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THE CENTER FOR THE STUDY
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Settlement with Multiple Plaintiffs:
The Role of Insolvency

By

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Abstract

This paper considers settlement negotiations between one defendant and two plaintiffs when the defendant's wealth is constrained. The acceptance of a settlement offer by one plaintiff may either increase or decrease the other plaintiff's expected payoff at trial. These externalities affect the settlement rate and the allocation of the bargaining surplus. Negotiations fail if and only if the two plaintiffs bargain independently of one another and their payoffs at trial are sufficiently correlated. Settlement is facilitated if the plaintiffs bargain collectively, accepting only offers that are in their mutual interest. Collective bargaining is unambiguously desirable in this case, leading to higher private and social welfare. For intermediate degrees of correlation, collective bargaining shifts bargaining surplus from the plaintiffs to the defendant. In contrast, for low degrees of correlation collective bargaining shifts surplus from the defendant to the plaintiffs. (Risk dominance is used to refine the set of equilibria in this last case.) These results suggest that (1) class actions increase the settlement rate by eliminating externalities, (2) class actions may be either pro plaintiff or prodefendant, depending upon the degree of correlation between the cases, (3) allowing plaintiffs to "opt out" of settlements reduces the overall rate of settlement.

1. Introduction

Many companies have suffered financial distress due to civil litigation. Dow Corning, for example, sought bankruptcy protection in 1995 from numerous individual and class action lawsuits relating to breast implants. Piper Aircraft faced a long string of lawsuits in the 1980's before finally filing for bankruptcy protection in 1991.¹ Johns Manville and many other asbestos manufacturers went bankrupt following two decades of litigation.² In July of 2000, a jury ordered the tobacco industry to pay \$145 Billion in punitive damages to Florida smokers – the largest award in United States history.³ Although large civil judgments can clearly bankrupt defendants (and possibly entire industries),⁴ there has been little economic analysis of settlement negotiations under these circumstances.⁵

This paper considers settlement negotiations between one defendant and two plaintiffs when the defendant's wealth is insufficient to cover the total level of damages should both plaintiffs win at trial. The likelihood of settlement and the allocation of the bargaining surplus among the litigants hinges on two factors. The first factor is the degree of correlation between

¹ "Judge rejects \$40 M Bid for Piper Aircraft," *New York Times*, September 4, 1993.

² "Trying the Lawyers," *US News and World Report*, June 28, 1999.

³ "Tobacco Lawsuit in Florida Yields Record Damages," *New York Times*, July 15, 2000.

⁴ Recently in the news, Toshiba recently settled a billion dollar lawsuit that contended that they sold defective laptop machines. Taizo Nishimuro, the president of Toshiba, defended the settlement by saying that the company faced the possibility of a \$10 billion dollar judgment if the case went before a jury "that would have endangered the very existence of the company." "Toshiba Faces \$1 B Bill Over a Lawsuit," *New York Times*, October 30, 1999.

Several small firearms manufacturers have gone bankrupt under the financial strain of lawsuits brought by local and federal government. These suits contend that the gun manufacturers do not impose strict enough controls on distributors and retailers. "U.S. to Join Legal Fray Against Gunmakers," *Los Angeles Times*, December 12, 1999.

⁵ Hay and Spier (1998) and Daughety (forthcoming) present surveys of the settlement literature. Spier and Sykes (1998) show that debt can be used strategically in settlement negotiations with a single plaintiff. Kornhauser and Revesz (1994b) consider multiple defendant litigation with insolvency. Shavell (1993) considers lawsuits over "nonmonetary" issues (such as child custody) when the litigations are financially constrained and shows that trials may be inevitable. These papers do not consider the multiple plaintiff situation explored here.

the probabilities that the cases will succeed at trial. (Two product liability suits brought against the same manufacturer would be correlated, for example, if the injuries resulted from the same underlying product defect. A contract suit and an employment discrimination suit, on the other hand, are more likely to be statistically independent.) The second factor is the organization, or lack thereof, of the plaintiffs in the bargaining process: The outcome of negotiations changes when the plaintiffs bargain collectively. Collective bargaining may be achieved through formal channels such as the formation of a class action lawsuit or through less formal channels such as hiring the same attorney.

It is shown that decentralized settlement negotiations necessarily break down in equilibrium when the correlation coefficient is in the *highest range*.⁶ A settlement range fails to exist because there are bargaining externalities: each plaintiff refuses to settle even though settlement is in their mutual interest.⁷ For these parameter values, collective bargaining facilitates settlement and avoids the expense of trial. For correlation coefficients in the *lowest range*, the defendant coerces independent plaintiffs into settling for less than they would receive if both cases went to trial. The plaintiffs are better off and the defendant is worse off with collective bargaining in this case. Finally, for correlation coefficients in an *intermediate range*, independent plaintiffs enjoy a settlement premium. In this case the plaintiffs prefer to bargain independently and use the settlement externalities to their strategic advantage.

⁶ The typical reasons given for settlement breakdowns are excessive optimism and asymmetric information (See Hay and Spier, 1998, and Daughety 1999 for surveys of the literature). Settlement negotiations may also fail due to externalities. These externalities may come from conflicts between lawyers and clients (Miller, 1987), defendants and liability insurers (Meurer, 1992; Sykes, 1994), corporate defendants and debtholders (Spier and Sykes, 1997), and multiple defendants (Kornhauser and Revesz, 1994a, 1994b) which will be discussed in more detail.

⁷ This refers to settlement negotiations with simple unconditional offers. More elaborate mechanisms would overcome these externalities. See, for example, Segal (1999). Papers in the game theory literature with delay or inefficiency due to externalities include Jehiel and

Piper Aircraft provides an interesting example of a defendant on the verge of insolvency.⁸ Piper faced a flurry of product liability lawsuits in the 1980's for alleged design defects in their airplanes. While Piper initially settled many of these claims out of court, by the end of the decade they cancelled their insurance policies and had adopted a "no-settlement" strategy, taking virtually all cases to trial. This behavior can be explained in different ways. One angle is that Piper's tough litigation strategy was a tactic to encourage existing plaintiffs to drop their claims and to discourage potential plaintiffs from bringing more lawsuits. Another angle, the one highlighted by this paper, is that Piper would have been strictly worse off settling since the plaintiff's claims were almost surely correlated. Settling with one plaintiff would confer a positive externality on the others, thereby reducing the value of Piper Aircraft's equity.

A simple example illustrates that bargaining externalities exist when the defendant's wealth is limited. Suppose that two plaintiffs, each of whom has suffered damages of \$100, are suing the same defendant. For simplicity, suppose that the defendant's wealth is \$100, sufficient to cover exactly one claim. The unconditional probability that a plaintiff will win at trial is .5, but the two cases may be correlated. q is the probability that both plaintiffs win at trial, and is isomorphic to the correlation coefficient.⁹ Assuming away all litigation costs, we can write each plaintiff's expected payoff if both cases go to trial as $q(\$50) + (.5 - q)(\$100)$.¹⁰ With probability q both plaintiffs win at trial they split the defendant's wealth and receive \$50 each. With

Moldovanu (1995) and Jehiel et. al. (1996). Fernandez and Glazer (1991) constructed delay in a model with complete information by exploiting multiple equilibria.

⁸ When they filed for bankruptcy protection in 1991, Piper had \$62 million in assets and \$47 million in liabilities, not including the uncertain liability for 20 pending crash lawsuits. "Judge rejects \$40 M Bid for Piper Aircraft," *New York Times*, September 4, 1993.

⁹ If $q=1/4$ the cases are uncorrelated, if $q=1/2$ the cases are perfectly correlated, and if $q=0$ the cases are negatively correlated. The correlation coefficient is $r=4q-1$.

¹⁰ We are implicitly assuming in this simple example that neither plaintiff expects to have priority over the other in bankruptcy (see the discussion in Section 2). This assumption is relaxed in Section 4.

probability $(.5 - q)$ a plaintiff wins alone and receives her full damages of \$100. We can rewrite a plaintiff's expected payoff as $\hat{S} = 50(1 - q)$. Notice that \hat{S} is decreasing in the parameter q .

If the plaintiffs bargain collectively, the defendant can offer to settle for $2\hat{S}$. The plaintiffs get \hat{S} apiece, exactly what each would get if both cases went to trial. Now suppose that the plaintiffs bargain independently of each other. One might think that the defendant would offer to settle with each plaintiff for \hat{S} , but this is not the defendant's optimal strategy. If only Plaintiff 2 accepted the offer, \hat{S} , then Plaintiff 1's expected payoff from going to trial would be $.5(\$100 - \hat{S})$. Plaintiff 1 would win with probability .5 and capture all of the defendant's remaining wealth, $\$100 - \hat{S}$.¹¹ Substituting the value of \hat{S} from above allows us to rewrite Plaintiff 1's expected payoff as $\$25(100 + q)$. This may be either higher or lower than the defendant's original offer, \hat{S} !

Bargaining externalities are responsible for the discrepancy between \hat{S} and Plaintiff 1's payoff at trial. When Plaintiff 2 accepts the settlement offer \hat{S} there are both positive and negative effects for Plaintiff 1. The acceptance by Plaintiff 2 *increases* Plaintiff 1's expected payoff in those states of nature where both plaintiffs would have won at trial. Instead of getting half of the defendant's wealth, \$50, Plaintiff 1 gets $\$100 - \hat{S} \geq \50 .¹² In these states of nature, the acceptance of the settlement offer confers a *positive externality* on Plaintiff 1. On the other hand, the acceptance by Plaintiff 2 lowers Plaintiff 1's expected payoff in those states of nature where Plaintiff 2 would have lost at trial. Now instead of getting all of the defendant's wealth,

¹¹ In this simple example, the settling plaintiff is paid immediately – she enjoys seniority relative to the non-settling plaintiff. This assumption is discussed in more detail in Section 2 and is relaxed in Section 4.

