Experimental Study of Settlement Delay under Asymmetric Information[1]

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Abstract

Research Topic

Delay between injury and settlement

Research Hypothesis

Asymmetric information

Research Method

Theoretic model & laboratory experimentation

Research Results

- Delay exists without asymmetric information
- Asymmetric information increases delay
- Average conformance with theory

Outline

1. Introduction
2. Theory
3. Experimental Design
4. Results
5. Discussion

Introduction: Tort Law

Tort Law

Area of U.S. law involving civil harms not arising from contract.

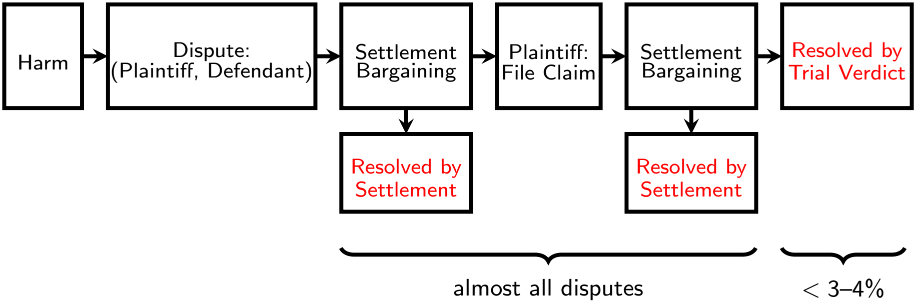
Types of Harms Covered By Tort Law

- traffic collisions
- product malfunctions
- adverse medical outcomes
- premise-related injuries
- slander
- assault
- battery
- wrongful death
- etc

Introduction: Definitions

Plaintiff	the party that was harmed
Defendant	the party alleged to have caused the harm
Dispute	disagreement over compensation owed to plaintiff
Trial Verdict	judge/jury determines liability and damages
Settlement	parties privately agree on a compensation package

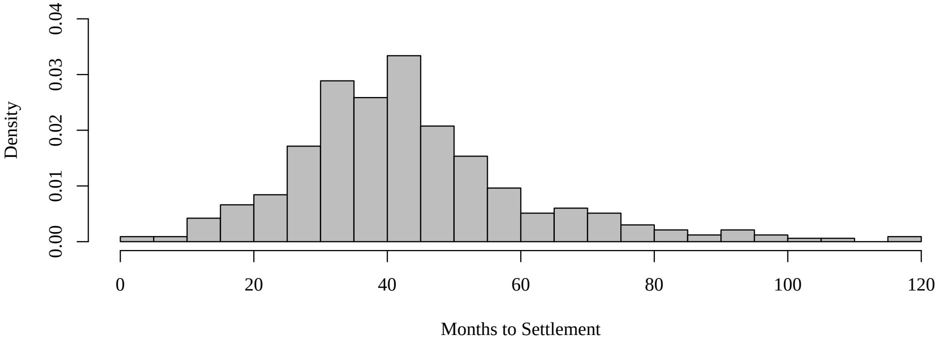
Introduction: Dispute Resolution



Additional Details

Introduction: Resolution Timing

Figure: Settlement Timing for Medical Malpractice Disputes



Introduction: Policy Relevance

Cost Figures

1. Aggregate cost of U.S. tort system about $250 billion per year
2. Settled disputes account for about 97% of costs
3. Defense costs $\approx$ $1,000 per month

Policy Insight

A small decrease in average settlement delay could cause a large decrease in the social cost of the tort system.

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Theory: Settlement Delay Puzzle

Monthly Legal Fees $c_p, c_d > 0$ for plaintiff and defendant

Eventual Settlement transfer $S > 0$ after $t > 1$ months

Simplification WLOG, ignore inter-temporal discounting, etc

Settlement Delay Puzzle

- Any transfer S at time t is Pareto dominated by a feasible transfer $S' \in (S - c_p, S + c_d)$ at time $t - 1$.
- By iteration, all disputes should settle instantly.

