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A Model of Infinitely Repeated Litigation with Correlated Decisions *

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Abstract This paper considers a model of repeated litigation in which a single long-lived defendant faces an infinite sequence of short-lived plaintiffs. Court decisions are correlated across periods, rejecting the presence of precedent effects. We derive unique Markov perfect equilibrium payoffs for the long-lived defendant, and compare them to the predictions of a corresponding two-period benchmark model.

Keywords Repeated litigation, Correlated court decision, Markov perfect equilibrium

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1 Introduction

This paper considers a model of repeated litigation in which a single long-lived defendant faces an infinite sequence of short-lived plaintiffs. Extending the two-period analysis of Che and Yi (1993), it is assumed that court decisions are correlated across time, reflecting the presence of precedent effects.[1]

The main purpose of this repeated analysis is two-fold. First, a number of liability litigations are better captured by an infinite horizon model than by a finite horizon model. For instance, a hospital constantly faces the possibility of a medical accident and a subsequent malpractice litigation. Moreover, the nature of a malpractice claim may well differ from case to case. A finite horizon model, on the other hand, is suitable for analyzing situations in which a sequence of litigations all arise from the same source. For example, consider a bus driver alleged with negligence in an accident causing injuries to the passengers.

Second, we want to compare the predictions of a two-period model with those of an infinite horizon model. Just as a two-period analysis brings useful additional insights from its one-period counterpart, an infinite horizon extension will further clarify the mechanism of precedent effects.

To these ends, the following stage game is considered. In each period, a short-lived plaintiff enters with a fixed, commonly known claim and makes a take-it-or-leave-it settlement demand to the long-lived defendant. A rejection invokes the court, whose liability decision rule is stochastic and depends on the disposition of the previous period's litigation. In order to focus on the role of infinite repetition of litigation, we assume that the two parties are symmetrically informed and that the correlation of court verdicts does not persist beyond two periods.[2]

[1] We refer the reader to Che and Yi (1993) for an introduction to the issue of precedent effects in a legal system.

[2] A more detailed discussion of these modeling assumptions are offered in Section 4 below.

The presence of precedent effects makes the infinitely repeated game non-stationary, and we characterize the set of subgame perfect equilibria in Markov strategies which summarize a history by the court decision rule that it induces. It is shown that, independently of the long-lived defendant's discount factor, the repeated model admits a unique equilibrium level of discounted average expected payment for the defendant which coincides with his reservation payment of the game. We also compare the defendant's equilibrium payment in the infinitely repeated game with those in the two-period and one-period counterparts. This reveals that indeed infinite repetition magnifies the role of precedent effects. Specifically, whenever correlated decisions increase (decrease) the defendant's payment in the two-period case, the payment is yet higher (lower) in the infinitely repeated model.

This paper is broadly related to repeated litigation models with externalities (for an excellent survey of litigation models, see Spier, 2007). This literature is concerned with a host of issues. For example, Katz (1988) and Spurr (1991) explore the relative desirability of various regimes of precedents; Spier (2002) looks at the role of insolvency on litigation behavior under correlated decisions; Daughety and Reinganum (1999, 2002) and Hua and Spier (2005) consider informational externalities across litigations. These analyses are however based on finite horizon models. More recently, Lee and Liu (2010) consider an infinitely repeated model of bargaining with a third party.[3] Their main concern is the effect of reputation for the long-lived player who possesses private information. In their model, precedents matter because of the persistence of private information. Uninformed short-lived players learn from past third party signals and the players condition their behavior accordingly.

The organization of the paper is as follows. In the next section, we lay out

[3] Also, see Lee (2004) who considers a timing game between multiple plaintiffs against a single defendant.

the model of repeated litigation. Section 3 then presents the results. Section 4 concludes the paper with discussion of the key assumptions of the analysis.

2 The Setup

It is assumed throughout that all parties are risk-neutral, that each party bears his own litigation costs (the American fee system), and that information is perfect.[4] The defendant's discount factor is $\delta \in (0, 1)$. Our results below are independent of the value of δ.

One-period litigation Consider a defendant and a plaintiff. The plaintiff's level of damage is fixed and denoted by $W > 0$. If there is a trial, then the plaintiff's winning probability is $p > \frac{1}{2}$, and the costs of trial to the plaintiff and the defendant are $c_p \geq 0$ and $c_d \geq 0$, respectively.