¹² \hat{S} is smaller than \$50 because although the plaintiff wins with probability .5 she will not always be compensated in full for her damages of \$100.

\$100, Plaintiff 1 gets $\$100 - \hat{S}$. In these states of nature, the acceptance of the settlement offer imposes a *negative externality* on Plaintiff 1.

The overall impact on Plaintiff 1's expected payoff depends on the degree of correlation between the cases. When the cases are not too correlated ($q < 1/3$) then Plaintiff 1 is made worse off by Plaintiff 2's acceptance since $\$25(1+q) < \hat{S}$. For these parameter values it would be a Nash equilibrium for both plaintiffs to accept \hat{S} . The defendant can do better than this, however. He can take advantage of the plaintiffs' lack of coordination and offer to settle for less than \hat{S} . For these parameter values, the plaintiffs are made better off and the defendant is made worse off when the plaintiffs bargain collectively. On the other hand, when the cases are sufficiently correlated ($q > 1/3$), Plaintiff 1 would benefit from Plaintiff 2's acceptance of \hat{S} since $\$25(1+q) > \hat{S}$. For these parameter values the defendant would have to offer more than \hat{S} to induce the plaintiffs to settle. Rather than do this, however, the defendant would prefer to take both cases to trial (since the litigation costs are negligible).¹³ Since decentralized settlement negotiations fail when $q > 1/3$, both social and private welfare increase if the plaintiffs bargain collectively and accept offers that are in their mutual interest.¹⁴

This paper is not the first to consider strategic motives for consolidating plaintiff claims.¹⁵ Che (1996) assumes that there are traditional economies of scale in consolidation (consolidation avoids duplication in case preparation, for example) and that each plaintiff has

¹³ We will argue later that when there are litigation costs the defendant may sometimes offer to settle for more than \hat{S} rather than engage in costly litigation. When this is true, the defendant is better off and the plaintiffs worse off with collective settlement bargaining.

¹⁴ The only social costs modeled in this paper are litigation costs. The model does not include the social costs associated with primary behavior.

¹⁵ Miller (1998) gives a survey of the economics of class action litigation. An important issue in the literature is the conflict of interest between the (often self-appointed) attorney and the dispersed clients he represents.

private information about the value of her claim. Che looks at the incentive for plaintiffs to join a class action when each class member will be compensated for the "average" value of damages within the class. A plaintiff's decision to join the class action signals to the defendant that the case is a "lemon" since a very strong plaintiff would prefer to litigate individually. Consequently, too few class actions are formed in equilibrium. In a second paper with asymmetric information (but without damage averaging or economies of scale), Che (1999) argues that consolidating claims changes the distribution of types facing the defendant, and derives conditions under which this enhances the bargaining power of the plaintiffs. Neither paper considers the bargaining externalities identified here.¹⁶

Multiple defendant lawsuits under joint and several liability share many of the issues identified here (See Kornhauser and Revesz (1994a) and (1994b)).¹⁷ In recent years these lawsuits have been prominent in the cleanup of toxic waste sites. Under the so-called "pro-tanto setoff rule," for example, the acceptance of a settlement offer by one defendant reduces the claim against the other defendants by exactly that amount. When the cases are perfectly correlated the acceptance by one defendant increases the remaining defendants' expected liability – a negative externality. This externality allows a plaintiff to profitably increase her settlement demands. On the flipside, when the cases are uncorrelated the acceptance by one defendant tends to reduce the other defendants' liability – a positive externality. In this case joint and several liability

¹⁶ Che and Yi (1993) consider the role of precedent in litigation when (1) the outcome of one trial directly impacts the outcomes of subsequent cases and (2) plaintiffs can learn about their case from observing past decisions. Daughety and Reinganum (1999 and forthcoming) consider settlement negotiations when the defendant may want to keep information about the lawsuit a secret. The externalities in bargaining are very different than those considered here

¹⁷ See also Spier (1994a), Klerman (1996), Kahan (1996), and Feess and Muelheusser (2000). Chang and Sigman (2000) provide empirical support for the theory.

discourages settlement: the plaintiff is better off taking the defendants to trial. The results presented here are just the opposite.¹⁸

The ideas here are related to the observed "rush to collect" the assets of near-insolvent firms and banks. The idea is that when a firm has limited assets, claimants will rush to be first to withdraw their claim – if they wait too long, the assets of the firm may already be depleted and there will be nothing left to claim.¹⁹ This tendency arises in my model when the degree of correlation between the two claims is below a threshold. The settlement by one plaintiff (the "withdrawal of firm value") hurts the other plaintiff whose expected winnings at trial are consequently lower. Negative correlation among claims may arise for a variety of reasons. Recently in the news, laid off employees of bankrupt Builders Square are suing to recover their severance packages. At issue is whether the severance debt was incurred after bankruptcy was filed (in which case the severance debt has priority) or whether it was part of a prior deal.²⁰ In this case, there is uncertainty about the status and merits of various contractual claimants, as well as uncertainty about the value of assets.²¹ According to my model, the defendant may be able to take advantage of this situation by making aggressive settlement offers to the disorganized plaintiffs.

¹⁸ While the games are formally similar, there are several differences between the formal analyses. My analysis (1) allows either one or both winning plaintiffs to bankrupt the defendant (there is no formal analogy in the joint and several liability setup); (2) considers the private and social desirability of collective bargaining; (3) considers alternative timings of the game, including sequential trials, sequential offers, and settlement in bankruptcy; (4) considers a full range of correlation between the cases, including negative correlation; (5) uses Harsanyi and Selten's (1988) risk dominance to refine the set of equilibria.

¹⁹ This can create a prisoners-dilemma type situation where the "grabbing" of the assets serves to destroy firm value. Thomas Jackson (1986). A related problem was modeled by Gertner and Scharfstein (1991), which they called the "hold-in problem." In their model, the existence of both long-term and short-term debt led to coordination problems and conflict among claimants.

²⁰ "Lawyers Offer Some Hope to Builders Square Workers," *The Plain Dealer*, June 30, 1999. While Section 2 of this paper is concerned with settlement outside of bankruptcy, it also applies to settlement after bankruptcy has already been declared (Section 4.3).

Related issues appear more generally in corporate workouts among creditors in Chapter 11 reorganizations. Workouts in corporate reorganizations succeed less than half the time, which is far less than the success rate in the settlement of typical civil claims (See Schwartz 1993 and the references therein). The failure of negotiations may be due to a "holdout problem" where the creditors refuse to exchange their claims (which is analogous to settlement here) because if enough of the other creditors settle then those that hold out will be repaid in full. Since each creditor wants the others to exchange their claims, there is a collective action problem.²² Offers that are made conditional upon a certain percentage of claimants accepting the offer can partially mitigate these problems and serve the interests of the equity holders.²³ A holdout problem arises in my model only when the two claims are sufficiently positively correlated. In the workout analogy, this would occur when the value of the firm's assets are uncertain at the time of workout – when the value of asset is low then neither claimant will collect, while when the value is high they both will receive some repayment. In this case, the acceptance of an offer by one claimant confers a positive externality on the other and negotiations may fail. Here, a collective bargaining will overcome this problem and increase the payoff of the defendant.

Section 2 generalizes the illustrative example of decentralized settlement bargaining and characterizes the defendant's optimal settlement strategy. Section 3 considers collective settlement bargaining and discusses the private and social desirability of class action lawsuits, opt-out provisions, and "conditional" settlement offers by the defendant. Section 4 considers alternative timings – including sequential offers, sequential trials, and settlement within

²¹ See the discussion of Jackson (1986).

²² Holdout problems were described by Roe (1987) and formalized by Gertner and Sharfstein (1991) and Schwartz (1993).

²³ See Schwartz (1993).

bankruptcy (where a settling plaintiff does not enjoy "seniority") – and shows that the same basic results would be obtained. Concluding remarks follow in Section 5.

2. The Model

Two plaintiffs, each with damages D , claim to have been injured by a defendant with wealth W . We assume that $W < 2D$, so the defendant's wealth is insufficient to cover both claims in full should both plaintiffs prevail at trial. The unconditional probability that a plaintiff will win at trial is p and the probability that both plaintiffs win at trial is $q \leq p$. Holding p fixed, the degree of correlation between the two cases is increasing in the parameter q .²⁴ When $q = p$ the cases are perfectly correlated, when $q = p^2$ the cases are uncorrelated, and when $q = 0$ the cases are negatively correlated. We assume that $p < 1/2$ to accommodate all $q \in [0, p]$.²⁵ Should a case go to trial, a plaintiff would bear litigation costs of $c_p \in [0, pD]$ and the defendant would bear costs of $c_d \geq 0$ (There are no economies of scale in litigation. If both cases go to trial then the defendant's costs are $2c_d$.) For simplicity, we assume that the defendant's costs are non-monetary and so do not reduce a plaintiff's expected recovery at trial.

A plaintiff's expected payoff when both cases go to trial is $g(q) = q(W/2) + (p - q) \min\{D, W\} - c_p$. With probability q both plaintiffs win and they split the defendant's wealth, each getting $W/2$. With probability $p - q$ the plaintiff wins alone and receives $\min\{D, W\}$. We can rewrite the plaintiff's expected payoff as

$$g(q) = p \min\{D, W\} - q[\min\{D, W\} - W/2] - c_p \quad (1)$$

²⁴ The correlation coefficient is $r = \frac{q - p^2}{p(1 - p)}$.

