Justice Delayed is Justice Denied: Strategic Settlements in Medical Malpractice Lawsuits*

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Abstract

Delayed justice jeopardizes the function of the judicial system, distoring the preponderance of bargaining powers in settlement negotiation. We empirically demonstrate that delayed justice leads to heterogeneous timings of settlements depending on whether a defendant is liable. We develop a dynamic bargaining model that matches our empirical ndings. All participating parties but liable defendants are shown to be worse o as a result of delayed justice, explicating the legal maxim: justice delayed is justice denied.

Keywords: Bargaining, Delay, Justice, Lawsuit, Litigation, Settlement

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A sense of confidence in the courts is essential to maintain the fabric of ordered liberty for a free people, and three things could destroy that confidence and do incalculable damage to society: That people come to believe that inefficiency and delay will drain even just judgment of its value; that people who have long been exploited in the smaller transactions of daily life come to believe that courts cannot vindicate their legal rights from fraud and over-reaching; that people come to believe that the law – in the larger sense – cannot fulfil its primary function to protect them and their families in their homes, at their work, and on the public streets.

— Former United States Chief Justice, Warren E. Burger (1970)

It is effectively the same as having no remedy if legal relief to an injured party is not forthcoming in a timely manner. Legal disputes must be resolved by the court within a reasonable time horizon as delayed justice undermines the effectiveness and reliability of the judicial system. In reality, however, it takes years to reach a trial due mainly to the large number of proceedings handled by the courts and the shortage of judges.

The total caseload of U.S. trial courts amounts to 83.8 million cases in 2018.[1] In response to a nationwide upsurge in COVID-19, a number of courts suspended trials and proceedings, and curtailed courthouse activities in 2020. Yet, there exists virtually no theoretical or empirical work on this issue to the best of our knowledge.

We investigate the impact of delays in civil proceedings on litigants' strategies and dispute outcomes. Engaging parties negotiate over settlement agreements and a court trial resolves a dispute if the parties fail to reach an agreement. Delay in proceedings increases the cost of litigation for all involved parties, distorts the preponderance of bargaining powers, and affects the strategic incentives in negotiating settlement agreements. Herein, our empirical findings together with a dynamic model demonstrate and explicate the common notion that delayed justice jeopardizes the function of the judicial system, harming all the involved parties but liable defendants.

Our contribution spans broadly to bargaining literature by demonstrating the role of *the shadow of power*. Often bargainers can use some form of power—be it legal, military, or political—to forcefully resolve a conflict, and such power behind the negotiations affects the bargaining outcomes through a change in the balance of bargaining powers (Powell, 1996). Our findings lend evidence that the power behind the negotiations distorts the balance of bargaining powers, and affects dispute outcomes via strategic interactions.

The empirical literature on litigation has primarily focused on verdict outcomes rather than the time-to-resolution.[2] This is surprising given that extended attention has been paid by both

[1] See Appendix 4.1 and CSP Annual Caseload Report (2018) for reference.

[2] Kessler (1996) empirically examines how legal institutions affect delay in settlements. There is also a strand of literature on identification and estimation of bargaining models. See, for example, Merlo and Tang (2017), Sieg (2000), Watanabe (2006), and Silveira (2017).

academia and practitioners on the issue of court delay, and that over 90 percent of disputes are resolved before a trial. This paper sheds a light on this previously understudied subject through a novel study design that extracts the impacts of delayed justice.

We exploit the plausibly exogenous upsurge in court caseload together with the difference in state foreclosure laws to estimate the impact of delayed justice on the time-to-resolution. The upsurge in court caseload was caused by foreclosure crisis in 2007-10, and the state foreclosure laws require that foreclosure cases need to bypass a court in certain states. The upsurge in court caseload was likely unanticipated by litigants, and the difference in state foreclosure laws developed in 19th century for idiosyncratic reasons. These facts together presumably limit the room for alternative stories to explain our empirical findings.

Our findings lend evidence that a surge in court caseload is associated with a sizable increase in the hazard rate of settlement for those cases with compensation payment, while the hazard rate decreases for those dropped/dismissed cases. The empirical findings are counterintuitive given that prolonged delay in justice seems to weaken the plaintiff's bargaining power at first glance.

We account for the empirical findings via construction of mixed strategy equilibrium in a dynamic bargaining model of litigation. The plaintiff in our model can dispose of or "give up" her claim without restraints during the course of litigation, and dismissal of cases naturally arises in the unique mixed strategy equilibrium. Mixed strategy accounts for counterintuitive empirical findings since any exogenous shock is countervailed by the change in strategy.

As delayed justice deteriorates plaintiff's payoff from continuing the dispute, the liable defendant compensates at an early stage in order for the plaintiff to continue the case. In a similar vein, as delayed justice improves the liable defendant's payoff from continuing the dispute, the plaintiff becomes more persistent and drop the case at a later stage in the dispute. A non-liable defendant never agree to compensate, and the plaintiff's persistence makes the non-liable defendant worse off. Thus, delay in justice harms all litigants but liable defendants, consistent with the notion that *justice delayed is justice denied.*

There is a vast theoretical literature on bargaining models of dispute resolution. As our focus is on the timing of settlement, we build a model in which a plaintiff could "give up" and drop the case at any point in time.[3] To this end, we develop a dynamic model with a fixed settlement/payment amount.[4] In this sence, our model is most closely related P'ng (1983) and Salant and Rest (1982). Those models, however, use two periods models, which is not suitable for analyzing the effect of delayed justice. Our model, which is based on dynamic Bayesian games of Kreps and Wilson (1982) and Ordover and Rubinstein (1982), allows for the duration of a pretrial negotiation to be

[3]In Vasserman and Yildiz (2019), the plaintiff drops the case if the defendant turns out to be non-liable evidently. In their model, however, information about liability arrives exogenously and thus, the plaintiff does not choose when to give up.

[4]Endogenizing settlement/payment amount generates a continuum of equilibria. More importantly, a plaintiff never gives up with delay in a circumstance where a defendant incurs per period cost of delaying settlement. This is due to the incentive that the defendant could always avoid paying the cost of delaying settlement by agreeing to settle with a small amount of payment to the plaintiff.

arbitrarily long.[5]

The feature of our equilibrium construction could also be found in Bar-Isaac (2003), Daley and Green (2012), Lee and Liu (2013), and Honryo (2018). In these models of Dynamic Bayesian games, low types take mixed strategy while high types do not. Mixing by low types is necessary to support an equilibrium with delay. That is, separating equilibria unravel senders' types and terminates negotiation immediately.

The remainder of the paper is organized as follows. Section 1 explains the litigation procedure in medical malpractice lawsuits, and why foreclosure laws differ across states. Section 2 presents the unique feature of data and shows reduced-form evidence on the impacts of delayed justice. We develop a model of dynamic litigation in Section 3, and characterize the unique equilibrium that matches our empirical findings.

1 Institution

Here, we outline the litigation procedure for medical malpractice lawsuits. We then describe the historical origin of judicial and non-judicial foreclosure states, and the implication of foreclosure crisis in 2007-10.

1.1 Litigation Procedure

Bargaining between litigants starts before a lawsuit. Injured parties, i.e., plaintiffs, are entitled to file a lawsuit within several years from the date of injury, i.e., statute of limitation. Once a lawsuit is filed, discovery process begins.[6] Discovery is a pre-trial procedure in which each party can obtain evidence from the other party via discovery devices such as a request for answers to interrogatories, request for production of documents, and request for admissions and depositions. Either litigant may submit a request for trial, describing the estimate of time required.[7] If the court finds the case ready for trial and a judge available, it enters an order fixing a date for trial.[8]

[5] The recent theoretical models on dynamic litigation focus on the frequency of settlements and in particular, on "deadline effect," in which much settlement occurs just prior to the trial. See, for example, Spier (1992) and Vasserman and Yildiz (2019).

[6] The cases are assigned blindly by the clerk to the judges in the order of when the cases were filed.

[7] According the Federal Rules of Civil Procedure, to submit a notice of jury trial, the litigants need to serve the other parties with a written demand and file the demand to the court. Some courts require participation in mediation, pretrial conference, mandatory settlement conference, agreement on trial length and available time periods from all parties, etc.

