney with high-damage client of type $A \in [S, \bar{A}]$:

$$\Pi_{PA} = [\gamma A - C_P - (C_P + f_M - x)r] - f_M.$$

(5.4) Average expected payoff (aggregating across plaintiff's types):

$$(1-\beta)\gamma SG(S) + \int_{\tilde{A}}^{S} \beta[\gamma A - C_P - (C_P + f_M - x)r]g(A)dA+$$

$$+\int_{S}^{\bar{A}} [\gamma A - C_P - (C_P + f_M - x)r]g(A)dA - f_M$$

Case 3

The equilibrium outcomes and payoffs are as follows.

(1) Mass of filed cases (conditional on accident occurrence): $\zeta = \int_{\tilde{A}}^{\bar{A}} g(A)dA + \nu$.

(2) Probability of trial (conditional on accident occurrence and filing):

$$\rho = \beta[1 - G(\tilde{A})] + (1 - \beta)[1 - G(S)] = 1 - G(\tilde{A}) - \frac{f_F[G(S) - G(\tilde{A})]}{\gamma S}.$$

(3) Defendant's expected litigation loss (conditional on accident occurrence and filing): $l_D = \int_{\tilde{A}}^{\bar{A}} (A + C_D)g(A)dA$.

(4) Plaintiff's expected payoff (conditional on accident occurrence and filing).

(4.1) Non-damage plaintiff ($A = 0$):

$$\Pi_P = \beta \bullet 0 + (1 - \beta)(1 - \gamma)S = \frac{f_F(1 - \gamma)}{\gamma}.$$

(4.2) Low-damage plaintiff ($0 < A < \tilde{A}$):

$$\Pi_P = \beta \bullet 0 + (1 - \beta)(1 - \gamma)S = \frac{f_F(1 - \gamma)}{\gamma}.$$

(4.3) High-damage plaintiff of type $A \in [\tilde{A}, S]$:

$$\Pi_P = \beta(1 - \gamma)A + (1 - \beta)(1 - \gamma)S = [(1 - \frac{f_F}{\gamma S})(1 - \gamma)A + \frac{f_F(1 - \gamma)}{\gamma}].$$

(4.4) High-damage plaintiff of type $A \in [S, \bar{A}]$:

$$\Pi_P = (1 - \gamma)A.$$

(4.5) Average expected payoff (aggregating across plaintiff's types):

$$\frac{\frac{f_F(1-\gamma)}{\gamma}[G(S) - G(\tilde{A}) + \nu] + \int_{\tilde{A}}^{S} \beta(1 - \gamma)Ag(A)dA + \int_{S}^{\bar{A}} (1 - \gamma)Ag(A)dA}{1 - G(\tilde{A}) + \nu}.$$

(5) Attorney's expected payoff (conditional on accident occurrence and filing).

(5.1) Attorney with no-damage client ($A = 0$):

$$\Pi_{PA} = \beta \bullet 0 + (1 - \beta)\gamma S - f_F = 0.$$

(5.2) Attorney with low-damage client ($0 < A < \tilde{A}$):

$$\Pi_{PA} = \beta \bullet 0 + (1 - \beta)\gamma S - f_M = f_F - f_M.$$

(5.3) Attorney with high-damage client of type $A \in [\tilde{A}, S]$:

$$\Pi_{PA} = \beta[\gamma A - C_P - (C_P + f_M - x)r] + (1 - \beta)\gamma S - f_M = \beta[\gamma A - C_P - (C_P + f_M - x)r] + (f_F - f_M).$$

(5.4) Attorney with high-damage client of type $A \in [S, \bar{A}]$:

$$\Pi_{PA} = [\gamma A - C_P - (C_P + f_M - x)r] - f_M.$$

(5.5) Average expected payoff (aggregating across plaintiff's types) is:

$$\frac{[G(S) - G(\tilde{A}) + \nu]f_F + \int_{\tilde{A}}^{S} \beta[\gamma A - C_P - (C_P + f_M - x)r]g(A)dA}{1 - G(\tilde{A}) + \nu} +$$

$$+ \frac{\int_{S}^{\bar{A}}[\gamma A - C_P - (C_P + f_M - x)r]g(A)dA}{1 - G(\tilde{A}) + \nu} - f_M.$$

2.2.2 Effects of a Cost-Reducing Policy on Plaintiff's and Attorney's Payoffs

This section presents the effects of a cost-reducing policy on the plaintiff's and attorney's payoffs for Case 1.

Effects on Plaintiff's Payoff

The average expected payoff for the plaintiffs (aggregating across plaintiff's types) is

$$\frac{\frac{f_F(1-\gamma)}{\gamma}[G(S)-G(\tilde{A})+\nu]+\int_{\tilde{A}}^{S}\beta(1-\gamma)Ag(A)dA+\int_{S}^{\bar{A}}(1-\gamma)Ag(A)dA}{1-G(\tilde{A})+\nu}.$$

The impact of a reduction in $\tilde{A}$ on the average expected payoff for the plaintiff is generally ambiguous. As we will show below, the effect depends on the value of A relative to the old and new thresholds and the old and new equilibrium offers.

Let $\tilde{A}' < \tilde{A}$, $S' < S$, and $\beta' < \beta$ denote the new threshold, the new equilibrium offer and the new probability of a zero offer, respectively. Let Π_P and Π'_P denote the old and new plaintiff's expected payoff, respectively. We analyze the effects of a cost-reducing policy on the plaintiff's payoff by classifying the cases into five different categories.The first and second inequalities refer to the old and new position of A, respectively.