Theory: Settlement Bargaining Model

Theoretic Model
: Slight modification of Spier (1989,1992)

Asymmetric Information
: Plaintiff asymmetrically informed about potential damages from a trail verdict

Structured Bargaining
: Defendant makes settlement proposals; concatenated ultimatum offer game

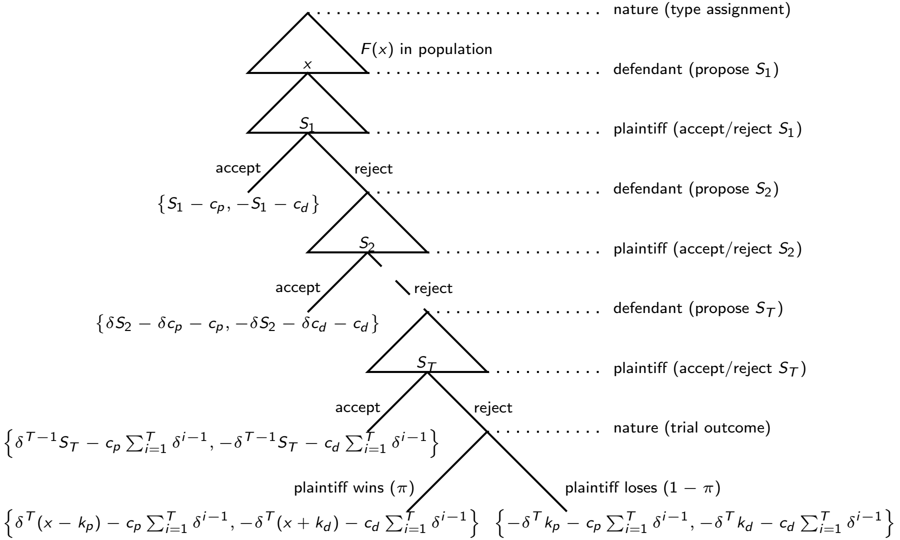
Settlement Delay
: Possible screening equilibrium with rational delay

Theory: Settlement Bargaining Model

Model Notation

x	potential damages; private information of plaintiff; distributed $F(x)$ on $[\overline{x},\underline{x}]$; (uniform distribution)
π	probability that plaintiff wins at trial
T	final period of bargaining (trial at $T+1$)
c_p, c_d	negotiation costs paid in periods $1,\ldots,T$
k_p, k_d	one-time court costs (only for trial verdict)
δ	common per-period discount factor; $\delta \in (0,1)$
S_t	settlement proposal made by defendant in period $t=1,\ldots,T$

Theory: Game Tree



Theory: Equilibrium

Equilibrium Concept

Perfect Bayesian Equilibrium with refinements

Additional Details

Boundary Solution

For sufficiently large costs, boundary solution where all types of plaintiff settle

Additional Details

Interior Solution

Some types of plaintiff never settle; positive measure of plaintiff types settle in each period

Theory: Interior Equilibrium Intuition

1. Very high plaintiff-types (big potential damages) never settle

   Additional Details

2. All plaintiff-types indifferent between all equilibrium proposals
   - e.g. $S_1 \prec S_2$ (not period-1 rational)
   - e.g. $S_1 \succ S_2$ (not period-2 rational)

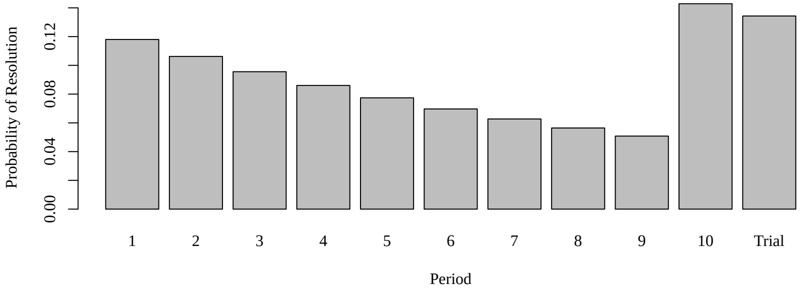
   Additional Details

3. Order of settlement by type makes $S_1^* \sim S_2^* \sim \ldots \sim S_T^*$ sequentially rational from defendant's perspective
   - e.g. $S_1^* = \delta(S_2^* - c_p)$

   Additional Details

Theory: Equilibrium Predictions

Figure: Example of Resolution Timing Distribution



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Experimental Design: Basic Structure