[8] Depending on jurisdiction and court, there could be a meeting before the trial, where all parties and the judge discuss their availability. The trial date is officially set by the judge, and any rescheduling would require a written demand to the judge and the judge's approval.

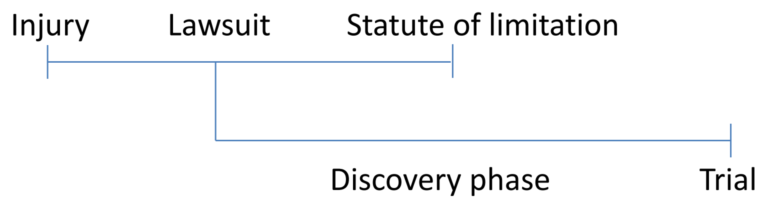


Figure 1: Timeline of Events

1.2 Foreclosure Crisis and Judicial/Non-judicial Foreclosure States

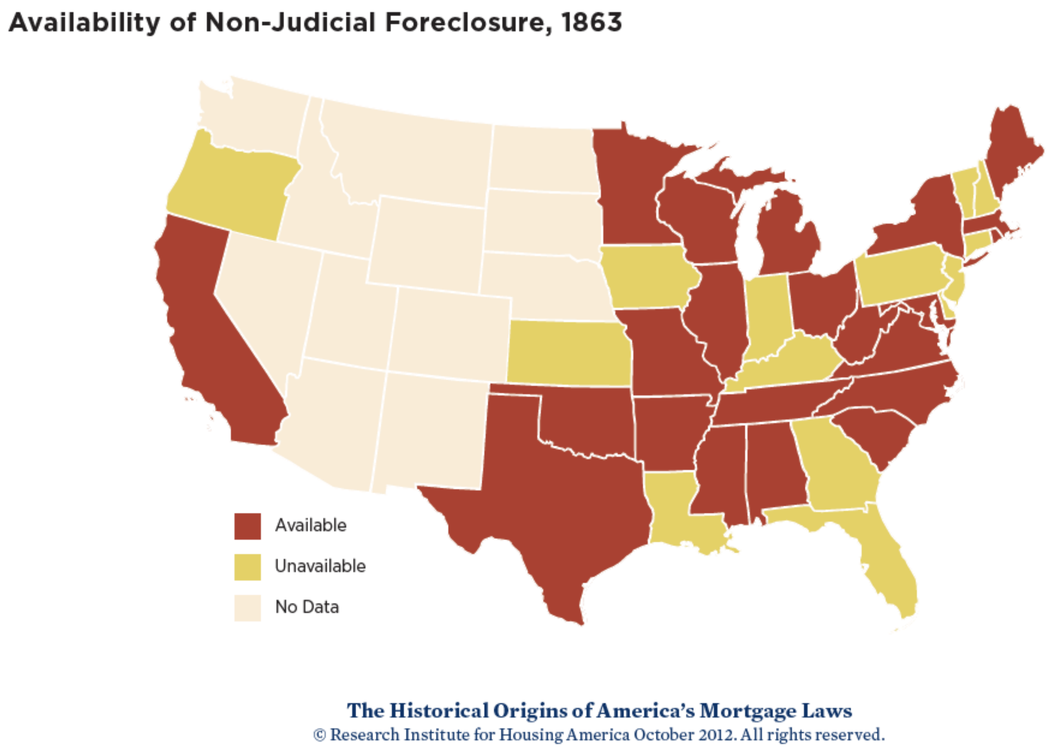
The foreclosure crisis was a period of drastically elevated property seizures in the U.S. housing market, which resulted in a surge in the number of foreclosures. Judicial foreclosure states mandate that a lender initiates foreclosure by filling a lawsuit against the borrower, and thus the courts in judicial foreclosure states experienced an upsurge in the number foreclosure cases as a result of foreclosure crisis. On the other hand, power-of-sale clause circumvents the litigation process, and permits the lender to sell a property in non-judicial foreclosure states.[9]

In the United States, state laws were based on the UK common law until the early 19th century, and a foreclosure sale necessitated the approval of a judiciary, i.e., lenders are required to file a lawsuit to foreclose a property. In 1827, however, the advent of case law recognizing non-judicial foreclosure (i.e., power of sale and trust deed) and the development of financial markets led to different interpretations of foreclosure in different states.[10] In most cases, the validity of power of sale and deeds of trust was determined in case law rather than by statute. As a result, it was usually the decision of a single judge that ended up determining the process.[11] By 1863, lenders were able to foreclose by a non-judicial foreclosure procedure in many states, and the changes have not been reversed since then in many states (J.F.D., 1863).

[9] There are currently 22 judicial foreclosure states and 28 non-judicial foreclosure states.

[10] A landmark U.S. Supreme Court ruling in Newman vs. Jackson (1827) favored a power-of-sale clause in regulating a dispute in the Georgetown neighborhood of Washington, D.C. and set a precedent for other states.

[11] For example, despite the national Supreme Court precedent in 1827, Justice J. Kellogg of the Supreme Court of Vermont judge declared that a power-of-sale clause was not generally valid. While this ruling did not exactly forbid non-judicial foreclosure, the interpretation of the ruling banned them for all practical purposes. The ruling seems to have been interpreted as requiring the lender to get the borrower's permission to use his power of sale after default which is usually even more difficult than getting a judge's approval. It seems likely that the other states that did not adopt non-judicial foreclosure failed to do so for similarly idiosyncratic reasons.



The difference in state law led to a significant increase in the number of foreclosure caseloads in judicial foreclosure states due to the foreclosure crisis (or subprime mortgage crisis) started in 2007, which was triggered by a large decline in home prices after the collapse of a housing bubble. As opposed to judicial foreclosure states, non-judicial foreclosure states were not exposed to such caseload increase due to a power-of-sale clause, which allows the trustees in deed of trust mortgages to conduct non-judicial foreclosures on delinquent borrowers without going to court.

Figure 2 shows the dynamics of the number of real estates related lawsuits filed in circuit courts of Florida: one of judicial foreclosure states.[12] The total number of real estate lawsuits is 4,300 cases in April 2007 while 39,000 cases were filed in March 2010.

[12] There are twenty circuit courts in Forida, each of which deals with civil disputes involving the amount in controversy greater than $15,000. e.g., controversies involving the estates of decedents, minors, and persons adjudicated as incapacitated; cases relating to juveniles; criminal prosecutions for all felonies; tax disputes; actions to determine the title and boundaries of real property, etc. Court caseload data is web-scraped. As every circuit court records how many cases are filded and disposed every month, we are able to keep track of the change in caseload held by each court at any point in time.

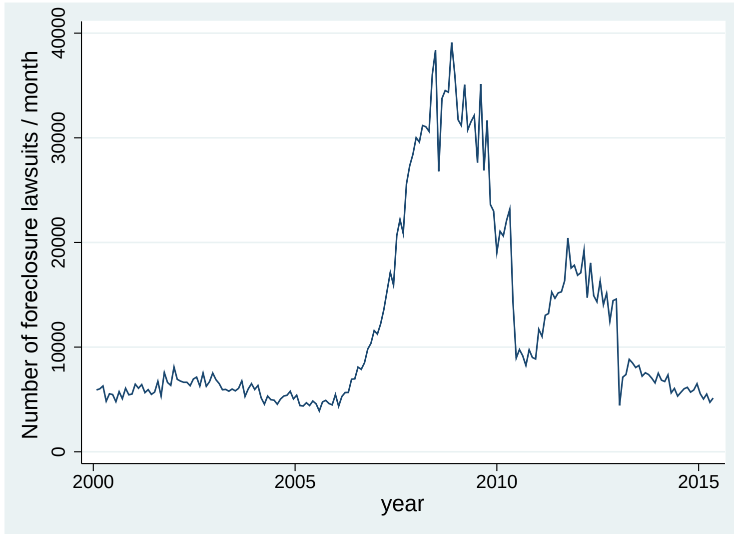


Figure 2: Foreclosure crisis and the number of foreclosure lawsuits

2 Data

Many states went through a sequence of legal reforms over the sample period, and some states are too small to have a decent number of lawsuits over the relevant period. California and Michigan are two non-judicial foreclosure states that went through only Appeal Bond Reform.[13] Appeal bond is an amount a defendant is required to pay to secure his or her right to appeal the verdict. The reform was aimed at billion dollar litigations involving tobacco companies, and thus the reform is likely irrelevant to the outcomes of medical malpractice litigation.[14]

Florida is one of judicial foreclosure states that went through a few tort reforms. For example, Florida experienced Class Action Reform in 2007, which narrowed the scope of permissible claims in class action lawsuits filed in Florida. Class Action Reform is likely to have negligible effects (if there is any) on medical malpractice lawsuits since most of medical malpractice lawsuits involve only one plaintiff.