(1) $0 < A < \tilde{A}$ and $0 < A < \tilde{A}'$: The plaintiff is not affected. Regardless of the change, the case does not proceed to trial. Due to asymmetric information, the plaintiff receives a strictly positive offer with a strictly positive probability. The reduction in the positive offer due to the policy is offset by the increase in the probability that the defendant makes a strictly positive offer.

$$\Pi_P = (1-\gamma)[\beta \bullet 0 + (1-\beta)S] = \frac{(1-\gamma)f_M}{\gamma} = (1-\gamma)[\beta' \bullet 0 + (1-\beta')S'] = \Pi'_P.$$

(2) $0 < A < \tilde{A}$ and $A > \tilde{A}'$: The plaintiff is better off. After receiving a zero offer, the plaintiff does not need to drop the case (and get a zero payoff). He can now go to trial and get a strictly positive payoff.

$$\Pi_P = (1-\gamma)[\beta \bullet 0 + (1-\beta)S] = \frac{(1-\gamma)f_M}{\gamma} <$$

$$< (1-\gamma)\left(\beta' A + \frac{f_M}{\gamma}\right) = (1-\gamma)[\beta' A + (1-\beta')S'] = \Pi'_P.$$

(3) $\tilde{A} < A < S$ and $\tilde{A}' < A < S'$: The plaintiff is worse off. The positive effect of an increase in the probability of a strictly positive offer less than offsets the negative effect of a reduction in the strictly positive offer.

$$\Pi_P = (1-\gamma)[\beta A + (1-\beta)S] = (1-\gamma)\left[\left(1-\frac{f_M}{\gamma S}\right)A + \frac{f_M}{\gamma S}S\right] >$$

$$> (1-\gamma)\left[\left(1-\frac{f_M}{\gamma S'}\right)A + \frac{f_M}{\gamma S'}S'\right] = (1-\gamma)[\beta' A + (1-\beta')S'] = \Pi'_P.$$

(4) $\tilde{A} < A < S$ and $A > S'$: The plaintiff is worse off. The case now proceeds to trial with certainty, and an award equal to A is granted to the plaintiff. Then, a generous expected payoff (due to a settlement offer greater than A) is now replaced with a lower payoff.

$$\Pi_P = (1-\gamma)[\beta A + (1-\beta)S] > (1-\gamma)A = \Pi'_P.$$

(5) $A > S$ and $A > S'$: The plaintiff is not affected. Regardless of the change, the case proceeds to trial and the plaintiff's payoff is $\Pi_P = (1-\gamma)A = \Pi'_P$.

Effects on Attorney's Payoff

The average expected payoff for the plaintiff's attorney (aggregating across plaintiff's types) is

$$\frac{\int_{\tilde{A}}^{S}(1-\frac{f_M}{\gamma S})\{\gamma A-[C_P+(C_P+f_M-x)r]\}g(A)dA}{1-G(\tilde{A})+\nu}+$$

$$+\frac{\int_{S}^{\bar{A}}\{\gamma A-[C_P+(C_P+f_M-x)r]\}g(A)dA}{1-G(\tilde{A})+\nu}-f_M.$$

The attorney's expected payoff depends directly on C_P, f_M, and r, which also affect $\tilde{A}$. Then, only an evaluation of the effects of individual factors can be implemented.

Consider a reduction in the lawyer's financial cost r. Its impact on the average expected payoff for the plaintiff's attorney is generally ambiguous. Two effects arise: An indirect negative effect of a reduction in r on the likelihood of trial (and hence, on the litigation costs C_P), which operates through a reduction in $\tilde{A}$; and, a direct positive effect of a reduction in r. The indirect negative effect might be partly or fully offset by the direct positive effect. We will show that the impact of a reduction in r depends on the value of A relative to the old and new thresholds and the old and new equilibrium offers.

Let $\tilde{A}' < \tilde{A}$, $S' < S$, $\beta' < \beta$, and $r' < r$ denote the new threshold, the new equilibrium offer, the new probability of proposing a zero offer, and the new lawyers' financial cost, respectively. Let Π_{PA} and Π'_{PA} denote the old and new attorney's expected payoff, respectively. We will analyze the effect of a reduction in r by classifying the cases into five different categories. The first and second inequalities denote the old and new position of A, respectively.

(1) $0 < A < \tilde{A}$ and $0 < A < \tilde{A}'$: The attorney is not affected. Regardless of the change, the case does not proceed to trial. His old and new expected payoffs are $\Pi_{PA} = \gamma[\beta \bullet 0 + (1-\beta)S] - f_M = f_m - f_M = 0$ and $\Pi'_{PA} = \gamma[\beta' \bullet 0 + (1-\beta')S'] - f_M = f_M - f_M = 0$, respectively.

(2) $0 < A < \tilde{A}$ and $A > \tilde{A}'$: The attorney is better off. The case can proceed to trial now; before the policy, the case was dropped. His old and new expected payoffs are $\Pi_{PA} = \gamma[\beta \bullet 0 + (1-\beta)S^*] - f_M = f_M - f_M = 0$ and $\Pi'_{PA} = f_M + \gamma\beta' A - \beta'[C_P + (f_M - C_P - x)r'] - f_M > 0$, respectively.

(3) $\tilde{A} < A < S$ and $\tilde{A}' < A < S'$: The effect is ambiguous because the indirect negative impact of the policy through a reduction in β is fully or partially offset by the direct positive effect. His old and new expected payoffs are $\Pi_{PA} = f_M + \gamma\beta A - \beta[C_P + (f_M - C_P - x)r] - f_M$ and $\Pi'_{PA} = f_M + \gamma\beta' A - \beta'[C_P + (f_M - C_P - x)r'] - f_M$, respectively.

(4) $\tilde{A} < A < S$ and $A > S'$: The effect is ambiguous. The impact of a lower r might be partially or fully offset by the higher litigation costs (after the policy, the case always goes to trial; before the policy, out-of-court settlement was possible). His old and new expected payoffs are $\Pi_{PA} = f_M + \gamma\beta A - \beta[C_P + (f_M + C_P - x)r] - f_M$ and $\Pi'_{PA} = \gamma A - [C_P + (f_M + C_P - x)r'] - f_M$, respectively.

(5) $A > S$ and $A > S'$: The attorney is better off. His initial expected payoff $\Pi_{PA} = \gamma A - [C_P + (f_M + C_P - x)r] - f_M$ increases due to the direct effect of a reduction in the financial cost r.

2.2.3 Social Welfare Function

Let $\Pi(A) \equiv \Pi_P(A) + \Pi_D(A) + \Pi_{PA}(A) + \Pi_F(A)$ be the sum of expected payoffs for the plaintiff, the defendant, the plaintiff's attorney, and the third-party funder when the plaintiff's type is A. Let $(1-\eta)$ be the mass of true victims who get access to justice.