Adaptation of Theoretic Model

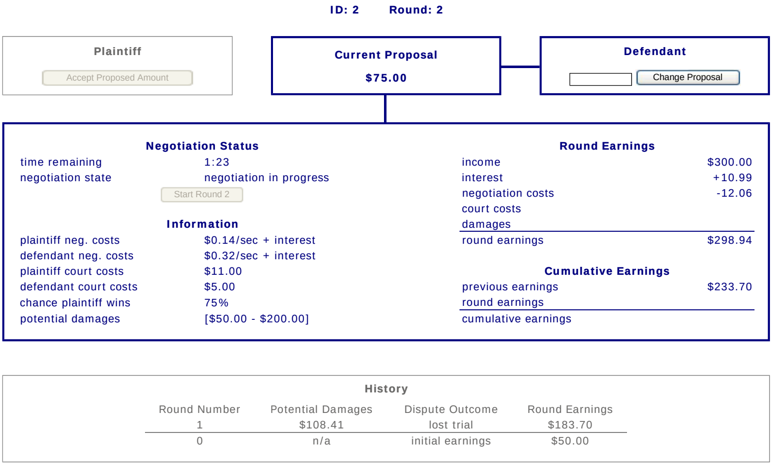
1. Exogenous wealth injections
2. Interest rate substitution
3. Injury as potential damages
4. Continuous-time bargaining

Procedural Practices

1. Persistent roles as plaintiff/defendant
2. Rich terminology
   - e.g. economic injury + pain and suffering

Experimental Design: Online Interface

Figure: Interface Screenshot



Experimental Design: Collected Data

Collected Data

- Value and timing of all settlement proposals
- Value and timing of all settlements
- History of matchings, random draws, etc

Online Illustration

- Continuous-Time Replays

Experiments: Identification Strategy

Symmetric Information

With symmetric information, zero predicted delay

Information Treatment Effect

Difference in delay when information asymmetric vs symmetric identifies treatment effect

Delay Concepts

- Delay-to-Resolution: D_R
- Delay-to-Settlement: $D_S = D_R|\text{settlement}$

Experimental Design: Treatment Structure

Treatments

Information factor (symmetric or asymmetric) crossed with 5 bargaining environments

Sequences

Treatments assigned in pairs: fixed environment, changing information

Replication

Each sequences replicated 2 times; each treatment assigned to 7 rounds

Sample Size

2 replications $\times$ 10 treatments $\times$ 7 rounds $\times$ 6 disputes per round $=$ 840 disputes

Experimental Design: Treatment Structure

Experimental Sequences

Seq.	$\mathbf{T}_A$	$\mathbf{T}_B$	Environment	Information Seq.
$\mathbf{S}_1$	$\mathbf{T}_0$	$\mathbf{T}_1$	Control	Asymmetric $\rightarrow$ Symmetric
$\mathbf{S}_2$	$\mathbf{T}_1$	$\mathbf{T}_0$	Control	Symmetric $\rightarrow$ Asymmetric
$\mathbf{S}_3$	$\mathbf{T}_2$	$\mathbf{T}_3$	Reverse Costs	Asymmetric $\rightarrow$ Symmetric
$\mathbf{S}_4$	$\mathbf{T}_3$	$\mathbf{T}_2$	Reverse Costs	Symmetric $\rightarrow$ Symmetric
$\mathbf{S}_5$	$\mathbf{T}_4$	$\mathbf{T}_5$	Low Costs	Asymmetric $\rightarrow$ Symmetric
$\mathbf{S}_6$	$\mathbf{T}_5$	$\mathbf{T}_4$	Low Costs	Symmetric $\rightarrow$ Symmetric
$\mathbf{S}_7$	$\mathbf{T}_6$	$\mathbf{T}_7$	Low Asymmetry	Asymmetric $\rightarrow$ Symmetric
$\mathbf{S}_8$	$\mathbf{T}_7$	$\mathbf{T}_6$	Low Asymmetry	Symmetric $\rightarrow$ Symmetric
$\mathbf{S}_9$	$\mathbf{T}_8$	$\mathbf{T}_9$	Law School	Asymmetric $\rightarrow$ Symmetric
$\mathbf{S}_{10}$	$\mathbf{T}_9$	$\mathbf{T}_8$	Law School	Symmetric $\rightarrow$ Symmetric

Experimental Design: Treatment Structure

Control Treatment

Prediction of delay under asymmetric information; no delay under symmetric information

Additional Details

Non-Control Treatments (Asymmetric Information)

Treatment	Description	ΔD_R	ΔD_S
Reverse costs	cost terms swapped	same	same
Low costs	reduced c_p, c_d	greater	greater
Low asymmetry	reduced range $\overline{x} - \underline{x}$	lower	same
Law school	law student subjects	same	same