Our assumption that $W < 2D$ guarantees that $\min\{D, W\} - W/2 > 0$, and so $g(\mathbf{q})$ is strictly decreasing in the parameter \mathbf{q} , $g'(\mathbf{q}) < 0$. Intuitively, a higher degree of correlation between the two cases means that the two plaintiffs will be forced to split the defendant's wealth more frequently, reducing the expected value of each claim. The defendant's expected payment conditional upon both cases going to trial is²⁶

$$2g(\mathbf{q}) + 2(c_p + c_d).$$

Although it is convenient to think about the two trials occurring at the same time, this is not necessary. In this section, all we really need is that neither plaintiff expects to have priority over the other in a bankruptcy proceeding following litigation. This would be true if (1) it is not clear at the time of relevant negotiations which case will reach its verdict first, or (2) the two trials are expected to be sufficiently close together in time that an early adverse judgment does not dilute the value of the second case.²⁷ The assumption of "equal priority" is not necessary for the results, however. Section 4 considers a model with sequential trials where the first case has priority over the second and establishes that the same basic results.

The surplus to be gained from settlement is simply $2(c_p + c_d)$, the sum of the litigation costs. Settlement negotiations are assumed to take a simple form: First the defendant places a

²⁵ If $\mathbf{p} > 1/2$ then perfect negative correlation would not be possible.

²⁶ With probability \mathbf{q} both plaintiffs win and the defendant loses his entire wealth and with probability $2(\mathbf{p} - \mathbf{q})$ exactly one plaintiff wins and the defendant loses $\min\{D, W\}$. So the defendant's expected liability is $\mathbf{q}W + 2(\mathbf{p} - \mathbf{q})\min\{D, W\} + 2c_d = 2g(\mathbf{q}) + 2(c_p + c_d)$.

²⁷ Under the US Bankruptcy Code, if one plaintiff collects first the second plaintiff may be able to force the defendant into bankruptcy and force the first plaintiff to disgorge its share. Under Section 547 of the US Bankruptcy Code, if bankruptcy were declared within 90 days of Plaintiff 2's victory, then the payment to Plaintiff 2 would be recovered and the two plaintiffs would share pro rata in the pool of general creditors, in which case Plaintiff 2 could not be "bought out" in the way described above. However, this scenario would require that the trial with Plaintiff 1 is fully resolved and bankruptcy declared within 90 days of the first settlement. Given the prolonged nature of these lawsuits, the 90-day limit may not be an obstacle in practice.

pair of offers, $\{S_1, S_2\}$, on the table. Second, the plaintiffs must decide whether to accept these offers. The plaintiffs act strategically and non-cooperatively in the acceptance subgame and binding contracts and side payments between the two plaintiffs are ruled out.²⁸ (Section 4.1 argues that the same results would be obtained if the offers were sequential instead of simultaneous.) We first characterize the equilibria of the acceptance subgame, and then characterize the defendant's optimal settlement strategy.

2.1 The Acceptance Subgame

The plaintiffs are considering a pair of settlement offers, $\{S_1, S_2\}$. If plaintiff i accepts the offer S_i then she is immediately paid this amount whether or not plaintiff j accepts S_j . If plaintiff i accepts S_i and plaintiff j rejects S_j then plaintiff j goes to court alone and her potential recovery is capped by the defendant's remaining assets, $W - S_i$. We are essentially assuming here that S_i is paid out immediately and cannot be seized by other claimants in the future. This assumption makes sense when settlement negotiations take place far enough in advance of the formal trials. Piper Aircraft, for example, settled many cases out of court over many years before filing for bankruptcy in 1991.²⁹ Section 4.3 shows that the results do not hinge upon this assumption, however.

²⁸ In this section we do not allow "conditional" settlement offers where, for example, both plaintiffs must accept their respective offers for either one to receive payment. These offers are discussed in Section 3.

²⁹ See the discussion of Section 547 of the US bankruptcy code in footnote 27. Note, however, that a significant percentage of cases settle on the courthouse steps. See Spier (1992) and the references therein.

Each plaintiff's maximum willingness to pay depends crucially upon whether she expects the other plaintiff to accept or reject the offer. If Plaintiff i expects that Plaintiff j will *reject* S_j , she is willing to accept S_i if and only if

$$S_i \geq g(\mathbf{q}).$$

Recall that the right hand side of this inequality is falling in \mathbf{q} , the degree of correlation between the cases. If Plaintiff i expects that Plaintiff j will *accept* S_j , she is willing to accept S_i if and only if

$$S_i \geq f(S_j),$$

where

$$f(S) = \mathbf{p} \min\{D, W - S\} - c_p. \quad (2)$$

With probability \mathbf{p} plaintiff i wins the case. If the defendant is not financially constrained ($D \leq W - S$) then the plaintiff is fully compensated for her damages, D . If the defendant is financially constrained ($D > W - S$) then she receives the defendant's remaining wealth, $(W - S)$. Notice that $f(S)$ does not depend on \mathbf{q} , the degree of correlation between the cases.

The derivative of this expression is

$$f'(S) \in \{0, -\mathbf{p}\} \leq 0. \quad (3)$$

When the defendant's wealth constraint is binding, then a one dollar increase in S_j reduces the least that plaintiff i is willing to accept by \mathbf{p} . The normal form of this subgame is shown in Figure 1 below.

		Plaintiff 2	
		Accept	Reject
Plaintiff 1	Accept	S_2 S_1	$f(S_1)$ S_1
	Reject	S_2 $f(S_2)$	$g(\mathbf{q})$ $g(\mathbf{q})$

FIGURE 1: The Acceptance Subgame

There are four types of pure strategy Nash equilibria may arise in the acceptance subgame. We define Ω_{st} to be the set of settlement offers for which it is a Nash equilibrium for Plaintiff 1 to play $s \in \{\text{Accept, Reject}\}$ and Plaintiff 2 to play $t \in \{\text{Accept, Reject}\}$.³⁰

$$\Omega_{AA} = \{ \{S_1, S_2\} \text{ s.t. } S_i \geq f(S_j) \text{ for both } i, j \},$$

$$\Omega_{RR} = \{ \{S_1, S_2\} \text{ s.t. } S_i < g(\mathbf{q}) \text{ for } i = 1, 2 \},$$

$$\Omega_{AR} = \{ \{S_1, S_2\} \text{ s.t. } S_1 \geq g(\mathbf{q}) \text{ and } S_2 < f(S_1) \},$$

$$\Omega_{RA} = \{ \{S_1, S_2\} \text{ s.t. } S_1 < f(S_2) \text{ and } S_2 \geq g(\mathbf{q}) \}.$$

It is proven in the Appendix that a pure strategy Nash equilibrium exists for any pair of offers, $\{S_1, S_2\}$, and we will restrict attention to these pure strategy equilibria. Clearly these definitions imply that if a pair of offers is in Ω_{AR} then it cannot also be in Ω_{AA} or Ω_{RR} (and similarly for a pair of offers in Ω_{RA}). Formally:

Lemma 1: $\{\Omega_{AR} \cup \Omega_{RA}\} \cap \{\Omega_{AA} \cup \Omega_{RR}\} = \emptyset$.

But multiple equilibria may exist. Consider, for example, the offer $\{S^*, S^*\}$ where S^* is implicitly defined by

$$S^* = f(S^*) .$$

$\{S^*, S^*\}$ minimizes the defendant's payments, $S_1 + S_2$, within the set of offers Ω_{AA} .³¹ But $\{S^*, S^*\}$ also belongs to the set Ω_{RR} when \mathbf{q} is sufficiently small because $S^* < g(\mathbf{q})$. If Plaintiff 1 thought that Plaintiff 2 would reject S^* , she would reject S^* as well and get $g(\mathbf{q}) > S^*$. The next Lemma establishes conditions on \mathbf{q} under which these multiple equilibria exist.³²

Lemma 2: There exists a unique cutoff $\mathbf{q}^* \in [0, \mathbf{p}]$ where $g(\mathbf{q}^*) = S^*$. If $\mathbf{q} \geq \mathbf{q}^*$ then $\{S^*, S^*\} \notin \Omega_{AA} \cap \Omega_{RR} = \emptyset$. If $\mathbf{q} < \mathbf{q}^*$ then $\{S^*, S^*\} \in \Omega_{AA} \cap \Omega_{RR}$.

When the degree of correlation between the cases is sufficiently small, $\mathbf{q} < \mathbf{q}^*$, then $\{S^*, S^*\}$ yields two pure strategy Nash equilibria in the acceptance subgame, one where both plaintiffs accept the offers and another where they both reject the offers. Notice that the acceptance equilibrium is supported by *weakly dominated strategies*: Plaintiff 1 is indifferent between accepting and rejecting S^* in the acceptance equilibrium, but would *strictly prefer to*

³⁰ We assume that when indifferent a plaintiff accepts the settlement offer.

³¹ If $S_1 = f(S_2)$ and $S_2 > f(S_1)$, then reducing S_2 by Δ and increasing S_1 by $-f'(S_2)\Delta$ to maintain equality would have the effect of reducing $S_1 + S_2$ since $f'(S) \in \{0, -\mathbf{p}\}$. Therefore both constraints bind. The closed form solution for S^* is given in the proof of Existence in the Appendix.

reject S^* if there was even a tiny chance that Plaintiff 2 would reject S^* (since $S^* < g(\mathbf{q})$). So there is good reason to believe that the plaintiffs would, in fact, reject $\{S^*, S^*\}$. In order to refine the equilibrium set for these low degrees of correlation, we adopt Harsanyi and Selten's (1988) definition of *risk dominance*.³³

Definition: Suppose that $\{S_1, S_2\} \in \Omega_{AA} \cap \Omega_{RR}$. The acceptance equilibrium *risk dominates* the rejection equilibrium if and only if:

$$h(S_1, S_2) = [S_1 - f(S_2)][S_2 - f(S_1)] - [g(\mathbf{q}) - S_1][g(\mathbf{q}) - S_2] \geq 0. \quad (4)$$

$S_i - f(S_j)$ is the so-called "deviation loss" to Plaintiff i – that is, the loss from unilaterally deviating from the acceptance equilibrium, so the first main term in the expression is the product of these losses for both plaintiffs. $g(\mathbf{q}) - S_i$ is the loss to Plaintiff i from unilaterally deviating from the rejection equilibrium, so the second term is the product of these losses for both plaintiffs. This definition selects the acceptance equilibrium if the product of the deviation losses from the acceptance equilibrium is larger than the product of the losses from the rejection equilibrium.