Definition 7. *The social welfare function SW, evaluated at λ_D, is defined as follows.*

$$SW = -K(\lambda_D) - \lambda_D \int_0^{\bar{A}} Ag(A)dA + \lambda_D \int_0^{\bar{A}} \Pi(A)g(A)dA - \lambda_D \theta\eta =$$

$$= -K(\lambda_D) - \lambda_D \int_0^{\bar{A}} Ag(A)dA + \lambda_D \int_0^{\bar{A}} [\Pi_P(A) + \Pi_D(A) + \Pi_{PA}(A) + \Pi_F(A)]g(A)dA +$$
$$-\lambda_D \theta\eta.$$

The expression $\int_0^{\bar{A}} \Pi(A)g(A)dA$ can be simplified as follows. Consider three possible options.

Option 1: $A \geq S$

$$\Pi(A) = (1-\gamma)A + [\gamma A - f_M - C_P - (f_M + C_P - x)r] - (A + C_D) + (f_M + C_P - x)r = -f_M - C_P - C_D.$$

Hence,

$$\int_S^{\bar{A}} \Pi(A)g(A)dA = (1 - G(S))[-f_M - C_P - C_D].$$

Option 2: $\tilde{A} \leq A < S$

$$\Pi(A) = [(1-\beta)(1-\gamma)S + \beta(1-\gamma)A] + [-f_M + (1-\beta)\gamma S + \beta(\gamma A - C_P - (f_M + C_P - x)r)] +$$
$$+[-\beta(A + C_D) - (1-\beta)S] + [(f_M + C_P - x)r] = -f_M - \beta(C_P + C_D).$$

Hence,

$$\int_{\tilde{A}}^{S} \Pi(A)g(A)dA = [G(S) - G(A)][-f_M - \beta(C_P + C_D)].$$

Option 3: $0 < A < \tilde{A}$

A mass ν of low-damage cases are filed, and a mass $[1 - G(\tilde{A}) - \nu]$ of low-damage cases are not filed.[2] If the lawyer with a client of type A does not file a lawsuit, then the expected payoffs for the four players is zero. Hence, $\Pi(A) = 0$. If the lawyer with a client of type A files a lawsuit, then

$$\Pi(A) = [(1-\beta)(1-\gamma)S] + [-f_M + (1-\beta)\gamma S] + [-(1-\beta)S] + 0 = -f_M.$$

Aggregating across types $A \in (0, \tilde{A})$:

$$\int_0^{\tilde{A}} \Pi(A)g(A)dA = -f_M \bullet \nu.$$

Aggregating across all the types:

$$\int_0^{\bar{A}} \Pi(A)g(A)dA = -[1 - G(\tilde{A}) + \nu]f_M - \{[1 - G(S)] + \beta[G(S) - G(\tilde{A})]\}(C_P + C_D) = -\zeta f_M - \rho(C_P + C_D).$$

Then,

$$SW = -K(\lambda_D) - \lambda_D \left[\int_0^{\bar{A}} Ag(A)dA + \zeta f_M + \rho(C_P + C_D) \right] - \lambda_D \theta\eta.$$

[2] Remember that this analysis corresponds to the equilibrium for Case 1.

Social Welfare Function and Values of θ

Consider two possible options.

Option 1: $\theta = 0$

$$SW = -K(\lambda_D) - \lambda_D \left[\int_0^{\bar{A}} Ag(A)dA + \zeta f_M + \rho(C_P + C_D) \right].$$

The social welfare function SW encompasses the sum of the net expected payoffs for all players.

Option 2: $\theta > 0$

$$SW = -K(\lambda_D) - \lambda_D \left[\int_0^{\bar{A}} Ag(A)dA + \zeta f_M + \rho(C_P + C_D) \right] - \lambda_D \theta \eta.$$

The social welfare function SW also accounts for the social value of preserving citizens' rights to get access to justice.

Social Welfare Function and Social Welfare Loss

Consider two possible options.

Option 1: $\theta = 0$
The maximization of the social welfare function SW

$$SW = -K(\lambda_D) - \lambda_D \left[\int_0^{\bar{A}} Ag(A)dA + \zeta f_M + \rho(C_P + C_D) \right]$$

is equivalent to the minimization of the social welfare loss function SWL:

$$SWL = K(\lambda_D) + \lambda_D \left[\int_0^{\bar{A}} Ag(A)dA + \zeta f_M + \rho(C_P + C_D) \right].$$

Option 2: $\theta > 0$
The maximization of the social welfare function SW

$$SW = -K(\lambda_D) - \lambda_D \left[\int_0^{\bar{A}} Ag(A)dA + \zeta f_M + \rho(C_P + C_D) \right] - \lambda_D \theta \eta$$

is equivalent to the minimization of the social welfare loss function SWL:

$$SWL = K(\lambda_D) + \lambda_D \left[\int_0^{\bar{A}} Ag(A)dA + \zeta f_M + \rho(C_P + C_D) \right] + \lambda_D \theta \eta.$$

2.2.4 Welfare Analysis: Effects of a Cost-Reducing Policy

This section presents the welfare definitions for Cases 2 and 3, and the analysis of the effects of a cost-reducing policy on social welfare for Case 3.[3]

Definitions

Consider the "No-Access to Justice" component η in Cases 2 and 3. Given Definition 2,

$$\eta = \beta \int_0^{\tilde{A}} g(A)dA.$$

Intuitively, in Cases 2, 3 and 4, all high-damage and low-damage cases are filed. Then, the η term only includes the low-damage plaintiffs who file a lawsuit but receive a zero offer, and hence, need to drop their cases.[4]

Definition 8. *The social loss from litigation l_W is defined as follows.*

$$l_W = \int_0^{\bar{A}} Ag(A)dA + TotalFilingCosts + \rho \bullet (C_P + C_D) + \theta\eta =$$

$$= \int_0^{\bar{A}} Ag(A)dA + f_M + [\nu - G(\tilde{A})]f_F + \left[\beta \int_{\tilde{A}}^{\bar{A}} g(A)dA + (1-\beta)\int_S^{\bar{A}} g(A)dA\right](C_P + C_D) + \theta G(\tilde{A})\beta,$$

where the total filing-taking costs ($TotalFilingCosts$) are equal to f_M and $f_M + [\nu - G(\tilde{A}]f_F$, for Cases 2 and 3, respectively. The social loss from litigation l_W encompasses four main components: (1) total social harm from an accident $\int_0^{\bar{A}} Ag(A)dA$;(2) total filing cost , term in f_M; (4) total legal costs incurred in case of trial, term in $(C_P + C_D)$; and, (4) social cost associated with the inability of true victims to get access to justice, "No Access to Justice," term in (η).