The extensive form of the one-period litigation game is as follows. First, the plaintiff makes a take-it-or-leave-it settlement demand to the defendant. If the defendant accepts the demand, then the game ends; if the defendant rejects it, then the case proceeds to a trial.

Trivially, there is a unique subgame perfect equilibrium (SPE) of this game. The plaintiff makes a settlement demand of $s^* = pW + c_d$ and the defendant accepts it.

Two plaintiffs and correlated decisions Suppose that there are two plaintiffs holding the same case against a single defendant. They litigate sequentially over two periods. The extensive form within each period is the same as above. All other details of this two-period litigation game are the same as before, except that, if the first case goes to trial, the second plaintiff's trial winning probability depends on

[4] Our analysis can easily be extended to the English, loser-pays, fee system, without altering the main messages.

the disposition of the previous period's litigation, i.e. we have *correlated decisions* (Che and Yi, 1993); this probability is

- p if the previous case was settled out of court;
- $p + \epsilon_p$, $\epsilon_p \in (0, 1-p)$, if the previous case ended up in court with plaintiff win;
- $p - \epsilon_d$, $\epsilon_d \in (0, p)$, if the previous case ended up in court with defendant win.

Thus, we allow for the possibility that the precedent effect works asymmetrically across the two sides of a trial.

Since we have externalities across the plaintiffs via correlated decisions, the SPE settlement demand by the first plaintiff, $\hat{s}$, is such that

$$\hat{s} + \delta(pW + c_d) = (pW + c_d) + \delta p[(p + \epsilon_p)W + c_d] + \delta(1-p)[(p - \epsilon_d)W + c_d],$$

which yields

$$\hat{s} = [p + \delta(p\epsilon_p - (1-p)\epsilon_d)]\, W + c_d$$

Thus, the impact of correlated decisions depends on its degree of asymmetry. It is readily seen that $\hat{s} > s^*$ if and only if $\epsilon_d < \frac{p}{1-p}\epsilon_p$.

Infinitely many plaintiffs Now, consider a repeated litigation game in which the defendant is long-lived and faces an infinite sequence of short-lived plaintiffs. Let $t = 1, 2, \ldots$ index the periods.

We assume that the precedent effect does not persist beyond two periods; that is, in any given period, the plaintiff's winning probability depends only on, if there was one, the outcome of the trial immediately before him and not on the outcome(s) of the trial(s) two (or more) periods previously.[5] Thus, at any given $t > 1$, the

[5] We later discuss this assumption in more detail.

plaintiff's winning probability is given by:

- p if the case at $t-1$ was settled out of court;
- $p+\epsilon_p$ if the case at $t-1$ ended up in court with plaintiff win;
- $p-\epsilon_d$ if the case at $t-1$ ended up in court with defendant win.

A (pure) strategy of the long-lived defendant is a mapping from the set of all possible histories that he can observe at the beginning of each period and the set of all possible demands from a short-lived plaintiff to the set $\{Y, N\}$, where Y and N denote acceptance and rejection, respectively. A (pure) strategy of the plaintiff in period t is a mapping from the set of all possible histories that he can observe over preceding $t-1$ periods to all possible offers, $\mathbb{R}$.

Correlated decisions make our repeated litigation game non-stationary. We focus on subgame perfect equilibria in Markov strategies, or Markov perfect equilibria, in which any relevant past history can be summarized by the plaintiff's winning probability that it induces for the current period. Let $\Theta = \{\theta^0, \theta', \theta''\}$ denote the set of three possible states of the repeated game, where θ^0 is the state in which the plaintiff's winning probability is p, θ' the state in which the probability is $p+\epsilon$ and θ'' the state in which the probability is $p-\epsilon$. Then, a Markov strategy for the defendant is

$$\sigma_d : \Theta \times \mathbb{R} \to \{Y, N\}$$

such that $\sigma_d(\theta, s) \in \{Y, N\}$ for any $\theta \in \Theta$ and $s \in \mathbb{R}$. The Markovian property renders irrelevant the period in which a plaintiff makes entry and, hence, we shall write a Markov strategy for the plaintiff simply as

$$\sigma_p : \Theta \to \mathbb{R}.$$

If $\sigma = (\sigma_d, \sigma_p)$ is a Makrov strategy profile, we write the defendant's *discounted average expected payment* in state θ as $S(\sigma, \theta)$. That is, it is the (discounted average) expected *sum* of transfers to the plaintiffs and, if any, trial costs incurred by the defendant. The plaintiff maximizes his expected stage game payoff while the defendant *minimizes* his (discounted average) expected payment. A strategy profile (σ_d, σ_p) forms a Markov perfect equilibrium (MPE) if the usual conditions are satisfied.