³² The sets Ω_{RA} and Ω_{AR} may overlap as shown in Figures 2 and 3. However, we will show that offers in these regions are never chosen by the defendant, so a full characterization of equilibrium selection is unnecessary.

³³ See Harsanyi and Selten (1988, page 88) for a definition of risk dominance, and their accompanying text for an axiomatic foundation for this definition. Risk dominance is adopted for its tractability and predictive power. Using the *Pareto refinement* would give qualitatively similar results as those presented here (although the equilibria would be asymmetric), and the proof is available from the author upon request. The *elimination of weakly dominated strategies* would rule out the acceptance equilibrium when the offers are exactly $\{S^*, S^*\}$, but would have no power if, say, the defendant added a penny to each offer: $\{S^* + \Delta, S^* + \Delta\}$.

This definition has a nice intuitive interpretation when $S_1 = S_2 = S$, so the acceptance subgame is symmetric. Rewriting the risk dominance condition from expression (4) for this special case:

$$S \geq 1/2f(S) + 1/2g(\mathbf{q})$$

In other words, the acceptance equilibrium risk dominates the rejection equilibrium if Plaintiff i would choose to accept S if she placed *equal weights* on Plaintiff j's two actions.³⁵

Assumption: (*The Risk Dominance Refinement.*) If $\{S_1, S_2\} \in \Omega_{AA} \cap \Omega_{RR}$ then the plaintiffs will accept the offers if $h(S_1, S_2) \geq 0$ and reject the offers if $h(S_1, S_2) < 0$.

2.2 The Defendant's Optimal Settlement Strategy

When the settlement negotiations are decentralized, the defendant's optimal settlement strategy hinges upon the degree of correlation between the cases and the resulting settlement externalities. When one plaintiff accepts a settlement offer, the other plaintiff is exposed to both positive and negative externalities. There is a *positive externality* because settlement raises the other plaintiff's expected recovery in those states of nature where both plaintiffs would have won at trial. There is a *negative externality* because it lowers the other plaintiff's expected recovery in those states of nature where the settling plaintiff would have lost at trial. The positive externality will be more important for high degrees of correlation, while the negative externality will be more important for low degrees of correlation.

³⁴ This definition is actually a modification of the Harsanyi and Selten's. In their treatise, the mixed strategy equilibrium would be the solution when equality holds. We use the strong equality in order to simplify the exposition.

³⁵ If she rejected S she would receive $f(S)$ half the time and $g(\mathbf{q})$ the other half.

The next proposition characterizes the defendant's optimal settlement strategy when the degree of correlation is low, $\mathbf{q} < \mathbf{q}^*$. Recall from Lemma 2 that multiple equilibria arise in the acceptance subgame for these parameter values. Under our assumption of risk dominance, the defendant cannot offer $\{S^*, S^*\}$ – the acceptance equilibrium is risk dominated by the rejection equilibrium. Instead, the settlement offers must be increased to satisfy the definition of risk dominance.

Proposition 1: If $\mathbf{q} < \mathbf{q}^*$ then the defendant offers $\{S_1, S_2\} = \{S(\mathbf{q}), S(\mathbf{q})\} \in \Omega_{AA}$ where $S(\mathbf{q})$ is implicitly defined by $S = 1/2f(S) + 1/2g(\mathbf{q})$. Furthermore, $S(\mathbf{q})$ has the property that $S^* < S(\mathbf{q}) < g(\mathbf{q})$.

An important property of this equilibrium is that $S(\mathbf{q}) < g(\mathbf{q})$ – the plaintiffs settle for less than they would receive if they collectively refused the offers and went to trial! This property is due to bargaining externalities: The settlement by one plaintiff (weakly) reduces the defendant's available wealth for the second plaintiff, and this imposes a *negative externality* on the other plaintiff in those states of nature where the settling plaintiff would have lost at trial. When the degree of correlation is small, $\mathbf{q} < \mathbf{q}^*$, this reduces the least that the other plaintiff is willing to accept. Since the plaintiffs are not centralized, the defendant can take advantage of this negative externality in the settlement process.

When $\mathbf{q} \geq \mathbf{q}^*$ we do not have to be concerned with multiple equilibria (Lemma 2) – if the defendant offered $\{S^*, S^*\}$ both plaintiffs would certainly accept. But for these parameter values $S^* > g(\mathbf{q})$ – the plaintiffs are receiving more than they would if they both rejected the

offers and went to trial! This result is again due to bargaining externalities but of the opposite kind. The settlement by one plaintiff *increases* payoff to the other plaintiff in those states of nature where they both would have won at trial – a *positive externality*. So the defendant would have to offer a premium of $S^* - g(\mathbf{q})$ to each plaintiff to induce both to settle. This premium is *increasing* in the degree of correlation between the cases. If the litigation costs were zero, then the defendant would never be willing to pay this premium to induce settlement. When the litigation costs are positive, however, then the defendant will settle on these terms so long as the premium $S^* - g(\mathbf{q})$ is not too large.

Proposition 2 states that the defendant will offer $\{S^*, S^*\}$ and settle with both plaintiffs when the degree of correlation is in an intermediate range, $\mathbf{q} \in [\mathbf{q}^*, \mathbf{q}^{**}]$. In this range, the settlement premium, $S^* - g(\mathbf{q})$, is smaller than the sum of the litigation costs.

Proposition 2: If $\mathbf{q} \in [\mathbf{q}^*, \mathbf{q}^{**}]$ where \mathbf{q}^{**} is defined by $S^* - g(\mathbf{q}^{**}) = c_p + c_d$ the defendant offers $\{S_1, S_2\} = \{S^*, S^*\} \in \Omega_{AA}$. Furthermore, $S^* > g(\mathbf{q})$.³⁶

Finally, when $\mathbf{q} > \mathbf{q}^{**}$ then the premium that must be paid to each plaintiff in order to get both to settle, $S^* - g(\mathbf{q})$, is larger than the litigation cost savings from settlement, $c_p + c_d$. So when the cases are sufficiently correlated then the defendant will forego settlement altogether and take both plaintiffs to trial.

Proposition 3: If $\mathbf{q} > \mathbf{q}^{**}$ then the defendant offers $\{S_1, S_2\} \in \Omega_{RR}$.³⁷

2.3 An Example

Consider the example from the introduction when $D = W = \$100$, $\mathbf{p} = 1/2$, and $c_p = c_d = 0$. From equation (2), it is a Nash equilibrium of the acceptance game for the plaintiffs to accept $\{S_1, S_2\}$ when $S_i \geq f(S_j) = 50 - S_j/2$. These two curves intersect at $\{S^*, S^*\} = \{33, 33\}$. It is a Nash equilibrium for the plaintiffs to reject $\{S_1, S_2\}$ when $S_i < g(\mathbf{q}) = 50(1 - \mathbf{q})$. Since $c_p = c_d = 0$ we have $\mathbf{q}^* = \mathbf{q}^{**} = .33$ (see Lemma 2 and Proposition 2).

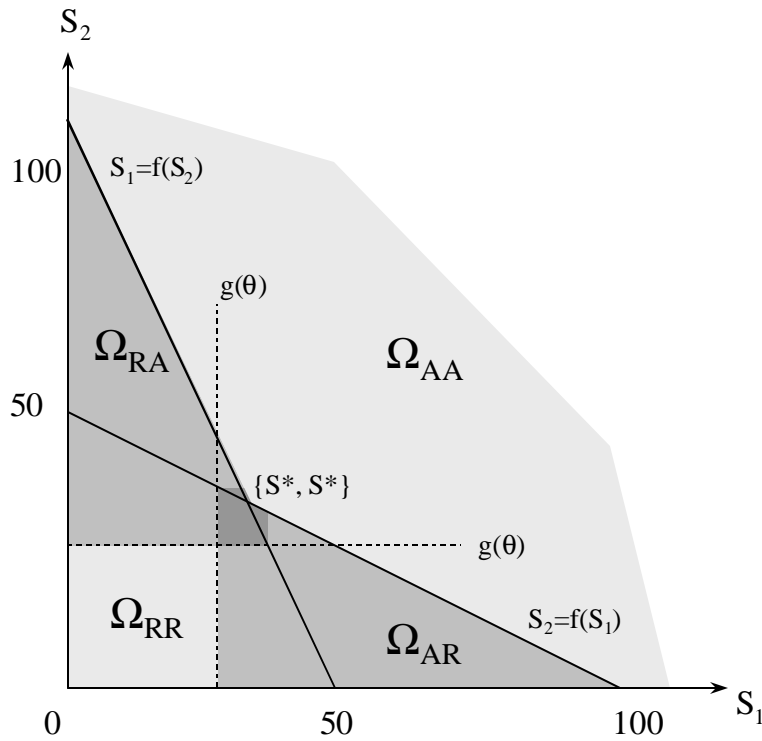


FIGURE 2: Equilibria of Acceptance Subgame, $\mathbf{q} > \mathbf{q}^*$

³⁶ The function $g(\mathbf{q})$ is well defined for all \mathbf{q} . If the litigation costs are very large, however, then the cutoff \mathbf{q}^{**} may be greater than \mathbf{p} , the highest correlation.