Definition 9. *The social welfare loss SWL is defined as follows.*

$$SWL = K(\lambda_D) + \lambda_D l_W =$$

$$= K(\lambda_D) + \lambda_D \left[\int_0^{\bar{A}} Ag(A)dA + TotalFilingCosts + \rho \bullet (C_P + C_D) + \theta\eta\right]$$

$$= K(\lambda_D) + \lambda_D \Bigg\{ \int_0^{\bar{A}} Ag(A)dA + [f_M + (\nu - G(\tilde{A}))f_F] +$$

$$+ \left[\beta \int_{\tilde{A}}^{\bar{A}} g(A)dA + (1-\beta)\int_S^{\bar{A}} g(A)dA\right](C_P + C_D) +$$

$$+ \theta \int_0^{\tilde{A}} g(A)dA \left(1 - \frac{f_F}{\gamma S}\right)\Bigg\}.$$

[3]Case 2 is a borderline case. Any change in $\tilde{A}$ will shift the equilibrium from Case 2 to Case 1 or to Case 3.

[4]In other words, in Cases 2 and 3, the first term stated in Definition 2 is an empty set.

Social Welfare Analysis

Lemma 7. *For Case 3, the No-Access to Justice component η is increasing in $\tilde{A}$.*

Proof.

$$\eta = \beta G(\tilde{A}) = (1 - \frac{f_F}{\gamma S})G(\tilde{A}).$$

$$\frac{\partial \eta}{\partial \tilde{A}} = \beta g(\tilde{A}) + G(\tilde{A})\frac{f_F}{\gamma S^2}\frac{\partial S}{\partial \tilde{A}} > 0.$$

■

For Case 3, the overall welfare effect can be written as:

$$\frac{dSWL(\lambda_D)}{d\tilde{A}} = (l_W - l_D)\frac{(\tilde{A} + C_D)g(\tilde{A})}{\frac{\partial K(\lambda_D)}{\partial \lambda_D}} -$$

$$-\lambda_D \frac{(\tilde{A} + C_D)g(\tilde{A})}{S} f_F + \lambda_D(C_P + C_D)\frac{\partial \rho}{\partial \tilde{A}} + \lambda_D \theta \left(\frac{\partial \eta}{\partial \tilde{A}} \right).$$

It is easy to show that the welfare analysis and main qualitative findings obtained in Case 1 also hold in Case 3. In particular, if the defendants are under-deterred and the positive effect on the expansion of access to justice is high enough, a cost-reducing policy will be welfare improving. The positive effect of alleviating the lawyer's financial constraint on social welfare operates through the increase on access to justice by low-damage plaintiffs: More low-damage cases can now proceed to trial (i.e., there is a reduction on the zero offer associated with the dropping of low-damage cases).

3 Appendix C: Cost-Shifting Model

This appendix presents formal analysis of the cost-shifting model.

3.1 Main Material

This section includes the technical conditions, the proofs of Lemmas 8–9, and the proofs of Propositions 14–15.

3.1.1 Technical Conditions

Consider the following four technical conditions.[5]

$$f_F < \tilde{A}'' - C_P^1. \tag{B1}$$

For any $\tau \in [\tilde{A}'', \bar{A}]$

$$[\mu + G(\tau)](\tau - C_P^1) > \int_{\tilde{A}''}^{\tau} (A + C_D)g(A)dA. \tag{B2}$$

$$g(A) - \max(C_D + C_P^1, A - C_P^1)\frac{\partial g(A)}{\partial A} > 0. \tag{B3}$$

$$\int_{\tilde{A}''}^{\bar{A}} Ag(A)dA + C_D[1 - G(\tilde{A}'')] - g(\bar{A})(\bar{A} - C_P^1)(C_D + C_P^1) > 0. \tag{B4}$$

3.1.2 Lemmas and Proofs

Lemma 8. *Assume (B1)–(B4) hold. The system (B5)-(B6)*[6]

$$\nu''S'' + \int_{\tilde{A}''}^{S''+C_P^1} S''g(A)dA + \int_{S''+C_P^1}^{\bar{A}} (A + C_D)g(A)dA = \int_{\tilde{A}''}^{\bar{A}} (A + C_D)g(A)dA \tag{B5}$$

$$\nu'' + G(S'' + C_P^1) - G(\tilde{A}'') = (C_D + C_P^1)g(S'' + C_P^1) \tag{B6}$$

has a unique solution (S'', ν'').

Proof. The proof follows the logic applied in Lemma 3. ■

Lemma 9. *The difference between the total mass of low-damage cases and the mass of low- and no-damage cases that are filed, $[G(\tilde{A}'') - \nu'']$, is increasing in $\tilde{A}''$.*

Proof: Total differentiation of equation (B5) and use of equation (B6) yield:

$$\frac{\partial \nu''}{\partial \tilde{A}''} = \frac{(S'' - \tilde{A}'' - C_D)g(\tilde{A}'')}{S''}.$$

Hence,

$$\frac{\partial[G(\tilde{A}'') - \nu'']}{\partial \tilde{A}''} = g(\tilde{A}'') - \frac{\partial \nu''}{\partial \tilde{A}''} = \frac{(\tilde{A}'' + C_D)g(\tilde{A}'')}{S''} > 0.$$

■

[5] These conditions are modified versions of conditions (1)–(4).

[6] These equations are modified versions of equations (5) and (6) for the cost-shift model.