The Florida Office of Insurance Regulation (OIR), the state agency responsible for regulation and enforcement of statutes related to insurance business, collects *all closed claims* once a claim resolved regardless of the outcome.[15] The report contains detailed information on the dispute resolution process, as well as individual case characteristics, and consists of all cases closed before

[13] The set of reforms that took place in other non-judicial foreclosure states include, but not limited to, Joint & Several Liability Reform, Punitive Damage Reform, Noneconomic Damage Reform, Prejudgment Interest Reform, Product Liabitliy Reform, Class Action Reform, Jury Service Reform, etc.

[14] Appeal bond reform ensures defendants have sufficient assets to make sure plaintiffs receive their awards. In California, Appeal Bond Reform has been in place since 2003 and applied to all civil litigations. In Michigan, Appeal Bond Reform has been in place since 2000 and 2002, respectively.

[15] A statute on professional liability claims requires that medical malpractice insurers file a report on all of their closed claims once a claim resolved regardless of the outcome.

March 2020. The information on the dispute resolution process includes important dates (date of occurrence, date of filing a lawsuit, date of case disposition, etc), severity of injury, settlement payment, judgment outcome, and total legal costs incurred by defendants. Importantly, OIR data contain settlements and judgements that resulted in no compensation payment to plaintiffs. This is crucial to avoid selection issue when analyzing the impacts of delayed justice on litigants' behavior.

National Practitioner Data Bank (NPDB) contains case-level dispute information that resulted in compensation to plaintiffs.[16] The information on the dispute resolution process includes important dates (date of occurrence, date of filing a lawsuit, date of case disposition, etc), severity of injury, settlement payment, and judgment outcome for litigations that resulted in some compensation payment to plaintiffs.

We complement OIR data with NPDB data to construct a dataset that contain dispute outcomes from both judicial and non-judicial foreclosure states. Our sample of medical malpractice cases consists of closed claims against physicians that occurred between 2001 and 2012.[17] We do not include cases that occurred in 2013 or after because we do not observe unresolved cases in the data, and wish to minimize selection issue by dropping recent cases.[18] Because the size/complexity of a dispute differs across the severity of injuries, we restrict attention to the cases in which injuries resulted in a permanent major damage or death of the patient.[19]

Table 1 shows summary statistics on the timing of case disposition using the selected sample. As is the case for any other type of civil litigation, most of the disputes are resolved via settlement before a trial. There are many cases that result in no compensation payment to a plaintiff. These dispositions may take the form of dismissal by the court, simplified summary judgement for defendant, or voluntary dismissal of the case by a plaintiff.

Most of the judgments resulted in no compensation to defendants. The major reason for this is that a defendant can move for summary judgement in early stage of a dispute to avoid the time and expense of a trial when the outcome is obvious. We observe only a small number of cases with compensation payment via judgement. When a trial does take place, however, the amount of compensation tends to be larger than that of settled cases. We also observe a large number of cases with no compensation payment to plaintiffs. As evidence accumulates over time through discovery process, the plaintiff may be convinced that the defendant actually did not make a mistake and drop the case.

[16]The data is retrieved from https://www.npdb.hrsa.gov/resources/puf/pufFormatBackground.jsp.

[17]We do not include, for example, lawsuits agaist nurses, midwifes, hospitals, abortion clinics, podiatric physicians, and physician assistants, etc.

[18]We also drop all cases settled by arbitration since less than 0.3 percent of the cases are resolved via arbitration. In medical malpractice lawsuits, claims are typically not subject to arbitration. Truncation of survival data is particularly relevant here since we examine how the timing of dispute resolution changes as a result of the foreclosure crisis. Having only closed claims may lead us to falsely conclude that foreclosure crisis resulted in early settlement if right truncation not taken into account.

[19]Severity of damage is classified into four categories: i) death, ii) quadraplegia, severe brain damage, lifelong care or fatal prognosis, iii) paraplegia, blindness, loss of two limbs, brain damage, iv) deafness, loss of limb, loss of eye, loss of one kidney or lung, etc.

Table 1: Average compensation in judicial and non-judicial states

		Compensation	Disposition Probability	N
FL	Settlement with compensation	319K	0.55	4,575
	Judgement with compensation	1,487K	0.01	105
	Settlement with no compensation	0	0.36	2,978
	Judgement with no compensation	0	0.08	652
CA	Settlement with compensation	326K	0.98	4,512
	Judgement with compensation	693K	0.02	80
MI	Settlement with compensation	209K	0.98	1,989
	Judgement with compensation	482K	0.02	40

Compensation payments are inflation adjusted and presented in 2018 dollars.

Judgement includes summary judgements which does not involve either jury nor formal trial.

Figure 3 shows frequency distribution of time-to-settelement, starting from the date of injury. On average, it takes 3.76 years for a case to settle and 10 percent of cases takes longer than 6 years to settle.

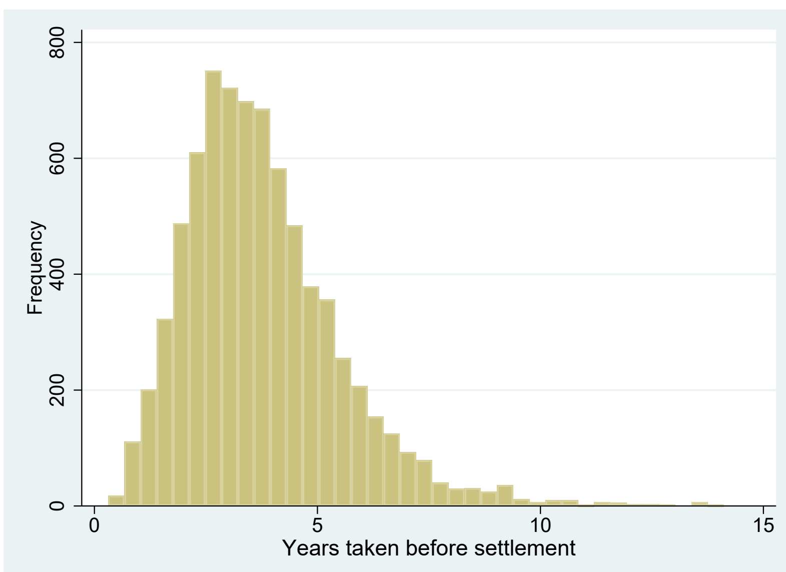


Figure 3: Frequency distribution of time-to-settlement

2.1 Reduced-form analysis

We analyze a survival model with varying timing of exposure to foreclosure crisis to examine the impact of the foreclosure crisis on the timing of settlement. Some cases are settled before the hit of foreclosure crisis while other cases were close to settlement already at the time of the foreclosure crisis. The timing of foreclosure crisis is not exogenous since long-lasting cases are more likely to be exposed to the foreclosure crisis. Also, the observed relationship between the foreclosure crisis and time-to-settlement could be due to the sources unrelated to court delay, such as increased cost of litigation due to the crisis. For example, a plaintiff may abandon the case early if the plaintiff faced a financial constraint as a result of losing her job.

To separate the cost story from the effect of delayed justice, we rely on cases from non-judicial foreclosure states. In non-judicial foreclosure states, the foreclosing party follows a set of state-specific, out-of-court procedural steps to foreclose the home. Since non-judicial foreclosure states did not face a significant increase in foreclosed cases as a result of foreclosure crisis, this allows us to net out the effect of foreclosure crisis unrelated to court caseload.