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Results: Treatment Effect of Asymmetric Information

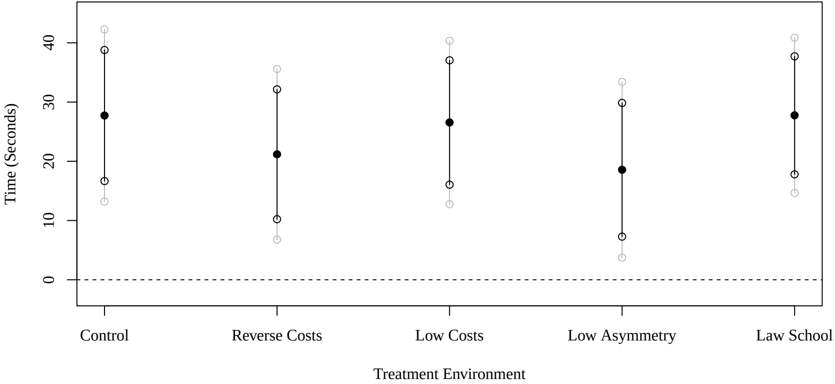
Table: Regression of Delay on Asymmetric Information

	D_R		D_S	
Parameter	(1)	(2)	(3)	(4)
Constant	46.876***	10.586†	35.484***	12.164*
	(5.7243)	(6.1978)	(5.1419)	(5.7191)
Asymmetric Information	27.728***	15.467**	31.836***	23.358***
	(5.6439)	(5.2354)	(4.9396)	(4.8077)
Reverse Costs	2.079	2.060	9.930†	9.067†
	(6.5875)	(5.7408)	(5.3102)	(4.8697)
...	...	...	...	...
Reverse Costs × Asymmetric	−6.546	−4.688	−15.397*	−13.062*
	(7.9447)	(7.1764)	(6.6202)	(6.3036)
...	...	...	...	...
Lag(1) D(p)		0.043		0.073**
		(0.0285)		(0.0270)
Lag(2) D(p)		0.139***		0.103***
		(0.0315)		(0.0304)
Lag(1) D(d)		0.159***		0.082**
		(0.0301)		(0.0297)
Lag(2) D(d)		0.199***		0.087**
		(0.0297)		(0.0282)
σ^2_ϵ	1269.39	1255.71	698.74	701.62
σ^2_η	479.44	152.01	531.5	381.84

Additional Details

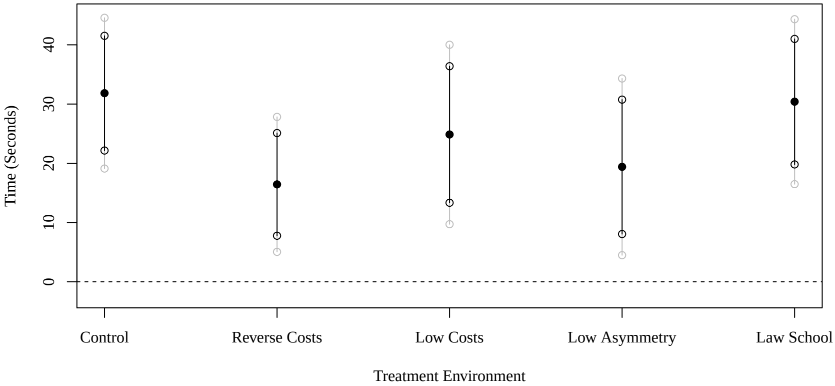
Results: Treatment Effect of Asymmetric Information

Figure: Effect of Asymmetric Information on D_R



Results: Treatment Effect of Asymmetric Information

Figure: Effect of Asymmetric Information on D_S



Observed Settlement Delay

Result #1

Presence of asymmetric information over the potential trial verdict increases settlement delay in every treatment environment

- Increase of 27.7 seconds in D_R about a 50% increase over symmetric information
- Increase of 31.8 seconds in D_S about a 95% increase over symmetric information
- 30 second delay 1/4 maximum duration of bargaining

Results: Treatment Effect of Bargaining Environment

Table: Effect of Bargaining Environment (Asymmetric Only)

Treatment Comparison	ΔD_R	ΔD_S
Control → Reverse Costs	-4.468	-5.467
	0.3822	0.3168
Control → Low Costs	9.679	11.372
	0.0481*	0.0549†
Control → Low Asymmetry	-2.681	-6.415
	0.6048	0.2640
Control → Law School	7.229	8.412
	0.1475	0.1547

Additional Details

Results: Treatment Effect of Bargaining Environment

Result #2

Reverse Costs and Law School treatments reveal no obvious biases.