3.1.3 Propositions and Proofs

Proposition 14. *Assume that conditions (B1)-(B4) hold. Then, the following strategy profile, together with the defendant's beliefs, represents the mixed-strategy perfect Bayesian equilibrium with an interior solution.*

Case 1: $G(\tilde{A}'') - \nu'' > 0$

(1) The defendant chooses probability of accident (level of care) $\lambda''_D = \arg\min \left\{ K(\lambda) + \lambda \int_{\tilde{A}''}^{\bar{A}} (A + C_D) g(A) dA \right\}$. *If the plaintiff files a lawsuit, the defendant mixes between proposing a zero offer with probability* $\beta'' = 1 - \frac{f_M}{\gamma S'' + (1-\gamma) f_M}$ *and proposing an offer* $S'' > 0$, *implicitly defined by equations (B5) and (B6), with the complementary probability.*

(2) A high-damage case is always filed by the plaintiff's attorney; a low-damage case is filed with probability $\frac{\nu''}{G(\tilde{A}'')}$*; a no-damage case is never filed.*

(3) A high-damage plaintiff always rejects a zero offer and accepts an offer $S'' > 0$ *only if* $A - C_P^1 \leq S''$*; a low-damage plaintiff always accepts a non-negative offer; a no-damage plaintiff always accepts a non-negative offer.*

(4) The defendant's equilibrium beliefs are as follows. When the defendant observes a lawsuit, he believes that $P(A = 0) = 0$, $P(0 < A < \tilde{A}'') = \frac{\nu''}{\nu'' + 1 - G(\tilde{A}'')}$, $P(\tilde{A}'' \leq A \leq y) = \frac{G(y) - G(\tilde{A}'')}{\nu'' + 1 - G(\tilde{A}'')}$ *for any* $y \in [\tilde{A}'', \bar{A}]$.

Case 2: $G(\tilde{A}'') - \nu'' = 0$

(1) The defendant chooses probability of accident (level of care) $\lambda''_D = \arg\min \left\{ K(\lambda) + \lambda \int_{\tilde{A}''}^{\bar{A}} (A + C_D) g(A) dA \right\}$. *If the plaintiff files a lawsuit, the defendant mixes between proposing a zero offer with probability* $\beta'' \in (1 - \frac{f_F}{\gamma S'' + (1-\gamma) f_F}, 1 - \frac{f_M}{\gamma S'' + (1-\gamma) f_M})$ *and proposing an offer* $S'' > 0$, *implicitly defined by equations (B5) and (B6), with the complementary probability.*

(2) A high-damage case is always filed by the plaintiff's attorney; a low-damage case is always filed; a no-damage case is never filed.

(3) A high-damage plaintiff always rejects a zero offer and accepts an offer S'' *only if* $A - C_P^1 \leq S''$*; a low-damage plaintiff always accepts a non-negative offer; a no-damage plaintiff always accepts a non-negative offer.*

(4) The defendant's equilibrium beliefs are as follows. When the defendant observes a lawsuit, he believes that $P(A = 0) = 0$, $P(0 < A \leq y) = G(y)$ *for any* $y \in (0, \bar{A}]$.

Case 3: $G(\tilde{A}'') - \nu'' < 0$

(1) The defendant chooses probability of accident (level of care) $\lambda''_D = \arg\min \left\{ K(\lambda) + \lambda \int_{\tilde{A}''}^{\bar{A}} (A + C_D) g(A) dA \right\}$. If the plaintiff files a lawsuit, the defendant mixes between proposing a zero offer with probability $\beta'' = 1 - \frac{f_F}{\gamma S'' + (1-\gamma) f_F}$ and proposing an offer $S'' > 0$, implicitly defined by equations (B5) and (B6), with the complementary probability.

(2) A high-damage case is always filed by the plaintiff's attorney; a low-damage case is always filed; a no-damage case is filed with probability $\frac{\nu'' - G(\tilde{A}'')}{\mu}$.

(3) A high-damage plaintiff always rejects a zero offer and accepts an offer S'' only if $A - C_P^1 \leq S''$; a low-damage plaintiff always accepts a non-negative offer; a no-damage plaintiff always accepts a non-negative offer.

(4) The defendant's equilibrium beliefs. When the defendant observes a lawsuit, he believes that $P(A = 0) = \frac{\nu'' - G(\tilde{A}'')}{\nu'' + 1 - G(\tilde{A}'')}$, $P(0 < A \leq y) = \frac{G(y)}{\nu'' + 1 - G(\tilde{A}'')}$ for any $y \in (0, \bar{A}]$.

Proof. The proof consists of several steps.

Step 1. Potential Composition of the Set of Equilibrium Offers. First, we will show that offers greater than $\bar{A}$ and offers $S'' \in (0, \tilde{A}'')$ are not in the set of equilibrium offers. Second, we will demonstrate that a zero offer must be in the set of equilibrium offers. Third, we will show that a zero offer cannot be the only equilibrium offer: A strictly positive offer in $[\tilde{A}'', \bar{A}]$ should be in the set of equilibrium offers, in addition to a zero offer. The proofs follow the logic applied in Lemma 1.

Step 2. Potential Composition of Filed Cases. First, we will demonstrate that there must be some low-damage cases that are filed. Hence, $\nu'' > 0$. Second, we will show that, all high-damage cases are filed.The proofs follow the logic applied in Lemma 2.

Step 3. Equilibrium S'' and ν''. We established that there are at least two offers, 0 and some strictly positive offer in $[\tilde{A}'', \bar{A}]$. This implies that the positive offer S'' must minimize the expected loss of the defendant, and the defendant must be indifferent between offering 0 and S''. We write down the indifference condition (equation (B5))

$$\nu'' S'' + \int_{\tilde{A}''}^{S''+C_P^1} S'' g(A) dA + \int_{S''+C_P^1}^{\bar{A}} (A + C_D) g(A) dA = \int_{\tilde{A}''}^{\bar{A}} (A + C_D) g(A) dA.$$

The first-order optimality condition below indicates that the defendant minimizes the expected litigation loss with respect to S'' over the interval $[\tilde{A}'', \bar{A}]$, i.e., he takes into account that all plaintiffs with $A \geq \tilde{A}''$ file and that $\nu'' > 0$.

$$\frac{\partial}{\partial S''} \left[\nu'' S'' + \int_{\tilde{A}''}^{S''+C_P^1} S g(A) dA + \int_{S''+C_P^1}^{\bar{A}} (A + C_D) g(A) dA \right] = 0.$$

This last equation simplifies to equation (B6) when evaluated at $S = S''$:

$$\nu'' + G(S'' + C_P^1) - G(\tilde{A}'') = (C_D + C_P^1) g(S'' + C_P^1).$$

The second-order optimality condition

$$g(A) > (C_D + C_P^1) \frac{\partial g(A)}{\partial A}$$

is satisfied for all $A \in [\tilde{A}'', \bar{A}]$ (ensured by condition (B4)). We established in Lemma 12 that there is a unique positive offer $S \in [\tilde{A}'', \bar{A}]$, and a unique equilibrium mass of no-damage and low-damage cases that are filed ν''.