Let $h\left(t, \mathcal{I}(\cdot), \boldsymbol{D}, \boldsymbol{X}\right)$ denote the hazard rate of settlement where t denotes time elapsed since the occurrence of injury (three month window), $\mathcal{I}(s)$ is an indicator variable equal to 1 if s years after the crisis, , $\boldsymbol{D} := [D_{FL}, D_{MI}, D_{CA}]$ is a vector of state fixed effects, and $\boldsymbol{X}$ is a vector of case characteristics, including injury severity and year of injury.

We examine how the hazard rate of settlement depends on exposure to foreclosure crisis using event study method. The case characteristics $\boldsymbol{X}$ includes injury severity, time fixed effects as well as injury occurrence year fixed effect to capture time trend in time-to-settlement across years. More specifically, we estimate:

$$h\left(t, \mathcal{I}(\cdot), \boldsymbol{D}, \boldsymbol{X}\right) \quad = \quad h_0(t) \exp\left(\sum_s \gamma_s D_{FL} \mathcal{I}(s) + \boldsymbol{D}\boldsymbol{\alpha} + \boldsymbol{X}\boldsymbol{\beta}\right)$$

Figure 4 plots log-difference in hazard rate against the time elapsed since crisis where the period before the crisis is normalized to 0. The results indicate that exposure to foreclosure crisis increases hazard rate of settlement for the cases. Figure 5 allows for heterogeneous effects on the hazard depending on whether a dispute has resulted in some compensation to plaintiffs or not. We find the hazard rate increases for those cases with some compensation to plaintiffs while the hazard decreases for those cases without any compensation.

Figure 6 examines whether there is a differential income effect across judicial and non-judicial foreclosure states. It shows no evidence that median income is affected differently across the two set of states. Figure 7 looks at the difference in settlement rate between California and Michigan, both of which are non-judicial foreclosure states. The average hazard rate does not show differential increase in these two states, suggesting that the result shown in Figure 4 is derived from the difference in court caseload. All the preceeding figures suggest that foreclosure crisis affected the timing of settlement heterogeneously through court delay, and not through income effect. In the following section, we develop a dynamic bargaining model to i) account for the empirical findings, and ii) examine the impact of delayed justice on the distribution of welfare across litigants.

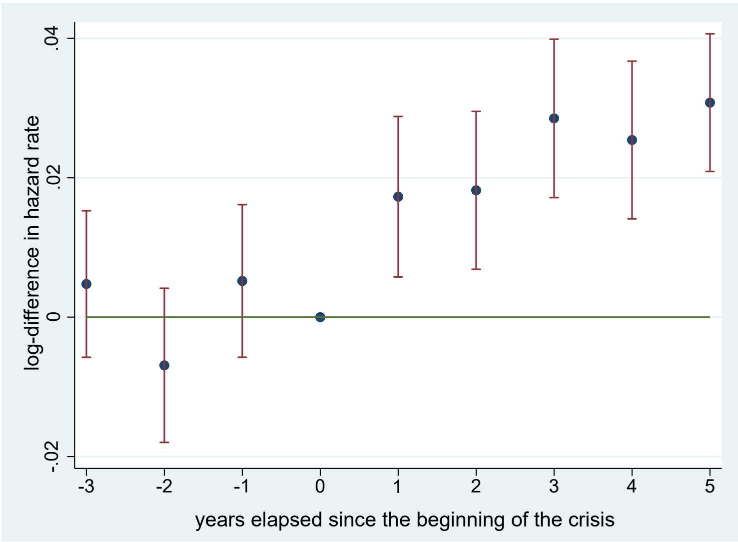


Figure 4: log-difference in settlement rate b/w judicial and non-judicial states

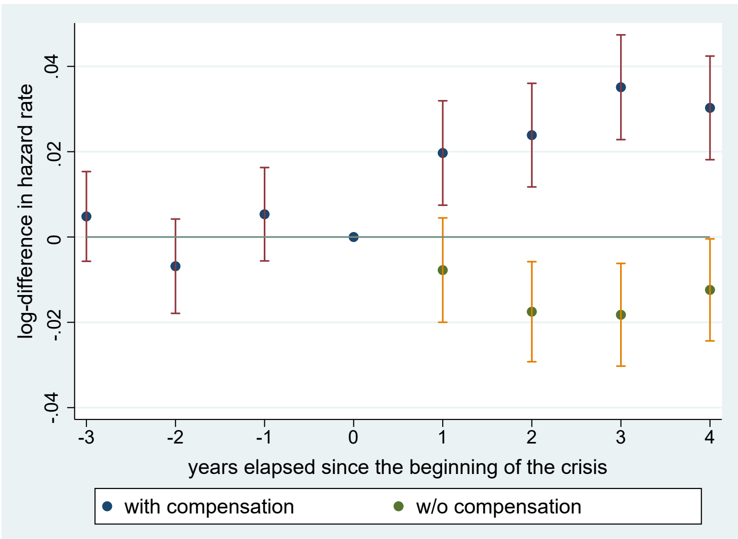


Figure 5: log-difference in settlement rate b/w judicial and non-judicial states

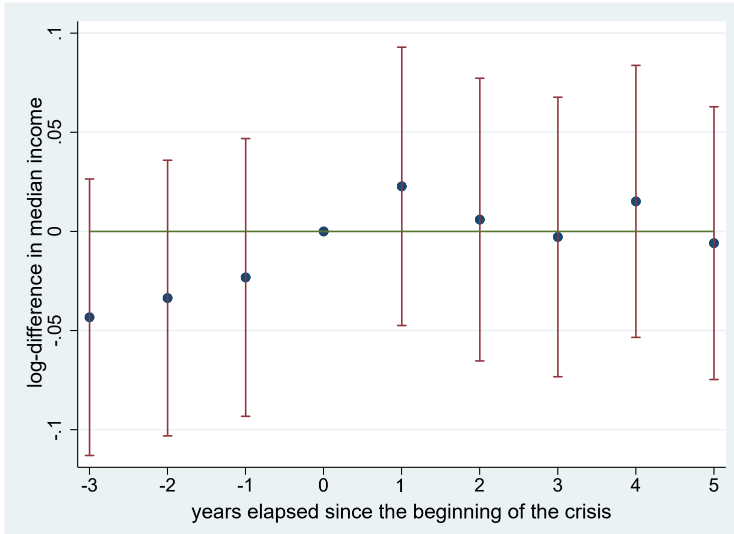


Figure 6: log-difference in median income b/w judicial and non-judicial states

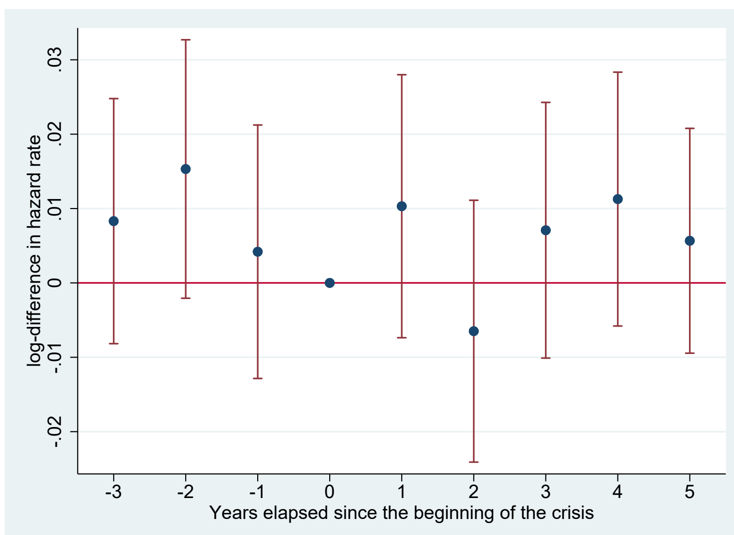


Figure 7: log-difference in settlement rate b/w California and Michigan (non-judicial)

3 The Model

In this section we construct a model that explains our empirical findings, and examine welfare effects of delayed justice. The idea here is to employ the standard logic in constructing a mixed strategy equilibrium. Recall that, in a matching pennies game, when a player 1's gain from tail increases player 2's strategy must adjust so that it becomes unlikely to win from tail to incentivise player 1 to play head. Following this logic, the liable defendant must become more likely to compensate to incentivise the plaintiff to continue since delayed justice deteriorates plaintiff's payoff from continuing the dispute. In a similar vein, the plaintiff must become more persistent since delayed justice increases the liable defendant's expected payoff from continuing the dispute.