3 Results

Before characterizing Markov perfect equilibria of the repeated game, let us first compute the long-lived defendant's reservation payoffs, i.e. what he can obtain from never settling out of court and having a trial in each period. For each $\theta \in \Theta$, let $\bar{S}(\theta)$ denote the defendant's expected payment by taking every plaintiff to court in a game that starts with state θ. Also, to aid exposition, let $p' = p + \epsilon_p$ and $p'' = p - \epsilon_d$. The value function can then be written as

$$\bar{S}(\theta^0) = (1-\delta)(pW + c_d) + \delta\left[p\bar{S}(\theta') + (1-p)\bar{S}(\theta'')\right] \tag{1}$$

$$\bar{S}(\theta') = (1-\delta)(p'W + c_d) + \delta\left[p'\bar{S}(\theta') + (1-p')\bar{S}(\theta'')\right] \tag{2}$$

$$\bar{S}(\theta'') = (1-\delta)(p''W + c_d) + \delta\left[p''\bar{S}(\theta') + (1-p'')\bar{S}(\theta'')\right]. \tag{3}$$

Solving these equations directly, we obtain

$$\bar{S}(\theta^0) = \frac{p - \delta\epsilon_d}{1 - \delta\left(\epsilon_d + \epsilon_p\right)}W + c_d$$

$$\bar{S}(\theta') = \frac{p + \epsilon_p - \delta\left(\epsilon_d + \epsilon_p\right)}{1 - \delta\left(\epsilon_d + \epsilon_p\right)}W + c_d$$

$$\bar{S}(\theta'') = \frac{p - \epsilon_d}{1 - \delta\left(\epsilon_d + \epsilon_p\right)}W + c_d.$$

Since $\delta < 1$, $\epsilon_p < 1 - p$ and $\epsilon_d < p$, it is straightforward to verify that $\bar{S}(\theta') > \bar{S}(\theta^0) > \bar{S}(\theta'') > 0$.

We next show that these values are the unique MPE payments of the repeated litigation game.

Proposition 1 *In any MPE, σ^*, of the repeated litigation game, $S(\sigma^*, \theta) = \bar{S}(\theta)$ for each $\theta \in \Theta$.*

Proof. Fix any δ, and consider any MPE of the game, σ^*. We first show that

$$S(\sigma^*, \theta^0) = (1 - \delta)(pW + c_d) + \delta \left[pS(\sigma^*, \theta') + (1 - p)S(\sigma^*, \theta'')\right] \equiv X(\theta^0). \qquad (4)$$

Suppose not. There are two cases to consider. On the one hand, suppose that $S(\sigma^*, \theta^0) > X(\theta^0)$. Notice that, given the Markovian property of σ^*, $X(\theta^0)$ represents the defendant's expected continuation payment from invoking a trial in the current period. Therefore, in this case, the defendant must be accepting the plaintiff's demand. But then, the defendant can profitably deviate by rejecting the demand, thereby reducing the expected payment. Hence, we derive a contradiction. On the other hand, if $S(\sigma^*, \theta^0) < X(\theta^0)$, the plaintiff can profitably deviate by demanding slightly more than the equilibrium level. Given the Markovian property, the defendant would accept such a demand. Hence, we derive a contradiction.

By similar arguments, we can also establish that

$$S(\sigma^*, \theta') = (1 - \delta)(p'W + c_d) + \delta \left[p'S(\sigma^*, \theta') + (1 - p')S(\sigma^*, \theta'')\right] \qquad (5)$$

$$S(\sigma^*, \theta'') = (1 - \delta)(p''W + c_d) + \delta \left[p''S(\sigma^*, \theta') + (1 - p'')S(\sigma^*, \theta'')\right] \qquad (6)$$

where $p' = p + \epsilon_p$ and $p'' = p - \epsilon_d$ as above.