Step 4. Composition of Equilibrium ν'' and Equilibrium β''. The prevalent magnitude of the lawyers' financial constraints $\tilde{A}''$ (the state of the world) determines one of three mutually-exclusive scenarios: $G(\tilde{A}'') - \nu'' > 0$, $G(\tilde{A}'') - \nu'' = 0$, and $G(\tilde{A}'') - \nu'' < 0$. We call these three scenarios, Case 1, Case 2, and Case 3, respectively. Lemma 13 shows that a relaxation of the lawyers' financial constraints (i.e., a reduction in $\tilde{A}''$) lowers $G(\tilde{A}'') - \nu''$. If there exists $\tilde{A}''^*$ such that $G(\tilde{A}''^*) = \nu(\tilde{A}''^*)$ (Case 2), then for $\tilde{A}'' > \tilde{A}''^*$, $G(\tilde{A}) > \nu$ (Case 1) and for $\tilde{A}'' < \tilde{A}''^*$, $G(\tilde{A}'') < \nu''$ (Case 3).

Cases 1, 2, and 3 involve different compositions of equilibrium ν'', and hence, different compositions of the equilibrium mass of filed cases ζ''. Next, we analyze the composition of equilibrium ν'' and β'' for Cases 1, 2, and 3.

(1) Case 1: The equilibrium mass of low- and no-damage cases that are filed ν'' is lower than the total mass of low-damage cases $G(\tilde{A}'')$, then the equilibrium mass of filed cases includes all high-damage cases and a subset of low-damage cases. An attorney with a high-damage client is always willing to file a lawsuit (by Step 5). An attorney with an average low-damage client mixes between filing and not filing.[7] Hence, he must be indifferent between these two strategies. The indifference condition

$$f_M = \beta'' \bullet 0 + (1 - \beta'')[S'' - (1 - \gamma)(S'' - f_M)]$$

yields β'', the probability that the defendant makes a zero offer.

$$\beta'' = 1 - \frac{f_M}{\gamma S'' + (1 - \gamma) f_M}.$$

An attorney with a no-damage client never files a lawsuit because his expected payoff is negative, $-f_F + f_M < 0$. The mass of low-damage cases that are filed is ν'' and the total mass of low-damage cases is $G(\tilde{A}'')$. Hence, the probability of filing for an average low-damage case is $\frac{\nu''}{G(\tilde{A}'')}$.

[7] In principle, the probability of filing for a low-damage plaintiff may depend on the specific A. That's the reason behind the expression "average low-damage client."

(2) Case 2: The equilibrium mass of low- and no-damage cases that are filed ν'' is equal to the total mass of low-damage cases $G(\tilde{A}'')$, then the equilibrium mass of filed cases includes all high-damage and all low-damage cases. An attorney with a high-damage case is always willing to file a lawsuit (by Step 5). An attorney with a low-damage client is always willing to file a lawsuit but an attorney with a no-damage client will never file a lawsuit. Mathematically,

$$\beta'' \bullet 0 + (1-\beta'')[S'' - (1-\gamma)(S'' - f_M)] > f_M$$

but

$$\beta'' \bullet 0 + (1-\beta'')[S'' - (1-\gamma)(S'' - f_F)] < f_F,$$

which yields the range of values $\beta'' \in (1 - \frac{f_M}{\gamma S'' + (1-\gamma) f_M}, 1 - \frac{f_F}{\gamma S'' + (1-\gamma) f_F})$.

(3) Case 3: The equilibrium mass of low- and no-damage cases that are filed ν'' is greater than the total mass of low-damage cases $G(\tilde{A}'')$, then the equilibrium mass of filed cases includes all high-damage, all low-damage, and a subset of no-damage cases. An attorney with a high-damage client is always willing to file a lawsuit (by Step 5). An attorney with a no-damage client must be indifferent between filing and not filing. The indifference condition

$$f_F = \beta'' \bullet 0 + (1-\beta'')[\gamma S'' + (1-\gamma) f_F]$$

yields β'', the probability that the defendant makes a zero offer.

$$\beta'' = 1 - \frac{f_F}{\gamma S'' + (1-\gamma) f_F}.$$

An attorney with a low-damage client always files a lawsuit because his expected payoff is $f_F - f_M > 0$. The mass of no-damage cases that are filed is $\nu'' - G(\tilde{A}'')$ and the total mass of no-damage cases is μ. Hence, the probability of filing for a no-damage case is $\frac{\nu'' - G(\tilde{A}'')}{\mu}$.

Step 5. Equilibrium λ''_D. Analyze the defendant's optimal level of care. The defendant's optimal probability for an accident is given by $\lambda''_D = \arg\min\{K''(\lambda) + \lambda l''_D\} = \arg\min\{K''(\lambda) + \lambda \int_{\tilde{A}''}^{\bar{A}} (A + C_D) g(A) dA\}$. By Lemma 3, for any positive value of l''_D, the function $K''(\lambda) + \lambda l''_D$ has a unique interior minimum $\lambda''_D \in (0, 1)$.

Step 6. Equilibrium Posterior Beliefs. The equilibrium strategies of the average plaintiff and his attorney and the equilibrium mass of filed cases determine the beliefs of the defendant.

Case 1: All high-damage cases and a subset of low-damage cases are filed, but no-damage cases are not filed. The mass of high-damage cases that are filed is equal to the total mass of high-damage cases, $1 - G(\tilde{A}'')$. ν'' includes only the subset of low-damage cases that are filed. Therefore, the total mass of filed cases is $1 - G(\tilde{A}'') + \nu''$. As no-damage cases are not filed, the posterior (conditional on filing) probability of a no-damage case is 0, the posterior probability of an average low-damage case is $\frac{\nu''}{G(\tilde{A}'')}$, while the posterior probability of an average high-damage case is $\frac{1 - G(\tilde{A}'')}{1 - G(\tilde{A}'') + \nu''}$. Given that all high-damage cases are filed and the distribution $G(A)$ is known by the defendant, he computes the posterior probability for any range of high-damage cases as the product of conditional probability for this particular range (conditional on a case being a high-damage case) and the posterior probability of a high-damage case. Then, for any $y \in (\tilde{A}'', \bar{A}]$,

$$P(\tilde{A}'' < A \leq y | Filing) = \frac{G(y) - G(\tilde{A}'')}{1 - G(\tilde{A}'')} \frac{1 - G(\tilde{A}'')}{1 - G(\tilde{A}'') + \nu''} = \frac{G(y) - G(\tilde{A}'')}{1 - G(\tilde{A}'') + \nu''}.$$