Consider a dispute between two risk-neutral agents: a plaintiff P and a defendant D. The time is discrete and indexed by $t = 0, 1, ...$ Let M be the value of the damages for which the defendant is possibly liable. At the outset, the nature determines whether the defendant is liable $\theta = 1$ or not liable $\theta = 0$, with $\Pr[\theta = 1] = p$. The value of θ is the defendant's private information and seen as his type.

The game proceeds as follows. In Period 0, the defendant decides whether to immediately compensate or not given his liability status θ. The game ends if the defendant agrees to compensate. If not, the defendant pays k, which is his cost of preparing for potential litigation.

At the beginning of period $t \in N_+$, the plaintiff first decides whether to continue or to drop her claim (in period 1 she decides whether to file a lawsuit). If the plaintiff decides to drop the game is over and she receives nothing. The plaintiff pays per-period cost c_P if she decides to continue the lawsuit. Then the defendant chooses either to compensate M or to refuse. The game is over if the defendant compensates. The defendant pays per-period cost c_D if he refuses. At the end of the period, the case goes to trial with probability q_t, and the court endorses the payment of θM from the defendant to the plaintiff. The case goes to period $t + 1$ with probability $1 - q_t$. We assume that the probability that the case goes to trial increases with t. The game continues until either the defendant compensates, the plaintiff drops, or the court orders the payment.

If the case is terminated in period t by the plaintiff's dropping her claim, the plaintiff and the defendant's payoffs are $-(t-1) \cdot c_P$ and $-t \cdot c_D$, respectively. If the case is terminated by the defendant's compensation, their payoffs are $M - t \cdot c_P$ and $-M - t \cdot c_D$, respectively. If the game is terminated at the court in period $t \geq 1$, the their payoffs are $\theta M - t \cdot c_P$ and $-\theta M - (t+1) \cdot c_D$, respectively, which depends on the defendant's type θ.

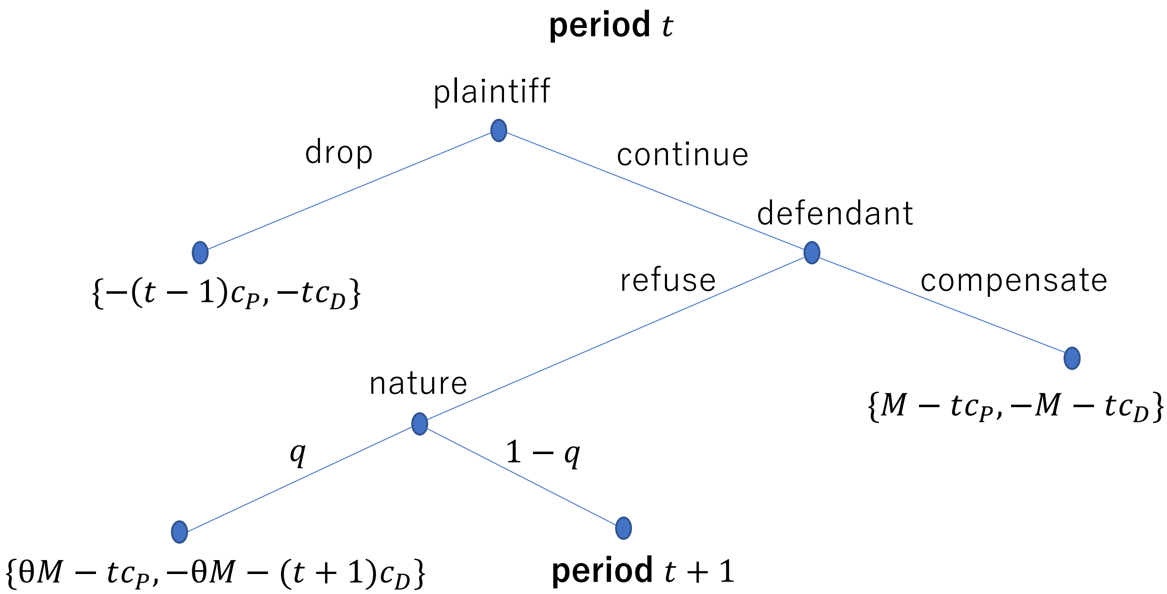


Figure 8: Timing of events and payoffs

The plaintiff's (behavior) strategy in period t is described by γ_t, which is a probability of dropping the case. The type θ defendant's (behavior) strategy is described by α_t^θ, which is the probability of agreeing to compensate in period t, conditional on the case reaching period t. The plaintiff's belief about the dependent type in period t is denoted by B_t, which is the plaintiff's subjective belief that the defendant is liable, $\theta = 1$.

Our solution concept is that of a perfect Bayesian Nash equilibrium. This requires that in each period, the plaintiff maximizes her expected payoff given her belief about the defendant's type and the future play of the game, and the defendant maximizes his expected payoff given the plaintiff's strategy. The plaintiff's belief about the defendant type is consistent with Bayes rule and the defendant's strategy.

In order to exclude the trivial case in which plaintiff withdraws immediately, we take the case in which $pM > c_P$ and $M > c_D$. For expositional simplicity, we let $k = c_D$. Finally, we assume that the rate at which the probability of the case goes to trial increases in each period is constant and hence it is expressed as $q_t = q(1+r)^{t-1}$, where $q \in (0,1)$ represents how prompt the court proceeding settles each case and $r > 0$ is the rate of increment. We will capture the delay in litigation by a decrease in q.

3.1 Litigation without Court Delay

In order to obtain the intuition for our equilibrium construction, we first consider the simplest case in which there is not much delay, i.e., $q_1 M > c_D$. In this case there is a unique equilibrium outcome and in there the case settles in Period 1 (hence in the following we omit the description of equilibrium strategy after Period 2).

Observe that there is no equilibrium such that the plaintiff pursues the law suit with probability one in period 1. This is because this strategy of the plaintiff makes the liable (type $\theta = 1$) defendant immediately compensate in period 0. Then in period 1 the plaintiff is informed of the fact that the defendant is type $\theta = 0$ when her turn comes, and hence she does not have incentive to pursue the law suit, which implies that her supposed strategy is not sequentially rational. In order for the law suit to begin, we need an indifference condition for the liable defendant in period 0. In turn, to make the liable defendant indifferent between compensating and refusing, we need the plaintiff's mixture in her equilibrium strategy, which also gives her indifference condition.

In the equilibrium, the non-liable defendant does not agree to compensate in period 0 and 1. The probability that the liable defendant agrees to compensate in $t = 1$, α_0^1, must make the plaintiff indifferent between dropping and pursuing the lawsuit. On the other hand, the probability of dropping her claim, γ_1, is set so that the liable defendant is indifferent between rejecting and compensating. If the plaintiff pursues the lawsuit, the liable defendant compensates, knowing that the court enforces payment with sufficiently high probability.

The indifference condition for the plaintiff is $B_1 \left(1 - \alpha_0^1\right) M - c_P = 0$, where the left hand side is her expected payoff from pursuing the law suit while the right hand side is the payoff from dropping her claim in $t = 1$.

The indifference condition for the liable defendant in $t = 0$ is $M = (1 - \gamma_1) M + c_D$, where the left hand side is his payment from agreeing to compensate while the right hand side is the expected payment from rejecting it.

The plaintiff's belief about the defendant type must be consistent with Bayes rule and the defendant's strategy; $B_1 = \frac{\left(1-\alpha_1^0\right)p}{\left(1-\alpha_1^0\right)p+1-p}$.

3.2 Litigation with Court Delay

We now consider the case in which delay is expected, i.e., $q_1 M < c_D$. In order to conduct comparative statics, we focus on the equilibrium in which the case does not settle immediately at period 1 and there is no period of inaction in which the case settles with zero probability. Such an equilibrium is unique and in there, the non-liable defendant never compensates until the game ends. The liable defendant and the plaintiff always mix strategies to terminate or not.