Result #3

Low Costs treatment weakly consistent with theory.

Result #4

Low Asymmetry treatment inconsistent with theory.

Results: Distribution of Delay (Asymmetric Information)

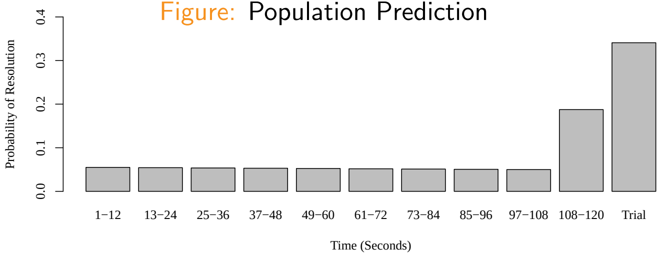


Figure: Population Prediction

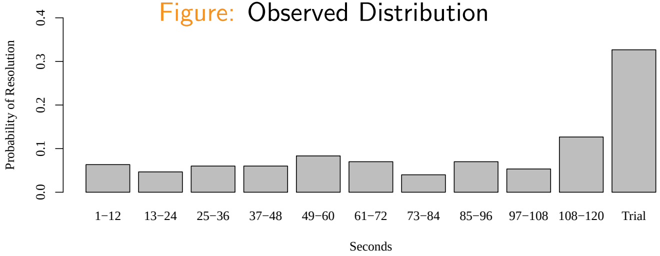
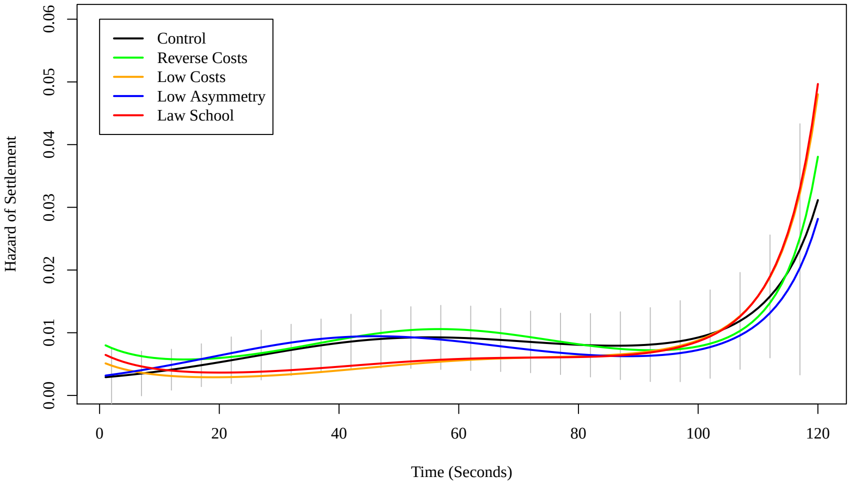


Figure: Observed Distribution

Results: Distribution of Delay (Asymmetric Information)

Figure: Comparative Hazards



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Comments

Asymmetric Information

- Very clear increase settlement delay in the lab
- Not the only cause of delayed agreement

Robustness Checks

- Results stable across environment perturbations
- Insensitivity to degree of asymmetry is odd

Final Analysis

- Plausible contributor to pervasive settlement delay

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Appendix: Distribution of Dispute Outcomes

Percent of Tort Cases Disposed

Trial verdict	2.9%
Settlement	73.4%
Summary/Default Judgment	4.8%
Dismissed/Dropped	9.5%
Arbitration	3.5%
Transfer or Other	5.8%

Source: Smith et al. (1994)

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Appendix: Equilibrium Refinements

Assumptions

Focus on pure strategy equilibria with the following assumptions:

1. In every period, the plaintiff expects the net present value of a trial verdict to exceed zero.
2. If S_t is accepted by a plaintiff of type x', then it is also accepted by a plaintiff of type $x < x'$.
3. A proposal weakly greater than the net present value of settlement to a plaintiff of type $\overline{x}$ is always accepted.
4. The population of plaintiff types has potential damages x distributed uniformly on support $[\underline{x}, \overline{x}]$.