³⁷ If the litigation costs are large then the cutoff \mathbf{q}^{**} may be greater than \mathbf{p} , the highest degree of correlation. Therefore this range may not exist and all cases will settle.

Figure 2 represents the game when $q > .33$. (Recall that when $q = p^2 = .25$ the cases are independent. Therefore $q > q^* = .33$ implies that these cases are not only positively correlated, but "very" positively correlated.) In this case, $g(q) < S^*$ and so $\Omega_{AA} \cap \Omega_{RR} = \emptyset$. By Proposition 3, the defendant's optimal strategy here is to "refuse to settle." He is better off taking both cases to trial and paying $g(q)$ to each than to make offers that one or both plaintiffs would accept.

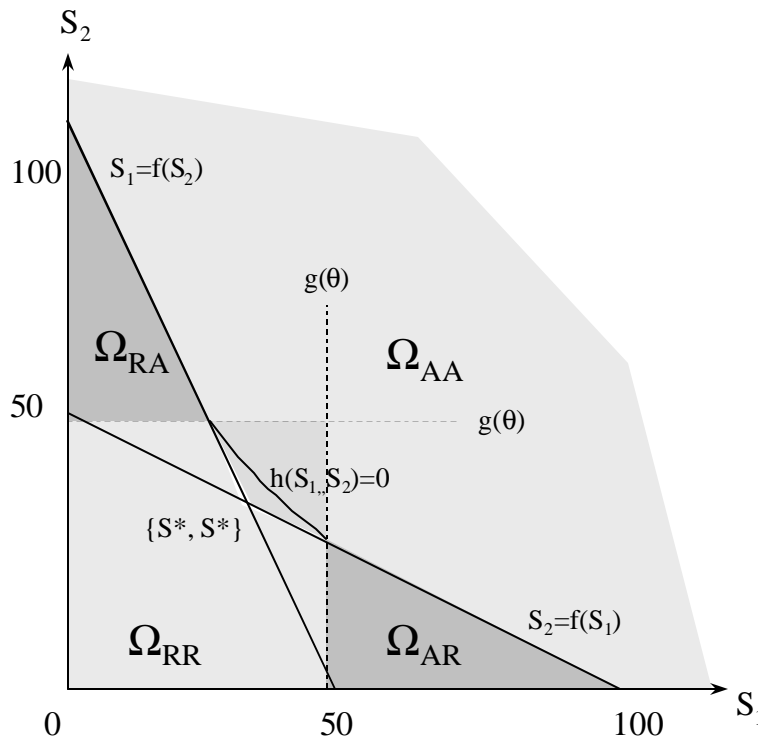


FIGURE 3: Equilibria of the Acceptance Subgame, $q < q^*$

Figure 3 illustrates the example when $q < .33$. Since independent cases have $q = p^2 = .25$, this case includes negative, independent, and (weakly) positive degrees of correlation. In this case, $g(q) > S^*$ and so $\Omega_{AA} \cap \Omega_{RR} \neq \emptyset$ as shown in the figure. So if the defendant offered to settle for $\{S^*, S^*\}$ there would be two Nash equilibria: one where both

plaintiffs accept and another where both plaintiffs reject. The risk dominance locus $h(S_1, S_2) = 0$ is also shown in Figure 3, and is convex to the origin.³⁸ The plaintiffs will accept settlement offers to the northeast of this locus, and reject settlement offers to the southwest. By Proposition 1, the best settlement offer for the defendant that also satisfies the definition of risk dominance is $S = 40 - 20\mathbf{q} < g(\mathbf{q})$. The plaintiffs are jointly worse off accepting these settlement offers than they would be if they collectively decided to reject them and go to trial instead.

3. Collective Settlement Negotiations

Now suppose instead that the plaintiffs negotiate *collectively* rather than independently. Formally, the proposal, $\{S_1, S_2\}$, is accepted by the plaintiffs if and only if the plaintiffs vote unanimously to accept the proposal. If one or both plaintiffs vote to reject the proposal then both cases go to trial and each plaintiff receives a payoff $g(\mathbf{q})$. Since either plaintiff can propel both cases to court, each plaintiff must be offered at least what she would get if both cases went to trial, $g(\mathbf{q})$. Consequently, the defendant offers to settle for $\{S_1, S_2\} = \{g(\mathbf{q}), g(\mathbf{q})\}$ and both plaintiffs accept.³⁹ The defendant's total payout, $2g(\mathbf{q})$, is of course less than his total expected

³⁸ See the proof of Proposition 1 for a more formal and general treatment of this constraint.

³⁹ Since there are only two plaintiffs in the model, a simple majority voting rule (over 50%) would give exactly the same result. The careful reader may notice that we are assuming here that side payments between the plaintiffs cannot occur (or, alternatively, that the payoffs are nontransferable). If side payments were possible then for $\mathbf{q} < \mathbf{q}^*$ it would be in the plaintiffs' joint interest to accept one settlement offer and reject the other and have one case go to trial.

payout if both cases went to trial, $2g(\mathbf{q}) + 2(c_p + c_d)$. The defendant gains the entire bargaining surplus, $2(c_p + c_d)$, in settlement negotiations.⁴⁰

Proposition 4: When the plaintiffs bargain collectively, the defendant's optimal settlement strategy is to propose $\{S_1, S_2\} = \{g(\mathbf{q}), g(\mathbf{q})\}$. Both plaintiffs vote to accept the proposal and the defendant's total payments are $2g(\mathbf{q})$.

The collective bargaining mechanism described above was chosen for its convenience. Many other mechanisms would give rise to the same outcome and allocation of payoffs. Consider, for example, a scenario where the defendant makes *a single lump-sum settlement offer* (rather than a pair of offers) to the plaintiffs, who are then responsible for dividing the proceeds among themselves. Assume further that rejection of the defendant's single offer would forfeit out-of-court recovery for either plaintiff. This alternative mechanism would eliminate the bargaining externalities inherent in decentralized bargaining and the same results would be obtained.

In practice, the collective bargaining outcome detailed in Proposition 4 may arise in a variety of ways. First, the plaintiffs may simply decide to collude. Enforcement of the collusive agreement is important, however, since a plaintiff may have the incentive to "back out" at the last minute. One way to facilitate collusion is for the plaintiffs to hire the same attorney (or law firm) to advise and represent them in negotiations. This attorney would have an incentive to maximize their joint return, especially if compensated on a contingent fee basis.

⁴⁰ The defendant gains the entire surplus because he has the power to make a take-it-or-leave-it offer. If the plaintiffs had some bargaining power as well then we would expect them to capture part of the bargaining surplus.

Second, the cases may be formally joined in a class action when the cases are sufficiently similar. The initiative to certify a class action can come from the plaintiffs themselves or through their attorneys. Interestingly, it can also come or through the defendant. Indeed, it is not uncommon for defendants to solicit plaintiffs' attorneys to organize plaintiff classes.⁴¹ Our maintained assumption in this section is that the expected payoffs at trial are identical with independent and collective bargaining so as to focus exclusively on the bargaining strategies. Class actions of course do more, however, than simply coordinate the plaintiffs' bargaining strategies. They also consolidate the evidence presented at trial, so there would be one trial instead of two – the plaintiffs would win or lose together. Our model is consistent with this for the case of perfect correlation (since the trials are redundant), but not otherwise.⁴²

Third, the defendant could achieve the very same outcome described in Proposition 4 if he can make *conditional settlement offers*. In other words, the defendant could place the following offer on the table: "I offer you each $g(q)$. If either of you refuse, the deal is off for both of you." These kinds of conditional offers are sometimes observed, especially in class action lawsuits. In some cases, the settlements are conditional upon a certain percentage plaintiffs not "opting out" of the settlement pool.⁴³ Alternatively, some defendants have structured settlements offers whose dollar value declines with the number of plaintiffs who settle.⁴⁴

⁴¹ See Coffee (1995 at note 21).

⁴² For all $q < 1/2$ the plaintiffs are strictly worse off and the defendant is strictly better off with one trial.

⁴³ See, for example, "AHP Announces it will Proceed with Proposed Settlement," *Pharmaceutical Litigation Reporter*, June, 2000, and "Qualcomm Settlement Could be Torpedoed; Some Former Employees Unhappy at the terms," *San Diego Union-Tribune*, March 22, 2000. This latter deal was subsequently voided.

3.1 The Private and Social Value of Collective Bargaining

Comparing the equilibrium strategies and payoffs under collective bargaining to those in Section 2 establishes that collective bargaining has two very important effects. First, collective bargaining changes the allocation of bargaining surplus among the litigants. Second, collective bargaining increases the settlement rate for high degrees of correlation. The comparison of these two regimes is summarized in the next proposition.

Proposition 5: (i) If $q < q^*$ collective bargaining shifts bargaining surplus from the defendant to the plaintiffs. (ii) If $q \in [q^*, q^{**}]$ collective bargaining shifts bargaining surplus from the plaintiffs to the defendant. (iii) If $q > q^{**}$ the settlement rate rises with collective bargaining. The defendant gains bargaining surplus and the plaintiffs are no worse off.

Recall from Section 2 that when the degree of correlation was in the low range, $q < q^* < q^{**}$,⁴⁵ the defendant took advantage of negative bargaining externalities and coerced the decentralized plaintiffs to settle their claims for $S(q) < g(q)$ (Proposition 1). In this low range, the plaintiffs are better off and the defendant is worse off with collective bargaining. Since the cases settle in either case, the settlement rate is unchanged.

In the intermediate range, $q \in [q^*, q^{**}]$, the externalities from decentralized bargaining worked in the plaintiffs' favor: they earned a premium, $S^* - g(q)$, over what they would receive at trial (Proposition 2). The plaintiffs took advantage of the settlement externalities! In this

⁴⁴ "Large Vitamin Producers Opt Out of Settlement Offer," *Los Angeles Times*, September 14, 1999.