Let T be the smallest t such that $q_t M > c_D$. In period T, the probability that case goes to trial is so high that the liable defendant agrees to compensates with probability 1, and hence the game is terminated if it continues until period T.

To understand the equilibrium construction, observe that in the equilibrium, the plaintiff cannot continue with probability one in any period. To see this, note that if the plaintiff continues for certainty, liable type of defendant must survive until then with a positive probability, since otherwise the plaintiff does not have an incentive to continue. Then there are two possibilities; the first is that liable type does not drop in this period, which is excluded by our equilibrium selection, and the second is that liable type drops with some probability in this period. The second, however, contradicts the sequential rationality of the defendant, as he should have been dropped in the previous period to avoid paying period cost c_D. Hence the plaintiff must mix her strategy, which gives an indifference condition for our equilibrium construction for periods 1 - T.

Similarly, the liable defendant must mix his strategy. If he does not agree to compensate in a particular period, the plaintiff continues with probability one in the period (if she drops she should have done earlier), and if he does agree, the plaintiff continues with probability one in the previous period. This tells that the liable defendant is indifferent, which gives another indifference condition for periods 1 - $T-1$. In period T, however, the liable defendant agrees to compensate.

In the equilibrium such that the case does not settle immediately at period 1, the case may not be settled until period T. By using the fact that the plaintiff's value at period $t+1$ is $-tc_P$, the period $t \leq T$ indifference condition for her is written as:

$$\{\alpha_t^1 + q_t(1-\alpha_t^1)\}B_t M = c_P. \tag{1}$$

The says that the expected value of compensation in this period (compensation occurs with probability α_t^1 by the defendant's voluntary compensation and with probability $q_t(1-\alpha_t^1)$ by the court order) must be equal to a period cost of continuing. Her indifference condition for the final period T is simply $B_T M = c_P$.

By using the fact that liable defendant's value in period $s < T-1$ is $M - tc_D$, period $t-1 < T$ indifference condition for him is;

$$M = q_t M + (1-\gamma_t)M + c_D. \tag{2}$$

The left hand side is compensation amount if he agrees to compensate now while the right hand side is the expected value of compensation if he waits and see one more period if the defendant drops her claim, added with a period cost.

Theorem 1. *The players' strategies are supported as an equilibrium if and only if (1) holds for all* $t \leq T$, (2) *holds for all* $t < T$, *and*

$$B_t = \frac{p\Pi_{s=0}^{t-1}\left(1-\alpha_s^1\right)}{p\Pi_{s=1}^{t-1}\left(1-\alpha_s^1\right)+1-p} \text{ for } t \leq T, \tag{3}$$

or the plaintiff withdraws in period 1. *In the equilibrium the liable defendant agrees to compensate in period* T.

In the equilibrium, the plaintiff's expected payoff is $p\alpha_0^1 M$, which is explained as follows. In period 0, with probability $p\alpha_0^1$ the defendant agrees to compensate the damage M. If the defendant disagrees, the game proceeds to period 1. However, because dropping her claim is optimal in period, 1 for the plaintiff in the equilibrium, her continuation value from period 1 is 0; hence her expected payoff in period 0 is $p\alpha_0^1 M$.

Corollary 1. *The plaintiff's expected payoff in the equilibrium, which is denoted by $W(q)$ is;*

$$p\alpha_0^1 M,$$

while that for liable defendant, which is denoted as $V^1(q)$, is simply $-M$ and that for the non-liable defendant, which is denoted by $V^0(q)$, is $-\sum_{s=1}^{T} c_D \gamma_s \Pi_{t=0}^{s}(1-\gamma_t)$, where γ_0 is set to be 0.

Let $\delta_t := B_t\alpha_t^1$ denote the probability that the defendant agrees to settle in time period t. The following is the main results of our model:

Proposition 1. *Consider the range of $q \in (0, \frac{c_D}{M})$. Then delay in court proceedings decreases the probability of agreeing to settle*

$$\frac{\partial B_t \alpha_t^1}{\partial q} < 0,$$

and increases the probability of the plaintiff dropping the case,

$$\frac{\partial \gamma_t}{\partial q} > 0$$

for $t = 1, 2, ..., T-1$.

This is explained as follows. Holding players' strategies fixed, more delay (a decrease in q) worsens the barging power of the plaintiff, thereby she is inclined to drop her claim in each period. In order to incentivise her to continue, the hazard rate that the defendant drops in each period must increase, which explains $\frac{\partial B_t \alpha_t^1}{\partial q} < 0$. On the other hand, delay increases the defendant's incentive to continue, which is mitigated by low probability of withdrawal from the plaintiff, which explains $\frac{\partial \gamma_t}{\partial q} > 0$.

Corollary 2. *The plaintiff's expected payoff decreases with delay;*

$$\frac{\partial W(q)}{\partial q} > 0.$$

The liable defendant's expected payoff is invariant with q while that of the non-liable defendant decreases with delay;

$$\frac{\partial V^1(q)}{\partial q} = 0 \text{ and } \frac{\partial V^0(q)}{\partial q} > 0.$$

The effect of delay (decrease in q) on plaintiff's payoff, $-\frac{\partial W(q)}{\partial q}$, is expressed as $-pM\frac{\partial \alpha_0^1}{\partial q}$, which is negative. This is explained as follows. In each period $t \geq 1$, the plaintiff must be indifferent between continuing and withdrawing in the equilibrium. As q decreases (and hence q_t decreases), her incentive to continue decreases, and to make her indifferent, the probability that the defendant agrees to compensate must increase in each period; $B_t\alpha_t^1$ must increase. For this "hazard rate" to increase in each period, the survival rate of liable defendant must increase; B_t must increase in each period. As α_0^1 and B_t are in an inverse relation, $-\frac{\partial\alpha_0^1}{\partial q}$ is negative.

The liable defendant's expected payoff must be invariant with q from the equilibrium construction: to immediately agree to compensate must be optimal in the equilibrium and hence equilibrium payoff is M. On the other hand, the non-liable defendant's expected payoff decreases with delay, since it decreases the probability of plaintiff's withdrawal in each period, which lengthen the pretrial negotiation.

4 Appendix A: Definitions

4.1 State Court Caseload

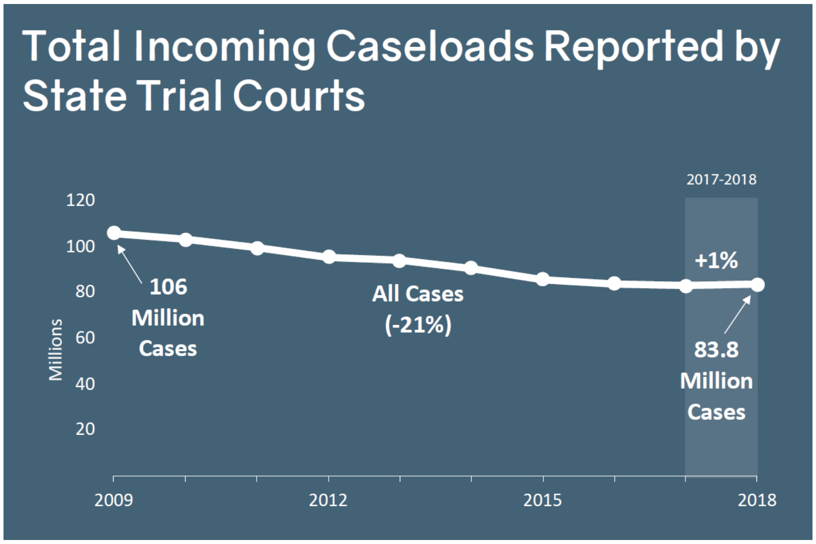


Figure 1: CSP Annual Caseload Report (2018)