Case 2: All high- and low-damage cases are filed but no-damage cases are not filed. The mass of filed cases (low-damage cases and high-damage cases) equals 1. Therefore, the posterior (conditional on filing) distribution of damage levels is described by the cdf $G(A)$. Then, for any $y \in (0, \bar{A}]$,

$$P(0 < A \leq y | Filing) = G(y).$$

Case 3: All high- and low-damage cases are filed, and $\nu'' - G(\tilde{A}'')$ of no-damage cases are filed. This is why the total mass of filed cases is $1 - G(\tilde{A}'') + \nu''$. Therefore, the posterior probability of a no-damage case is $\frac{\nu'' - G(\tilde{A}'')}{1 - G(\tilde{A}'') + \nu''}$, and the posterior probability of a meritorious case (high-damage, or low-damage case) is $\frac{1}{1 - G(\tilde{A}'') + \nu''}$. Given that all meritorious cases are filed and the distribution $G(A)$ is known by the defendant, he computes the posterior probability for any range of meritorious cases as the product of conditional probability for this particular range (conditional on a case being a meritorious case) and the posterior probability of a meritorious case. Then, for any $y \in (0, \bar{A}]$,

$$P(\tilde{0} < A \leq y | Filing) = G(y) \frac{1}{1 - G(\tilde{A}'') + \nu''} = \frac{G(y)}{1 - G(\tilde{A}'') + \nu''}.$$

■

Proposition 15. *A cost-shifting policy: (1) increases the expected litigation loss of the defendant; (2) reduces the probability of an accident; (3) reduces the (strictly) positive out-of-court settlement offer; (4) increases the mass of filed cases; (5) might increase or reduce the probability of a zero offer; and (6) increases the probability of trial if $C_D < \tilde{A}''$.*

Proof.

(1) The defendant's expected litigation loss is:

$$l''_D = \int_{\tilde{A}''}^{\bar{A}} (A + C_D) g(A) dA$$

$$\frac{\partial l_D}{\partial \tilde{A}''} = -(\tilde{A}'' + C_D) g(\tilde{A}'') < 0.$$

As $\tilde{A}'' < \tilde{A}$,

$$l''_D > l_D = \int_{\tilde{A}}^{\bar{A}} (A + C_D) g(A) dA.$$

This result applies to Cases 1 and 3 and across cases. ■

(2) By Lemma 5, an increase in the defendant's expected litigation loss increases the spending on care and, therefore, reduces the probability of an accident. This result applies to Cases 1 and 3 and across cases. ■

(3)–(4) Consider Case 1. We will show that a cost-shifting policy reduces the positive offer to settle, S, and raises the overall measure of filing, $1 - G(\tilde{A}) + \nu$. Specifically, we will assess the effects of a cost-shift policy by considering the effects of a reduction in $\tilde{A}$ (when $C_P^1 = 0$; i.e., in the benchmark model) and an increase in C_P^1 (for a given $\tilde{A}''$). From the analysis of the benchmark model (where $C_P^1 = 0$), we know that a reduction in $\tilde{A}$ lowers the likelihood of a positive offer S and increases filing. We will show now that an increase in C_P^1 (for a given $\tilde{A}''$) affects the likelihood of a positive offer S'' and filing in similar ways: $\frac{\partial S''}{\partial C_P^1} < 0$ and $\frac{\partial \nu''}{\partial C_P^1} > 0$.
Total differentiation of equations (B5) and (B6) yield (after some algebra):

$$\frac{\partial S''}{\partial C_P^1} = -\frac{(C_P^1 + C_D)[g(S'' + C_P^1) - S'' g'(S'' + C_P^1)]}{S''[g(S'' + C_P^1) - (C_D + C_P^1) g'(S'' + C_P^1)]} < 0.$$

$$\frac{\partial \nu''}{\partial C_P^1} = \frac{(C_D + C_P^1) g(S'' + C_P^1)}{S[g(S'' + C_P^1) - (C_D + C_P^1) g'(S'' + C_P^1)]} > 0.$$

By condition (B3), both inequalities are satisfied. This result also applies to Case 3 and across cases. ■

(5) Consider Case 1. The change in the probability of the zero offer is:

$$\beta'' - \beta = (1 - \frac{f_M}{\gamma S'' + (1-\gamma) f_M}) - (1 - \frac{f_M}{\gamma S}) = \frac{f_M[\gamma(S'' - S) + (1-\gamma) f_M]}{\gamma S[\gamma S'' + (1-\gamma) f_M]}.$$

The last expression can be positive, or negative, because $S'' < S$, but the term $(1-\gamma) f_M$ is positive. Similar analysis applies to Case 3. ■.

(6) Consider Case 1. Define an auxiliary function

$$\Omega(\tilde{A}, S(\tilde{A})) = (1 - \frac{f_M}{\gamma S})(1 - G(\tilde{A})) + \frac{f_M}{\gamma S}(1 - G(S)),$$

where

$$\frac{\partial S}{\partial \tilde{A}} > 0.$$

We will show that

$$\rho(\tilde{A}'', S'') > \Omega(\tilde{A}'', S'') > \rho(\tilde{A}, S).$$

In part (6) of the proof of Proposition 9, we effectively showed that

$$\frac{\partial \rho}{\partial \tilde{A}} < 0,$$

where $\rho = \Omega$. Then, a reduction in $\tilde{A}$ increases the value of Ω. Hence,

$$\Omega(\tilde{A}'', S'') > (1 - \frac{f_M}{\gamma S})(1 - G(\tilde{A})) + \frac{f_M}{\gamma S}(1 - G(S)) = \rho(\tilde{A}, S)$$

Define a second auxiliary function

$$Z(\pi) = (1 - \frac{f_M}{\gamma S'' + \pi})(1 - G(\tilde{A}'')) + \frac{f_M}{\gamma S'' + \pi}(1 - G(S'')).$$

It is straightforward to verify that $Z(0) = \Omega(\tilde{A}'', S'')$, that $Z((1-\gamma) f_M) = \rho(\tilde{A}'', S'')$ and that

$$\frac{\partial Z}{\partial \pi} > 0.$$

This is why $\rho(\tilde{A}'', S'') > \Omega(\tilde{A}'', S'')$. This result also applies to Case 3. ■

3.2 Additional Material

This section includes the analysis of equilibrium outcomes and payoffs, and the analysis of the effects of a cost-shifting policy on plaintiff's and attorneys' payoffs.