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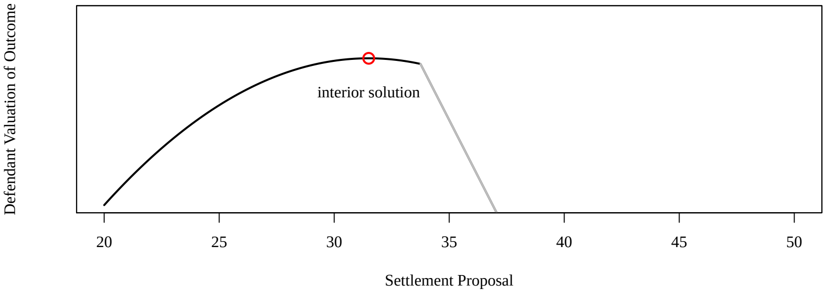
Appendix: Interior vs Boundary Solutions

Figure: Objective Function and Optimum



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Appendix: Plaintiff & Defendant Preferences

Settlement Preferences

$$U_p(S_t) = \delta^{t-1} S_t - c_p \sum_{i=1}^{t} \delta^{i-1}$$

$$U_d(S_t) = -\delta^{t-1} S_t - c_d \sum_{i=1}^{t} \delta^{i-1}$$

Trial Verdict Preferences

$$W_p(x) = \delta^T (\pi x - k_p) - c_p \sum_{i=1}^{T} \delta^{i-1}$$

$$W_d(x) = -\delta^T (\pi x + k_d) - c_d \sum_{i=1}^{T} \delta^{i-1}$$

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Appendix: One-Period Equilibrium

Defendant's Problem

$$\min_{S_1} = \mathrm{P}\left[\text{plaintiff accepts } S_1\right] \times \left(\text{cost to settle at } S_1\right)$$
$$+\, \mathrm{P}\left[\text{plaintiff rejects } S_1\right] \times \mathrm{E}\left[\text{cost of trial verdict} | S_1 \text{ rejected}\right]$$

Type Revelation

Rejection of S_1 means trial preferred: i.e. $x > \pi^{-1}(\delta^{-1} S_1 + k_p)$

Operational Objective Function

$$\max_{S_1} - F(\pi^{-1}(\delta^{-1} S_1 + k_p))(S_1 + c_d) - \int_{\pi^{-1}(\delta^{-1} S_1 + k_p)}^{\overline{x}} \left(\delta(\pi x + k_d) + c_d\right) f(x)\, dx$$

Appendix: One-Period Equilibrium

Interior Solution FOC

$$S_1^I : \underbrace{-F(\pi^{-1}(\delta^{-1}S_1^I + k_p))}_{\text{mc of higher } S_1} + \underbrace{\pi^{-1}(k_d + k_p)f(\pi^{-1}(\delta^{-1}S_1^I + k_p))}_{\text{mb of more settlement}} = 0$$

Boundary Solution

$$S_1^B = \underbrace{\delta(\pi\overline{x} - k_p)}_{\text{NPV of trial verdict to type } \overline{x}}$$

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Appendix: T-Period Equilibrium

Interior Solution

$$S_1^I = \delta^T(\pi \underline{x} + k_d) + c_d \sum_{i=1}^{T-1} \delta^i.$$

Boundary Solution

$$S_1^B = \delta^T(\pi \overline{x} - k_p) - c_p \sum_{i=1}^{T-1} \delta^i.$$

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Appendix: Interior Solution Path of Play

Proposal Sequence

$$S_t^* = \begin{cases} \delta^T(\pi \underline{x} + k_d) + c_d \sum_{i=1}^{T-1} \delta^i & t = 1 \\ \delta^{-1} S_{t-1}^* + c_p & t = 2, \ldots, T \end{cases}$$

Settlement Sequence

$$\underline{x}_t = \begin{cases} \underline{x} & t = 1 \\ \underline{x}_{t-1} + \pi^{-1}\delta^{-T+t-1}(c_p + c_d) & t = 2, \ldots, T \\ \underline{x}_{t-1} + \pi^{-1}(k_p + k_d) & t = T + 1 \end{cases}$$