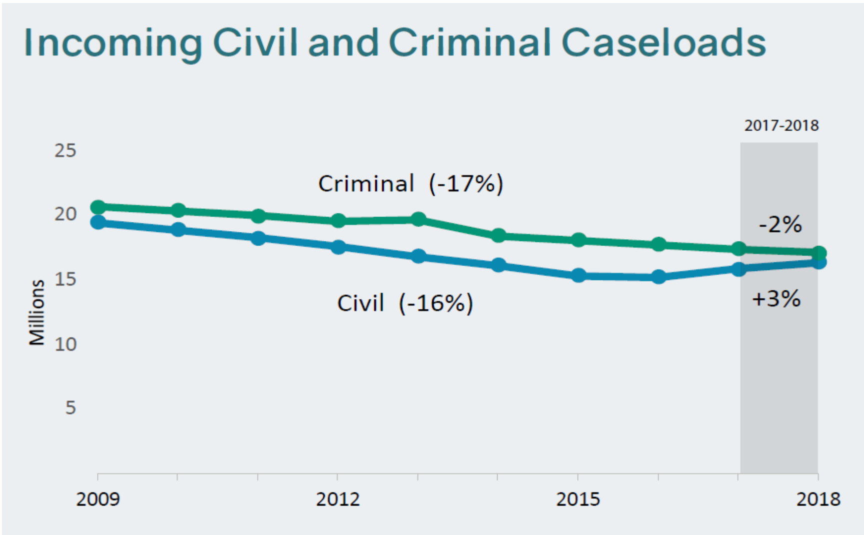


Figure 2: CSP Annual Caseload Report (2018)

4.2 Tort Reforms

Table 1: Tort reforms over the period of 2001-2012

	Florida	California	Michigan	Texas	Arizona
Appeal Bond Reform	y	y	y	y	y
Punitive Damage Reform					y
Class Action Reform	y			y	y
Attorney Retention Sunshine					y
Jury Service Reform				y	
Non-economic Damage Reform				y	
Prejudgment Interest rate (in 2019)	4.75%	10%	3.8%	5.0%	4.25%
Statute of Limitations (year)	2	3	2	2	2
Caps on non-economic damages (in 2019)	500K	250K	445K	250K	No Cap
Caps on serious non-economic damages (in 2019)	1.0M	N/A	795K	N/A	No Cap
Median household income (in 2019 dollars)	56K	75	57	61	59
Per capita income (in 2019 dollars)	32K	37	32	31	31
Population (in 2019)	21M	39M	10M	29M	7.3M
Total employment (in 2019)	8.7M	15M	3.9M	11M	2.5M

4.3 Perfect Bayesian Equilibrium

We start by defining the value functions for the players. For this purpose, define function u_t, which represents the plaintiff's payoff when the case settles in period t by the principal's dropping the case, the defendant's agreement to compensate, and compensation decided at the court, as:

$$u_t(d) = -(t-1)c_P,\ u_t(a) = M - tc_D,\ \text{and } u_t(c) = M - tc_P.$$

Similarly, define V_t^θ, which represents the defendant's payoff when the case is settled in period t as:

$$v_t^\theta(d) = -tc_D,\ v_t^\theta(a) = -M - tc_D,\ \text{and } v_t^\theta(c) = -\theta M - (t+1)c_D.$$

We represent the plaintiff's belief over the defendant types by a function $B : Z_+ \to [0,1]$ for $t = 0, 1, 2, ...$ That is, B_t is the probability that the plaintiff attaches to the event that $\theta = 1$. Also, let φ_t be a probability that the defendant agrees to compensate in period t, which is the plaintiff's belief about the defendant's action, should she continue.

We say that a function $W : \{1, ..., T\} \to \mathbb{R}$ is a value function for the plaintiff given (φ, B) if, for all t,

$$W(t) = \max \left\{ \begin{array}{c} u_t(d), \\ \varphi_t u_t(a) + (1-\varphi_t)\{q u_t(c) + (1-q) W(t+1)\} \end{array} \right\}. \quad (4)$$

A function $V^\theta : \{0, .., T\} \to \mathbb{R}$ is a value function for the defendant type θ, given the plaintiff's strategy γ if for all $t < T$,

$$V^{\theta}(t) = \max \left\{ \begin{array}{c} v_t^{\theta}(a), \\ q_t v_t^{\theta}(c) + (1 - q_t) \{\gamma_{t+1} v_{t+1}^{\theta}(a) + (1 - \gamma_{t+1}) V^{\theta}(t+1)\} \end{array} \right\}, \tag{5}$$

and $V^{\theta}(T) = \max \{-M - Tc_D, -\theta M - (t+1) c_D\}$.

Given the plaintiff's strategy, $V^{\theta}(t)$ is uniquely determined. Also, given given (φ, B), W is uniquely determined.

With the above preparations, we define the equilibrium.

Definition 1. *A tuple $(\alpha, \beta, B, \varphi)$ is a perfect Bayesian equilibrium if there is W such that following conditions are satisfied:*

D1. The optimality of the defendant's strategy in every $t \leq T$: There is V_j that satisfies (5) as well as:

$$\alpha_t^{\theta} > 0 \text{ only when } V^{\theta}(t) = v_t^{\theta}(a),$$
$$\alpha_t^{\theta} < 1 \text{ only when } V^{\theta}(t) = q_t v_t^{\theta}(c) + (1 - q_t) \{\gamma_{t+1} v_{t+1}^{\theta}(a) + (1 - \gamma_{t+1}) V^{\theta}(t+1)\}.$$

D2. The optimality of the plaintiff's strategy in every $t \leq T$:

$$\gamma_t > 0 \text{ only when } W(t) = u_t(w),$$
$$\gamma_t < 0 \text{ only when } W(t) = \varphi_t u_t(a) + (1 - \varphi_t) \{q_t u_t(c) + (1 - q_t) W(t+1)\}.$$

D3. Bayes' rule for the belief of the plaintiff: For all t,

$$\varphi_t = B_t \alpha_t^1 + (1 - B_t) \alpha_t^0,$$

and

$$B_t = \frac{p \Pi_{s=0}^{t-1} (1 - \alpha_s^1)}{p \Pi_{s=1}^{t-1} (1 - \alpha_s^1) + (1 - p) \Pi_{s=1}^{t-1} (1 - \alpha_s^0)}.$$

5 Appendix B: Proofs

Proof of Theorem 1:

Only if direction: Suppose that there is an equilibrium in which the maximum length of the dispute is $s > 2$, i.e., either $\gamma_s = 0$ or $\alpha_{s-1}^{\theta} = 1$ for all $\theta \in \{0, 1\}$, and $\gamma_t > 0$ and $\min_{\theta \in \{0,1\}} \alpha_t^{\theta} < 0$ for all $t < s$.

Step 1: $\alpha_t^1 = 0$ for all $t < s$.

From $v_t^1(a) = v_t^0(a)$ and $v_t^0(c) > v_t^1(c)$ for all $t < s$, we have $V^1(t) \leq V^0(t)$ for all $t \leq s$. Then from D1, it must be true that $\alpha_t^0 \leq \alpha_t^1$ for all $t < s$ and $\alpha_t^1 = 0$ whenever $\alpha_t^1 < 1$. Since $p\Pi_{t=0}^{s-1}\left(1-\alpha_s^1\right) + (1-p)\Pi_{s=0}^{s-1}\left(1-\alpha_s^0\right) > 0$, it must be that $\alpha_t^1 = 0$ for all $t < s$.

Step 2: $s = T$.

Suppose that $s < T$. First think of the case in which $\gamma_s = 0$. Then from D1 and $q_s M < c_D$, it must be that $\alpha_{s-1}^0 = 0$ and $\alpha_{s-1}^1 = 1$, which gives $B_s = 0$. Then from D2, it must be true that $\gamma_s = 1$, which is a contradiction. Next think of the case in which $\alpha_{s-1}^\theta = 1$ for $\theta \in \{0,1\}$. Then it holds that $W(s) = M - sc_P$ and from $D2$, it must be that $\gamma_s = 0$. Those imply $V^\theta(s) = -sc_D$ for $\theta \in \{0,1\}$ and then from D1, $\alpha_{s-1}^\theta = 1$ for $\theta \in \{0,1\}$. This contradicts $s = T$.

Step 3: (2) for all $t < T$.