⁴⁵ The example in Section 2.3 illustrates that the cases may be positively correlated in this lower range.

intermediate range, the plaintiffs are worse off and the defendant is better off with collective bargaining and the settlement rate is unchanged.

Finally, when the degree of correlation is in the high range, $\mathbf{q} > \mathbf{q}^{**}$, decentralized settlement negotiations broke down altogether (Proposition 3). The litigants were unable to achieve settlement even though settlement was in their mutual interest. For these parameter values, the settlement rate rises when the plaintiffs bargain collectively. Private welfare rises as well since the defendant captures the entire costs savings, $c_p + c_d$, while the plaintiffs are no worse off.⁴⁶ As in the case where $\mathbf{q} \in [\mathbf{q}^*, \mathbf{q}^{**}]$, the defendant has an interest in encouraging the collective bargaining mechanisms. A social planner would have a similar interest, for the settlement rate rises and fewer resources are wasted when the plaintiffs bargain collectively.⁴⁷

3.2 Opting Out of the Collective Agreement

These results have some interesting policy implications. First, they suggest that judges should look favorably upon requests for class certification when the cases are highly correlated. Since independent settlement negotiations fail in this case, class certification and the resulting collective bargaining will clearly improve social welfare. Second, the results also imply that plaintiffs should be discouraged from "opting out" of settlement agreements, for this will destroy settlement opportunities. Let me elaborate on this last claim.

Suppose that the defendant has placed offers $\{S_1, S_2\} = \{g(\mathbf{q}), g(\mathbf{q})\}$ on the table. Next, imagine that Plaintiff 1 unilaterally opts out of the collective settlement mechanism and goes to

⁴⁶ The result that the defendant gains the entire settlement surplus is driven by the assumption that the defendant makes a take-it-or-leave-it offer. Under more egalitarian bargaining specifications, the plaintiffs would share in the surplus as well.

⁴⁷ This discussion ignores the impact on primary behavior. See the discussion in the conclusion.

trial and gets $f(g(\mathbf{q}))$ while Plaintiff 2 settles for $g(\mathbf{q})$. Plaintiff 1 would, *ex post*, benefit from this strategy when the cases are sufficiently positively correlated, $\mathbf{q} > \mathbf{q}^*$; in this case, the acceptance of $g(\mathbf{q})$ by Plaintiff 2 confers a positive externality upon Plaintiff 1 and raises his or her outside option of a trial: $f(g(\mathbf{q})) > g(\mathbf{q})$. So Plaintiff 1 would like to "opt out" of the class settlement when $\mathbf{q} > \mathbf{q}^*$, but is willing to stay in when $\mathbf{q} < \mathbf{q}^*$. Note further that the two plaintiffs are jointly better off *ex post* if Plaintiff 1 opts out in this way, for Plaintiff 1 is strictly better off while Plaintiff 2 receives $g(\mathbf{q})$ in either case.

Of course this is not the end of the story: the possibility that a plaintiff could "opt out" in this way would change the defendant's equilibrium strategy ex ante. If the defendant anticipated that Plaintiff 1 would opt out when $\mathbf{q} > \mathbf{q}^*$, he would not be willing to offer $\{S_1, S_2\} = \{g(\mathbf{q}), g(\mathbf{q})\}$ to begin with! Indeed, the game would revert back to the decentralized case outlined in Section 2. As described in Proposition 3, for example, the defendant will take both cases to trial when the cases are sufficiently correlated ($\mathbf{q} > \mathbf{q}^{**}$).

The value of collective bargaining is inextricably linked to its commitment power. Collective bargaining agreements must be binding for all parties involved. Since it is not in the plaintiffs' joint interest to enforce their own collective bargaining agreement when $\mathbf{q} > \mathbf{q}^*$, further contractual arrangements and legal intervention may be necessary to preserve the integrity and efficiency of settlement bargaining. In practice, class action settlements are often structured so that defendants may withdraw settlement offers if too many members of a class exercise the right to opt out of the settlement agreement.⁴⁸ Furthermore, some judges have taken

⁴⁸ See the discussion of conditional offers in Section 3.1.

an aggressive stance on opt outs, invalidating opt outs at the request of defendants.⁴⁹ These policies make sense given the settlement eternalities identified here.

4. Alternative Timings

The models of the previous sections were very stylized representations of complex litigation. It was assumed that the offers to each plaintiff were made simultaneously, and that the trials were essentially at the same time. In practice, of course, negotiations are in real time and trials are rarely simultaneous. We also assumed that a settlement was senior to the remaining claims. In practice, a non-settling plaintiff may be able to force the settling plaintiff to disgorge the money. We now consider three variations of the basic model presented in Section 2 to illustrate that the basic results do not depend on these specific assumptions. In the first, the defendant makes sequential offers rather than simultaneous offers to the plaintiffs. (The trials, however, are still at the end). In the second, the trials are sequential with settlement before each trial.⁵⁰ In the third, a settling plaintiff and a winning plaintiff will share the defendant's wealth *pro rata*, so the settling plaintiff does not enjoy "seniority." To ease these illustrations, we assume that the litigation costs are arbitrarily small, $c_p = c_d = 0$. In the last two extensions, we use the illustrative example that was first discussed in the introduction with $D = W = \$100$ and $p = 1/2$. The results generalize, but a full analysis would be lengthy.

⁴⁹ Coffee (1995) at note 149.

⁵⁰ Recall that the basic model in Section 2 represents sequential trials so long as the litigants do not know at the time of settlement which plaintiff's case will be heard first. Here, the litigants know the order of the cases.

4.1 Sequential Offers

Consider a variation of our basic model from Section 2 where instead of placing a pair of offers, $\{S_1, S_2\}$, on the table, the defendant makes sequential offers. Specifically, assume that the defendant first makes an offer S_1 to Plaintiff 1. Next, Plaintiff 1 may either accept or reject the offer. Then the defendant makes an offer S_2 to Plaintiff 2, which Plaintiff 2 may either accept or reject. Finally, any unsettled cases go to trial. The trials, as before, are at the end of all negotiations. We will proceed by backwards induction.

What offer, S_2 , should the defendant make to the second plaintiff? The answer hinges on whether the first plaintiff settled, and for how much. If the first plaintiff settled for S_1 , then the defendant would settle with the second plaintiff for $S_2 = f(S_1)$. Second, suppose that the first plaintiff *did not settle*. Should the defendant settle with the second plaintiff? The answer depends on \mathbf{q} . The least the second plaintiff is willing to receive is $S_2 = g(\mathbf{q})$, what he would get if both cases go to trial. If the defendant settled the second case for this amount, then the defendant's expected liability with the first plaintiff alone at trial is $f(g(\mathbf{q}))$. The defendant will therefore refuse to settle with the second plaintiff when $g(\mathbf{q}) + f(g(\mathbf{q})) > 2g(\mathbf{q})$, or $\mathbf{q} > \mathbf{q}^*$ (so the cases are highly correlated).⁵¹

Working backwards, what is the least that the first plaintiff would be willing to receive in settlement? If $\mathbf{q} > \mathbf{q}^*$ then the first plaintiff knows that if she refuses to settle then the second case will not settle either and both cases will go to trial. She will get $g(\mathbf{q})$ in the end, and this is the least she is willing to receive when $\mathbf{q} > \mathbf{q}^*$. So should the defendant offer $S_1 = g(\mathbf{q})$ in settlement? If he does, he pays $g(\mathbf{q}) + f(g(\mathbf{q}))$ in total (because he will settle for $f(g(\mathbf{q}))$ with

⁵¹ This follows from the fact that $f(S^*) = S^*$, $f(S) < S$ for $S < S^*$, and $f(S) > S$ for $S > S^*$.

the second plaintiff). If he refuses to settle with the first plaintiff then both cases go to trial and he pays $g(\mathbf{q})$ to each. Since $g(\mathbf{q}) < f(g(\mathbf{q}))$ refusing to settle is clearly the better strategy in this case. So, as in Section 2, *negotiations break down when the correlation coefficient is in the high range.*

Now suppose that the correlation parameter is in the low range. If $\mathbf{q} < \mathbf{q}^*$ then the first plaintiff knows that if she refuses to settle the second case will settle for $S_2 = g(\mathbf{q})$. She will go to trial by herself and get $f(g(\mathbf{q}))$. $S_1 = f(g(\mathbf{q}))$ is the least Plaintiff 1 is willing to accept when $\mathbf{q} < \mathbf{q}^*$. If the first plaintiff settles for this amount, then the second case will settle as well for $S_2 = f(S_1) = f(f(g(\mathbf{q})))$. The defendant's payments from settling both cases is $f(g(\mathbf{q})) + f(f(g(\mathbf{q})))$, which is smaller than his total payments if he refuses to settle with the first plaintiff, $f(g(\mathbf{q})) + g(\mathbf{q})$.⁵² So, as in Section 2, *negotiations succeed when the correlation parameter is in the low range, $\mathbf{q} < \mathbf{q}^*$, and break down in the high range, $\mathbf{q} > \mathbf{q}^*$.* (Analogous results for collective bargaining would be obtained as well.)

4.2 Sequential Trials

Suppose now that the trials and their respective settlement games are sequential instead of simultaneous. The timing is as follows. First, the defendant offers S_1 to the first plaintiff. If this offer is refused there is a trial. Notice that if the defendant loses the first case then there is no money left for the second plaintiff and the game ends.⁵³ If the defendant wins the first case, he makes an offer, S_2 , to the second plaintiff.

⁵² Again, this follows from the fact that that $f(S^*) = S^*$, $f(S) < S$ for $S < S^*$, and $f(S) > S$ for $S > S^*$.