We compare (4), (5) and (6) with (1), (2) and (3) above to complete the proof. ■

It is straightforward to construct an equilibrium that supports the payment result of Proposition 1. From the arguments behind its proof, we can compute the equilibrium demand for each state, $s^*(\theta)$, and let the equilibrium strategies σ_d^* and σ_p^* be such that $\sigma_d^*(\theta, s) = Y$ if and only if $s \leq s^*(\theta)$ and $\sigma_p^*(\theta) = s^*(\theta)$ for each θ.

It immediately follows that a higher chance of winning for the plaintiff or a stronger precedent effect of a plaintiff victory in court adds to the equilibrium payment of the defendant, while a stronger precedent effect of a defendant victory lowers it.

Proposition 2 $\frac{\partial \bar{S}(\theta^0)}{\partial p} > 0$, $\frac{\partial \bar{S}(\theta^0)}{\partial \epsilon_p} > 0$ *and* $\frac{\partial \bar{S}(\theta^0)}{\partial \epsilon_d} < 0$.

Finally, we compare the defendant's equilibrium payments across the one-period, two-period and repeated models. Indeed, we observe that infinite repetition of litigations magnifies the impact of correlated decisions. Whenever facing two plaintiffs yields a higher/lower (average) payment for the defendant compared to the one-period case, infinite repetition raises/reduces the expenditure even further.

Proposition 3 *If* $\epsilon_d < \frac{p}{1-p}\epsilon_p$, $\bar{S}(\theta^0) > \hat{s} > s^*$; *otherwise,* $\bar{S}(\theta^0) \leq \hat{s} \leq s^*$.

Proof. Simple algebra shows that $\bar{S}(\theta^0) > \hat{s}$ if and only if $\epsilon_d < \frac{p}{1-p}\epsilon_p$. We have also shown that $\hat{s} > s^*$ if and only if $\epsilon_d < \frac{p}{1-p}\epsilon_p$. ■

4 Concluding Discussion

We conclude with discussion of the key assumptions of our model.

Correlated decisions in the repeated model Our repeated model assumes that the precedent effect lasts only one period. It is however feasible that a court verdict on a similar case many periods prior to the current one, with no trials in between, has an impact on the outcome of the case at present. Introducing such a possibility is an interesting extension of the model but we conjecture that the effect of repetition on the defendant's payments will increase with the duration of the precedent effect. In fact, the main purpose of our exercise is to verify whether or not infinite repetition of litigation further increases the impact of correlated decisions compared with the two-period case. In order to focus on this issue, we consider the correlation to persist for the shortest possible time interval.

Symmetric information We compare one-period, two-period and repeated models with complete information. Our analysis remains unchanged by assuming that the stake in each period is drawn from some commonly known distribution. Then, W would represent the expected level of damage. Che and Yi (1993), however, consider informational asymmetry across each defendant-plaintiff pair. It is also possible to extend our models by assuming that, in each period, nature independently draws a level of damage from an identical distribution and each realization is observed privately by the defendant. Again, for the sake of highlighting the role of repetition, we choose to abstract away from the added complication that would arise from this type of asymmetric information.

A more interesting alternative is to endogenize the source of correlated decisions by considering persistent private information. In the repeated model of bargaining with a third party by Lee and Liu (2010), the long-lived player possesses private information that remains fixed throughout the infinite horizon. A third party signal (e.g. court verdict) would then endogenously generate a precedent effect as later short-lived players learn about the informed long-lived player from it and the updated belief determines their behavior as well as the behavior of the long-lived player himself.[6]

Other equilibria The repeated model could admit other non-Markovian equilibria in which the defendant on average expects to pay less than in the Markov equilibrium that we derive. The Markovian restriction however gives a unique payment result, and this allows for a useful comparison between the outcomes of one-period, two-period and repeated models. Indeed, many non-stationary repeated models adopt this approach. See, for example, Maskin and Tirole (2001) for justifications of the Markovian approach.

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[6]Che and Yi (1993) also address this issue of learning in their two-period setup by also considering the case in which privately known damages are correlated across the two plaintiffs.

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