Ex Ante Probability of Resolution

$$p_t = \begin{cases} \pi^{-1}\delta^{-T+t}(c_p + c_d)/(\overline{x} - \underline{x}) & t = 1, \ldots, T - 1 \\ \pi^{-1}(k_p + k_d)/(\overline{x} - \underline{x}) & t = T \\ 1 - \sum_{i=1}^{T} p_i & t = T + 1 \end{cases}$$

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Appendix: Control Parameter Values

Control Parameter Values

Parameter	Value	Translation to Experiment
$\underline{x}$	\$50.00	economic injury = \$50.00
$\overline{x}$	\$200.00	pain and suffering $\in$ [\$0.00, \$150.00]
π	0.75	(direct translation)
T	120	continuous bargaining
δ	$1000/1001$	$r = 0.001$
c_p	\$0.14	(direct translation)
c_d	\$0.32	(direct translation)
k_p	\$11.00	(direct translation)
k_d	\$5.00	(direct translation)

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Appendix: Non-Control Parameter Values

Non-Control Parameter Values

Parameter	Control	Reverse Costs	Low Costs	Low Asymmetry
$\underline{x}$	\$50.00	—	—	—
$\overline{x}$	\$200.00	—	—	\$150.00
π	0.75	—	—	—
T	120	—	—	—
δ	$^{1000}/_{1001}$	—	—	—
c_p	\$0.14	\$0.32	\$0.07	—
c_d	\$0.32	\$0.14	\$0.16	—
k_p	\$11.00	\$5.00	—	—
k_d	\$5.00	\$11.00	—	—

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Appendix: Regression Details

Sample Size

- D_R sample: $n = 620$ pairs, $M \in \{1, \ldots, 4\}$ repetitions (unbalanced), $N = 1200$ observations
- D_S sample: $n = 532$ pairs, $M = \{1, \ldots, 4\}$ repetitions (unbalanced), $N = 842$ observations

Effects

- Random pair-effects
- Fixed round-effects

Treatment Effects with Lag Terms

- D_R effect: 33.6 seconds
- D_S effect: 35.6 seconds

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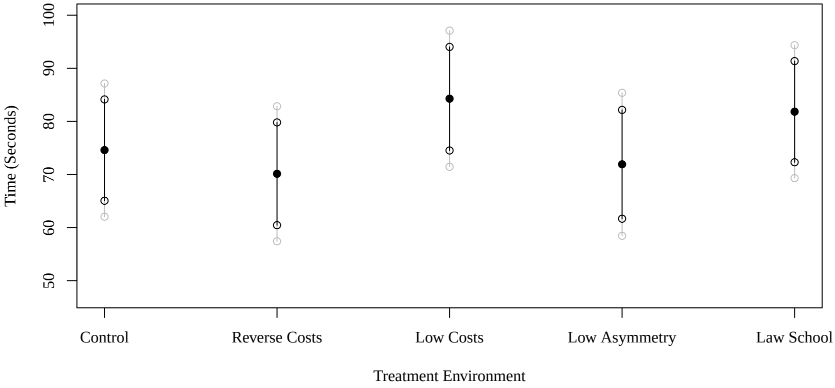
Appendix: Treatment Effect of Bargaining Environment

Figure: Effect of Bargaining Environment on D_R



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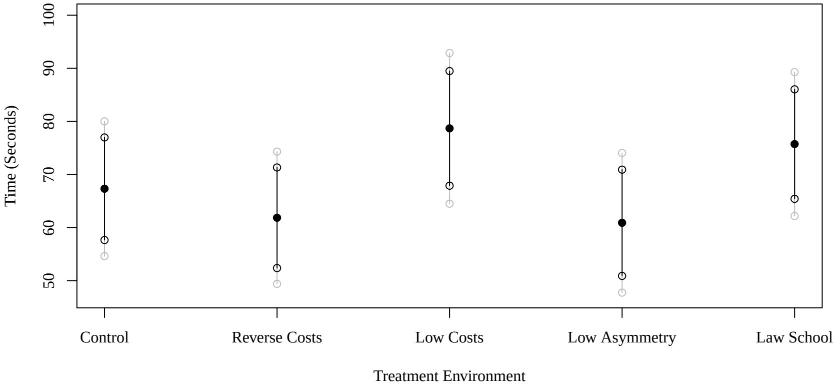
Appendix: Treatment Effect of Bargaining Environment

Figure: Effect of Bargaining Environment on D_S



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