We prove it inductively. Suppose that $M < (1 - \gamma_T + q_T\gamma_T)M + c_D$. Then from $D1$ for $t = T-1$, $\alpha_{T-1}^1 = \alpha_{T-1}^0 = 0$. This leads $\gamma_{T-1} = 1$ for $t = T-1$, which contradicts Step 2, $s = T$. Conversely, suppose that $M > (1 - \gamma_T + q_T\gamma_T)M + c_D$. Then from $D1$ for $t = T-1$, $\alpha_{T-1}^1 = \alpha_{T-1}^0 = 1$, which again contradicts Step 2, $s = T$. Hence (2) holds for $t = T-1$, which gives $W^1(T-1) = -M - (T-1)c_D$ from $D1$. Using $W^1(T-1) = -M - (T-1)c_D$, (2) for $t = T-2$ is similarly proved. Then (2) for all $t < T-2$ is proved inductively.

Step 4: $B_T M = c_P$. and (1) for all $t < T$.

Suppose that $B_T M > c_P$. Then from $D2$ for $t = T$, it holds that $\gamma_T = 0$, which leads $\alpha_{T-1}^1 = 1$ from $D1$. This, however, implies $\gamma_T = 1$ from $D1$, which is a contradiction. On contrary, suppose that $B_T M < c_P$. Then from $D2$ for $t = T$, it holds that $\gamma_T = 1$, which gives $W(T) = -Tc_D$ from D2. This, however, contradicts $\gamma_{T-1} < 1$ and Step 2, $s = T$. On contrary, suppose that $B_T M > c_P$. Then from $D2$, it holds that $\gamma_T = 0$. This, however, implies $\alpha_{T-1}^1 = 1$ from $D1$, which implies $B_T = 0$ and hence contradicts $\gamma_T = 0$ from D2.

Step 1-4 proves only if direction.

If direction: take strategies and B_t described in Theorem 1. Further let $\alpha_T^1 = 1$, $\alpha_t^0 = 0$ for all $t \leq T$, $\alpha_t^\theta = 1$ for $\theta \in \{0,1\}$, $\gamma_t = 1$, and $B_t = B_T$ for all $t > T$, and finally let φ_t satisfy $D3$. Then it can be verified that for $t < T$,

$$V^1(t) = q_t v_t^1(c) + (1-q_t)\left\{\gamma_{t+1} v_{t+1}^1(a) + (1-\gamma_{t+1}) V^1(t+1)\right\} = v_t^1(a),$$
$$V^0(t) = q_t v_t^0(c) + (1-q_t)\left\{\gamma_{t+1} v_{t+1}^0(a) + (1-\gamma_{t+1}) V^0(t+1)\right\} > v_t^0(A),$$

and

$$V^\theta(t) = q_t v_t^\theta(c) + (1-q_t)\left\{\gamma_{t+1} v_{t+1}^\theta(a) + (1-\gamma_{t+1}) V^\theta(t+1)\right\} > v_t^\theta(A)$$

for all $t \geq T$ and $\theta \in \{0,1\}$. This shows that D1 is satisfied.

By letting $W(t) = MB_t$, it is also verified that

$$W(t) = u_t(d) = \varphi_t u_t(a) + (1-\varphi_t)\{q_t u_t(c) + (1-q_t) W(t+1)\}$$

for all $t < T$ and

$$W(t) = u_t(d) > W(t) = \varphi_t u_t(a) + (1-\varphi_t)\{q_t u_t(c) + (1-q_t) W(t+1)\}$$

for all $t > T$. This shows that D2 is satisfied. This completes the proof.

Proof of Proposition 1.
That $\frac{\partial B_T \alpha_T^1}{\partial q} = 0$ follows immediately from $\alpha_T^1 = 1$ and (1) for $t = T$.
From (1), for all $t < T$, it holds that:

$$(1-q_t)\frac{\partial B_t \alpha_t^1}{\partial q} + q_t \frac{\partial B_t}{\partial q} = -\left(1-\alpha_t^1\right) B_t (1+r)^{t-1}.$$

Also from (3), we have $B_{t+1} = \frac{B_t\left(1-\alpha_t^1\right)}{1-B_t\alpha_t^1}$ and thus:

$$\frac{\partial B_t}{\partial q} = (1-B_t\alpha_t^1)\frac{\partial B_{t+1}}{\partial q} + (1-B_{t+1})\frac{\partial B_t \alpha_t^1}{\partial q}. \tag{6}$$

Solving those equalities for $\frac{\partial B_t \alpha_t^1}{\partial q}$ and $\frac{\partial B_t}{\partial q}$ gives:

$$\frac{\partial B_t \alpha_t^1}{\partial q} = -\frac{q_t(1-B_t\alpha_t^1)}{1-q_tB_{t+1}}\frac{\partial B_{t+1}}{\partial q} - \frac{1-\alpha_t^1}{1-q_tB_{t+1}}B_t(1+r)^{t-1}, \tag{7}$$

and

$$\frac{\partial B_t}{\partial q} = \frac{(1-q_t)(1-B_t\alpha_t^1)}{1-q_tB_{t+1}}\frac{\partial B_{t+1}}{\partial q} - \frac{\left(1-\alpha_t^1\right)B_t(1-B_{t+1})}{(1-q_tB_{t+1})}(1+r)^{t-1} \tag{8}$$

From (7), $\frac{\partial B_t \alpha_t^1}{\partial q} < 0$ if and only if:

$$q_t\frac{\partial B_{t+1}}{\partial q} + \frac{1-\alpha_t^1}{(1-B_t\alpha_t^1)}B_t(1+r)^{t-1} > 0. \tag{9}$$

We prove (9) by Induction. Since $\frac{\partial B_T}{\partial q} = 0$, (9) holds for $t = T-1$. Suppose that (9) holds for all $t > s$. From (8) it is computed that:

$$
\begin{aligned}
& q_s \frac{\partial B_{s+1}}{\partial q} + \frac{1-\alpha_s^1}{(1-B_s\alpha_s^1)} B_s (1+r)^{s-1} \\
&= \frac{q_s\,(1-q_{s+1})\,(1-B_{s+1}\alpha_{s+1}^1)}{1-q_{s+1}B_{s+2}} \frac{\partial B_{s+2}}{\partial q} - \frac{q_s\left(1-\alpha_{s+1}^1\right) B_{s+1}\,(1-B_{s+2})}{(1-q_{s+1}B_{s+2})}(1+r)^s \\
&+ \frac{1-\alpha_s^1}{(1-B_s\alpha_s^1)} B_s (1+r)^{s-1} \\
&> -\frac{(1-q_{s+1})\,(1-\alpha_{s+1}^1) B_{s+1} (1+r)^{s-1}}{1-q_{s+1}B_{s+2}} - \frac{q_{s+1}\left(1-\alpha_{s+1}^1\right) B_{s+1}\,(1-B_{s+2})\,(1+r)^{s-1}}{(1-q_{s+1}B_{s+2})} \\
&+ \frac{1-\alpha_s^1}{(1-B_s\alpha_s^1)} B_s (1+r)^{s-1} \\
&= -(1-\alpha_{s+1}^1)(1+r)^{s-1} B_{s+1} + \frac{1-\alpha_s^1}{(1-B_s\alpha_s^1)} B_s (1+r)^{s-1} \\
&> (1+r)^{s-1}\{\frac{\left(1-\alpha_s^1\right) B_s}{(1-B_s\alpha_s^1)} - B_{s+1}\} = 0,
\end{aligned}
$$

where the first inequality follows from (9) for $t = s+1$ and the second one follows from the fact that the third expression is increasing in α_{s+1}^1. Hence we have (9) for $t = s$, and from the induction arguments (9) holds for all $t \geq 1$. Hence $\frac{\partial B_t \alpha_t^1}{\partial q} < 0$ for all $t \in \{1, .., T-1\}$.

Proof of Corollary 2.

It is sufficient to prove that $\frac{\partial \alpha_0^1}{\partial q} > 0$. From (6) for $t = T-1$ and $\frac{\partial B_T}{\partial q} = 0$ and $\frac{\partial B_{T-1}\alpha_{T-1}^1}{\partial q} < 0$, we have $\frac{\partial B_{T-1}}{\partial q} < 0$. Using this argument inductively, we obtain $\frac{\partial B_1}{\partial q} < 0$. Because $B_1 = \frac{(1-\alpha_t^1)p}{(1-\alpha_t^1)p+1-p}$, this implies that $\frac{\partial \alpha_0^1}{\partial q} > 0$.

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