⁵³ We are assuming that second plaintiff's case comes sufficiently long after the first case that the second plaintiff is essentially junior to the first plaintiff in his claim on the defendant's assets.

Unlike the previous sections, the defendant would always be willing to settle the second case. There are no bargaining externalities because the first case is over and done with by the time negotiations begin with the second plaintiff. We will compare two strategies for the defendant: (1) to settle the first case, and (2) to litigate the first case. We will show that the defendant refuses to settle the first case when the degree of correlation is above a threshold.

To start, what is the least that the first plaintiff is willing to accept in settlement? If Plaintiff 1 refuses to settle, the case goes to trial and she wins $D = W = \$100$ with probability $p = 1/2$. Therefore she would be willing to accept $S_1 = \$50$. After Plaintiff 1 has settled for this amount, there is $W - S_1 = \$50$ remaining for the second plaintiff. Since the second plaintiff wins that \$50 at trial with probability $p = 1/2$, the defendant's total payments from settling with the first plaintiff is $\$50 + \$25 = \$75$.

Now suppose the defendant chooses to litigate rather than settle the first case. If the defendant loses the first case then he loses his entire wealth of \$100 and the game ends, for there is no wealth remaining for the second plaintiff. If the defendant wins the first case, however, then the \$100 remain on the table. What is the least that Plaintiff 2 is willing to accept in settlement? Since the first case was won by the defendant, the conditional probability that Plaintiff 2 will win at trial is now $1 - 2q$ instead of $p = 1/2$.⁵⁴ So $S_2 = 100(1 - 2q)$. Taking these two pieces together, the defendant's expected payments from litigating the first case are $(1/2)100 + (1/2)S_2 = 100(1 - q)$.

⁵⁴ If $q = 1/4$ the cases are uncorrelated and the conditional probability is $1/2$. If $q = 1/2$ the cases are perfectly correlated and the conditional probability is 0. Etc. More generally, the unconditional probability that Plaintiff 1 loses and Plaintiff 2 wins is $p - q$ or $1/2 - q$, while the probability that Plaintiff 1 loses and Plaintiff 2 loses is q . Since Plaintiff 1 loses with probability $1 - p = 1/2$, we can divide through by $1/2$ to get the conditional probabilities.

The defendant's decision whether to settle the first case or take it to trial hinges upon the degree of correlation between the two cases, q . When the cases are sufficiently correlated, $q > .25$, then $100(1-q) < 75$ and the defendant strictly prefers to litigate the first case. When the degree of correlation is below this threshold, however, then the defendant will prefer to settle the first case. As in Section 2, these results are driven by settlement externalities. If the defendant settles the first case there is a positive externality for the second plaintiff because there is now money remaining on the table for those states of nature where both would win at trial. There is a negative externality because there is less money for the state of nature where the first plaintiff would have lost at trial. Therefore the qualitative results are unchanged under the different timings.

4.3 Settlement in Bankruptcy

So far, we have assumed that a settling plaintiff is paid immediately, and a non-settling plaintiff can acquire, at most, the defendant's remaining wealth. This section relaxes this assumption. Specifically, if Plaintiff 2 accepts an early offer, S_2 , and Plaintiff 1 goes to trial and wins, then the two plaintiffs share the defendant's assets *pro rata*. This situation may be reasonable in practice if (1) the trial takes place within 90 days of the settlement, or (2) the non-settling plaintiff can force the defendant into bankruptcy after S_2 is paid even though the defendant is still solvent.

Proceeding as we did in Section 2, if Plaintiff 1 expects that Plaintiff 2 will *accept* S_2 , she would be willing to accept S_1 if and only if $S_1 \geq f(S_2)$ where now

$$f(S_2) = \left(\frac{1}{2} \right) \left(\frac{100}{100 + S_2} \right) (100) = \frac{5,000}{S_2 + 100}.$$

In other words, Plaintiff 1 will win with probability $1/2$ and get her *pro rata* share, $(100)/(100+S_2)$, of the defendant's wealth, 100 . These loci are downward sloping (as they were in Section 2) and intersect at

$$S^* = 50(\sqrt{3} - 1).$$

Since $g(\mathbf{q}) = 50(1 - \mathbf{q})$, we see that the defendant would rather take both plaintiffs to trial rather than settle with each for S^* when $g(\mathbf{q}) < S^*$ or $\mathbf{q} > 2 - \sqrt{3} \cong .27$. If, on the other hand, \mathbf{q} is below this cutoff then the defendant would strictly prefer to settle on these terms.⁵⁵

It is perhaps not surprising that the same basic results are obtained under these alternative circumstances, for the externalities that were responsible for the results remain. When one plaintiff settles, this has both positive and negative externalities on the other plaintiff. The non-settling plaintiff is hurt in those states of nature where the settling plaintiff would have, in fact, lost at trial. (Now the non-settling plaintiff's claim is reduced to her *pro rata* share of the defendant's assets). But the non-settling plaintiff is better off in those states of nature where the other plaintiff would have won at trial. So, as before, the overall impact will hinge upon the degree of correlation between the cases.

5. Conclusion

This paper has illustrated that bargaining externalities exist when multiple plaintiffs bring suit against a single defendant who may go bankrupt. These externalities have implications for both the probability of settlement and the allocation of bargaining surplus. When the plaintiffs bargain independently of one another, then settlement negotiations will break down when the degree of correlation between the cases is above a threshold. The plaintiffs refuse to settle even

though settlement is in their mutual interest, and the defendant will not find it profitable to increase his offers enough to induce them to settle. Here, collective bargaining facilitates settlement and avoids the expense of trial, benefiting both the private litigants and society as a whole. When the degree of correlation is below the threshold, however, then collective bargaining has important distributive consequences. The plaintiffs are harmed by collective bargaining for intermediate degrees of correlation. The bargaining externalities would work to the plaintiffs' strategic advantage, allowing them to extract higher settlement offers from the defendant. In contrast, the plaintiffs are helped by collective bargaining for low degrees of correlation. If they remain independent, the defendant will use the settlement externalities to his advantage, inducing the plaintiffs to accept less than they would receive if they both went to trial.

These results have implications for the consolidation of bargaining strategies through class action lawsuits as discussed in Section 3. In so far as the formation of a plaintiff class eliminates the bargaining externalities, a class action may be either pro defendant (when the cases are highly correlated) or pro plaintiff (when the cases are less correlated). Therefore the movement to certify a class may come from either side. Second, collective bargaining increases the settlement rate when the cases are highly correlated – an efficiency justification for class actions. Finally, allowing plaintiffs to "opt out" of class settlement agreements is inefficient. If the defendant anticipated that plaintiffs would opt out, the defendant would be less willing to make acceptable offers to begin with and more cases would go to trial.

While this paper has investigated an interesting set of strategic issues in litigation, there are many other issues that warrant attention. The results concerning the private and social desirability of collective settlement negotiations and class actions are limited by the fact that the

⁵⁵ This is, of course, a very cursory treatment of the problem. A more thorough analysis would refine the set of multiple equilibria using risk dominance as was done in Section 2.

analysis is from an *ex post* rather than an *ex ante* perspective. Presumably these lawsuits are take place in a broader economic and legal environment, where companies like Piper Aircraft must make important business decisions about how much care to take in the development and production of their products. The analysis in this paper does explicitly address how the organization of plaintiffs will influence primary behavior, although it does provide some insights. When cases are highly correlated, for example, negotiations will tend to break down and this leads to greater legal costs being incurred by the defendant. This additional burden may lead to greater precautions and a reduction in the level of business activity. When the cases are not very correlated, on the other hand, then the defendant takes advantage of decentralized plaintiffs in settlement and will take fewer precautions and increase the level of business activity in anticipation. Whether these distortions are socially desirable or undesirable depend upon a number of factors that are beyond the scope of this paper and remain open for future research.

Appendix

Proof of Existence: Suppose that a pure-strategy equilibrium does not exist. Then we would have (i) $S_i \geq f(S_j)$, (ii) $S_j < f(S_i)$, (iii) $S_i < g(\mathbf{q})$, and (iv) $S_j \geq g(\mathbf{q})$.

Claim: (i) and (ii) imply (v) $S_j < S^*$ and (vi) $S_i \geq S^*$.

Proof of claim: First we will show that the largest S_j that satisfies these two conditions is S^* . Maximize S_j subject to conditions (i) and the modified condition (ii') $S_j \leq f(S_i)$. If condition (i) was binding but condition (ii') was not, then S_j could be increased slightly without violating condition (i), since the right hand side of (i) is decreasing in S_j . If condition (ii') was binding but condition (i) was not, then S_i could be reduced to $f(S_j)$ without violating condition (i). This might create slack in condition (ii') in which case S_j could be increased. If reducing S_i does not create slack in condition (ii') then S_j will not be raised. We conclude that the maximum S_j is achieved where both conditions (i) and (ii') bind, $S_i = S_j = S^*$ where $S^* = f(S^*)$:

$$S^* = \begin{cases} \frac{\mathbf{p}W - c_p}{1 + \mathbf{p}} & \text{if } W < (1 + \mathbf{p})D - c_p \\ \mathbf{p}D - c_p & \text{if } W \geq (1 + \mathbf{p})D - c_p \end{cases}$$

We conclude that (i) and (ii) imply that (v) $S_j < S^*$. Using an analogous technique we show that the smallest S_i to satisfy (i) and (ii') gives us (vi) $S_i \geq S^*$.

If $S^* < g(\mathbf{q})$ then (iv) and (v) give a contradiction, and if $S^* \geq g(\mathbf{q})$ then (iii) and (vi) give a contradiction. We conclude that there do not exist offers that satisfy conditions (i) through (iv) and therefore an equilibrium exists.