3.2.1 Equilibrium Outcomes and Payoffs

The equilibrium outcomes and payoffs for Cases 1, 2, and 3 are as follows. When the analysis applies only to one case, the specific case will be mentioned before presenting the outcome or payoff.

(1) Mass of filed cases (conditional on accident occurrence): $\zeta = \int_{\tilde{A}''}^{\bar{A}} g(A)dA + \nu''$.

(2) Probability of trial (conditional on accident occurrence and filing):

$$\rho = \beta''(1 - G(\tilde{A}'')) + (1 - \beta'')(1 - G(S'')).$$

(3) Defendant's expected litigation loss (conditional on accident occurrence and filing):

$$l_D = \int_{\tilde{A}''}^{\bar{A}} (A + C_D)g(A)dA.$$

(4) Plaintiff's expected payoff (conditional on accident occurrence and filing).

(4.1) No-damage plaintiff ($A = 0$).

Case 3:

$$\beta'' \bullet 0 + (1 - \beta'')(1 - \gamma)(S'' - f_M) = (1 - \beta_3'')(1 - \gamma)(S'' - f_M).$$

(4.2.) Low-damage plaintiff ($0 \leq A < \tilde{A}''$):

$$\beta'' \bullet 0 + (1 - \beta'')(1 - \gamma)(S'' - f_M) = (1 - \beta'')(1 - \gamma)(S'' - f_M).$$

(4.3) High-damage plaintiff of type $A \in [\tilde{A}, S'')$:

$$\beta''[(1 - \gamma)(A - f_M - C_P^1)] + (1 - \beta'')(1 - \gamma)(S'' - f_M).$$

(4.4) High-damage plaintiff of type $A \in [S'', \bar{A}]$:

$$(1 - \gamma)(A - f_M - C_P^1).$$

(5) Attorney's expected payoff (conditional on accident occurrence and filing).

(5.1) Attorney with no-damage client ($A = 0$).

Case 3:

$$\beta'' \bullet 0 + (1 - \beta'')[S'' - (1 - \gamma)(S'' - f_F)] - f_F = 0.$$

(5.2) Attorney with low-damage client ($0 < A < \tilde{A}$).

Case 1:

$$\beta'' \bullet 0 + (1 - \beta'')[S'' - (1 - \gamma)(S'' - f_M)] - f_M = 0.$$

Case 2:

$$\beta'' \bullet 0 + (1 - \beta'')[S'' - (1 - \gamma)(S'' - f_M)] - f_M > 0.$$

Table B1: Effects of Cost-Shifting Policy on Plaintiff's and Attorney's Payoffs

Plaintiff's Type Position		Payoff Effect	
Benchmark	Cost-Shifting	Plaintiff	Attorney
$0 < A < \tilde{A}$	$0 < A < \tilde{A}''$	$-$	0
$0 < A < \tilde{A}$	$A > \tilde{A}''$	$+/-/0$	$+$
$A > S$	$A > S''$	$-$	$+$
$0 < A < S$	$A > S''$	$-$	$+$
$\tilde{A} < A < S$	$\tilde{A}'' < A < S''$	$+/-/0$	$+/-/0$

Notes: $+$, $-$, 0 denote positive change, negative change, and no effect, respectively.

Case 3:

$$\beta'' \bullet 0 + (1-\beta'')[S'' - (1-\gamma)(S'' - f_M)] - f_M > 0.$$

(5.3) Attorney with high-damage client of type $A \in [\tilde{A}, S'')$:

$$\beta''[\gamma(A - f_M - C_P^1) - C_P^2 - (f_M + C_P - x)r] + (1-\beta'')(S'' - f_M).$$

(5.4) Attorney with high-damage client of type $A \in [S'', \bar{A}]$:

$$\gamma(A - f_M - C_P) - C_P^2 - (C_P + f_M - x)r.$$

3.2.2 Effects of a Cost-Shifting Policy on Plaintiff's and Attorney's Payoffs

This section outlines the effects of a cost-shifting policy on the payoffs for the plaintiff and his attorney for Case 1.

Table B1 summarizes the effects of a cost-shifting policy on the payoffs for the plaintiff and his attorney by plaintiff's type position (before and after the policy). Unsurprisingly, most plaintiff's types are worse off. This effect might be explained by the lower equilibrium offer and the high costs for the plaintiff (he now needs to pay a part of the case-taking and litigation costs). However, for two plaintiff's types, the effect of a cost-shifting policy is ambiguous. In the first case $\tilde{A}'' \leq A < \tilde{A}$, plaintiff's type A was unable to go to trial before the cost-shift policy was implemented. His expected payoff was $\frac{f_M(1-\gamma)}{\gamma}$. After the shift, this type of cases can proceed to trial. The plaintiff's expected payoff is now

$$\frac{f_M}{\gamma S'' + (1-\gamma) f_M}(1-\gamma)(S'' - f_M) + \left[1 - \frac{f_M}{\gamma S'' + (1-\gamma) f_M}\right](1-\gamma)(A - C_P^1 - f_M).$$

The first term comes from the positive offer made by the defendant, which is smaller than $\frac{f_M(1-\gamma)}{\gamma}$, the portion of the plaintiff's expected payoff associated with the positive offer before the shift. However, the plaintiff's expected payoff under a cost-shift policy includes another positive term (as the plaintiff's attorney can now proceed to trial). As a result, the overall comparison reveals ambiguity. In the second case, $\tilde{A}'' < \tilde{A} < A < S'' < S$, ambiguity is caused by the possibility of lower probability of a zero offer under the cost-shift policy.

The impact of the cost-shifting on the payoff of the attorney is positive for most cases: The attorney shifts some of the cost to his client, which makes him better off. However, when $\tilde{A}'' < \tilde{A} < A < S'' < S$, the effect is ambiguous. Although the attorney successfully shifts some of the costs to the plaintiffs, the positive offer to settle is smaller and the probability of the zero offer might be higher under a cost-shifting policy. These last two factors negatively affect the attorney's expected payoff and might offset the positive effect of a cost-shifting policy.