Proof of Lemma 2: Refer to the definition of S^* in the previous proof. When $W \geq (1 + \mathbf{p})D - c_p$ then $S^* = \mathbf{p}D - c_p = g(0)$. Since $g'(\mathbf{q}) < 0$ we have $S^* > g(\mathbf{p})$. So we have $0 = \mathbf{q}^* < \mathbf{p}$ for this case. Now suppose instead that $S^* = (\mathbf{p}W - c_p)/(1 + \mathbf{p})$. This is strictly smaller than $g(0)$ for both $W \leq D$ and $W > D$, and since $g'(\mathbf{q}) < 0$ we have $\mathbf{q}^* > 0$. Furthermore, $S^* = (\mathbf{p}W - c_p)/(1 + \mathbf{p}) > g(\mathbf{p}) = \mathbf{p}W/2 - c_p$ so we have $\mathbf{q}^* < \mathbf{p}$. We have proven that $\mathbf{q}^* \in [0, \mathbf{p}]$.

Finally, if $\mathbf{q} \geq \mathbf{q}^*$ then $S^* \geq g(\mathbf{q})$ so $\Omega_{AA} \cap \Omega_{RR} = \emptyset$. If $\mathbf{q} < \mathbf{q}^*$ then $S^* < g(\mathbf{q})$ so $\Omega_{AA} \cap \Omega_{RR} \neq \emptyset$.

Proof of Proposition 1: Since $\mathbf{q} < \mathbf{q}^*$ multiple equilibria will arise (Lemma 2) and we use risk dominance to refine the set. Consider the following simplified program: Minimize $S_1 + S_2$ s.t. $h(S_1, S_2) \geq 0$. We will characterize the solution to this program, show that it is an element of Ω_{AA} , and finally prove that the defendant prefers this solution to the strategy of settling with neither plaintiff and settling with just one plaintiff.

The objective function $S_1 + S_2$ is linear, and the evaluation of the Hessian matrix shows that constraint $h(S_1, S_2) \geq 0$ is a convex set. Lagrangian techniques give us the solution, $S(\mathbf{q})$, defined in the Proposition. Plugging $g(\mathbf{q}^*) = S^*$ into the definition establishes the $S(\mathbf{q}^*) = S^*$. Totally differentiating the expression establishes that $S'(\mathbf{q}) = g'(\mathbf{q})/[2 - f'(S)]$. Since $g'(\mathbf{q}) < 0$ and $f'(S) \in \{0, -\mathbf{p}\}$ we have that $g'(\mathbf{q}) < S'(\mathbf{q}) < 0$ and we conclude $S(0) < g(0)$. Therefore $S^* < S(\mathbf{q}) < g(\mathbf{q})$. It follows from this that $\{S(\mathbf{q}), S(\mathbf{q})\} \in \Omega_{AA} \cap \Omega_{RR}$. We conclude that there was no loss of generality from considering the simplified program.

The defendant prefers settling with both plaintiffs for a total of $2S(\mathbf{q})$ to taking both to court and paying $2g(\mathbf{q}) + 2(c_p + c_d)$ because $2S(\mathbf{q}) < 2g(\mathbf{q}) < 2g(\mathbf{q}) + 2(c_p + c_d)$. What about settling with just one plaintiff? The best the defendant could do in the set $\Omega_{AR} \cup \Omega_{RA}$ is to offer $S_i = g(\mathbf{q})$ and $S_j = 0$. Plaintiff j will surely reject, and Plaintiff i will accept. His expected payment from the trial with the second plaintiff is

$p \min\{D, W - g(\mathbf{q})\} + c_d = f(g(\mathbf{q})) + c_p + c_d$, and so his overall payments under this strategy are $g(\mathbf{q}) + f(g(\mathbf{q})) + c_p + c_d$. But $2S(\mathbf{q}) \leq g(\mathbf{q}) + f(g(\mathbf{q}))$ by revealed preference: $\{S_1, S_2\} = \{g(\mathbf{q}), f(g(\mathbf{q}))\} \in \Omega_{AA} \cap \Omega_{RR}$ and satisfies the definition of risk dominance. So $2S(\mathbf{q}) < g(\mathbf{q}) + f(g(\mathbf{q})) + c_p + c_d$ and we are done.

Proof of Proposition 2: $\mathbf{q} \in [\mathbf{q}^*, \mathbf{q}^{**}]$ implies $\mathbf{q} \geq \mathbf{q}^*$ so $\{S^*, S^*\} \notin \Omega_{RR}$ (Lemma 2). So if the defendant wishes to settle with both plaintiffs he will offer $\{S^*, S^*\}$ and his total payments will be $2S^* = 2g(\mathbf{q}^*)$. It is clear that the defendant prefers settling with both plaintiffs for $\{S^*, S^*\}$ to settling with neither because $2g(\mathbf{q}^*) \leq 2g(\mathbf{q}) + 2(c_p + c_d) \leq 2g(\mathbf{q}^{**}) + 2(c_p + c_d)$ for all $\mathbf{q} \leq \mathbf{q}^{**}$. It remains to be shown that the defendant will not prefer to settle with just one plaintiff.

The defendant prefers settling with just one when $2g(\mathbf{q}^*) < g(\mathbf{q}) + f(g(\mathbf{q})) + c_p + c_d$. The derivative of the right hand side is $g'(\mathbf{q})[1 + f'(g(\mathbf{q}))] < 0$ so it suffices to show that this is true at \mathbf{q}^{**} : $2g(\mathbf{q}^*) < g(\mathbf{q}^{**}) + f(g(\mathbf{q}^{**})) + c_p + c_d$. But $g(\mathbf{q}^*) - g(\mathbf{q}^{**}) = c_p + c_d$ by the definition of \mathbf{q}^{**} , so this becomes $g(\mathbf{q}^*) - f(g(\mathbf{q}^{**})) < 0$. Since $(d/d\mathbf{q})f(g(\mathbf{q})) = f'(g(\mathbf{q}))g'(\mathbf{q}) \geq 0$ we have $f(g(\mathbf{q}^{**})) \geq f(g(\mathbf{q}^*))$ and so $g(\mathbf{q}^*) - f(g(\mathbf{q}^{**})) \leq g(\mathbf{q}^*) - f(g(\mathbf{q}^*)) = 0$. We are done.

Proof of Proposition 3. For parameter values in the range $\mathbf{q} > \mathbf{q}^{**} > \mathbf{q}^*$ we know that $\{S^*, S^*\} \notin \Omega_{RR}$. So if the defendant wished to settle with both plaintiffs he will offer $\{S^*, S^*\}$ and his total payments will be $2S^* = 2g(\mathbf{q}^*)$. We will compare his payoff from settling with neither plaintiff to (1) his payoff from setting with both plaintiffs and (2) his payoff from settling with exactly one plaintiff.

The defendant prefers taking both plaintiffs to court to settling with both for $\{S^*, S^*\}$ when his expected liability from taking both plaintiffs to trial, $2g(\mathbf{q}) + 2(c_p + c_d)$, is smaller than his payments from settling, $2g(\mathbf{q}^*)$. This is true when $\mathbf{q} = \mathbf{q}^{**}$ by the definition of \mathbf{q}^{**} and since $g'(\mathbf{q}) < 0$ it is true for all $\mathbf{q} > \mathbf{q}^{**}$.

If the defendant wants to settle with exactly one plaintiff, he can do no better than offer $S_1 = g(\mathbf{q})$ and $S_2 = 0$ (since the second plaintiff will surely reject this offer). As before, the defendant's total payments from the strategy of settling with just one plaintiff is

$$g(\mathbf{q}) + f(g(\mathbf{q})) + c_p + c_d.$$

The defendant would rather take both plaintiffs to trial (rather than settle with just one) when $2g(\mathbf{q}) + 2(c_p + c_d) < g(\mathbf{q}) + f(g(\mathbf{q})) + c_p + c_d$ or $g(\mathbf{q}) - f(g(\mathbf{q})) + c_p + c_d < 0$. The left-hand side of this expression is decreasing in \mathbf{q} , so it suffices to show that this holds at $\mathbf{q} = \mathbf{q}^{**}$. $g(\mathbf{q}^{**}) - f(g(\mathbf{q}^{**})) + c_p + c_d = g(\mathbf{q}^*) - f(g(\mathbf{q}^{**}))$ by the definition of \mathbf{q}^{**} and $g(\mathbf{q}^*) - f(g(\mathbf{q}^{**})) \leq g(\mathbf{q}^*) - f(g(\mathbf{q}^*)) = 0$ because $(d/d\mathbf{q})f(g(\mathbf{q})) \geq 0$ and we are done.

Proof of Proposition 5. If $\mathbf{q} < \mathbf{q}^*$ then the cases settle under either regime. As proven in Proposition 1, the plaintiff's joint payoff from bargaining independently is $2S(\mathbf{q})$. This is smaller than their payoff from bargaining jointly, $2g(\mathbf{q})$. If $\mathbf{q} \in [\mathbf{q}^*, \mathbf{q}^{**}]$ then with decentralized negotiations the cases settle for $\{S_1, S_2\} = \{g(\mathbf{q}^*), g(\mathbf{q}^*)\}$. With the centralized negotiations the cases settle for $\{S_1, S_2\} = \{g(\mathbf{q}), g(\mathbf{q})\}$. Since $S^* > g(\mathbf{q})$ in this range the defendant is better off with centralized negotiations and the plaintiffs are worse off. If $\mathbf{q} > \mathbf{q}^{**}$ then the case fails to settle with decentralized negotiations and the plaintiffs each receive $g(\mathbf{q})$ at trial. With centralization, the cases settle for $\{S_1, S_2\} = \{g(\mathbf{q}), g(\mathbf{q})\}$. The plaintiffs are indifferent between the two regimes but the defendant is strictly better off because he captures the settlement surplus $2(c_p + c_d)$.

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