A Dynamic Model of Lawsuit Joinder and Settlement*

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ABSTRACT

In this paper we model the dynamic process wherein multiple related lawsuits may be filed and combined; we also examine actions a defendant may employ that may disrupt the formation of a joint suit. Our initial model involves two potential plaintiffs, with private information about the harm they have suffered, in a multi-period setting with positive costs of filing a suit. If two plaintiffs file, they join their suits to obtain a lower per-plaintiff trial cost and a higher likelihood of prevailing against the defendant. We find that some plaintiff types never file, some wait to see if another victim files and only then file, some file early and then drop their suits if not joined by another victim and, finally, some file and pursue their suits whether or not they are joined; thus, the equilibrium resembles a "bandwagon."

We then consider the effect of allowing preemptive settlement offers by the defendant aimed at discouraging follow-on suits. Preemptive settlement results in a "gold rush" of cases into the first period. In general, plaintiffs (*ex ante*) strictly prefer that such preemptive settlements not be allowed, and computational results demonstrate that this may be true for defendants as well; however, in the absence of a commitment mechanism, the defendant is unable to resist making preemptive settlement offers. Finally, we consider partial unawareness of victims as to the source of harm; this provides a role for plaintiffs' attorneys, who may seek additional victims to join a combined lawsuit. Confidential preemptive settlements in the case of partial unawareness restrict the plaintiff's attorney from seeking additional victims and therefore lead to higher preemptive settlement amounts. Moreover, the defendant strictly prefers to employ preemptive settlement if the fraction of unaware victims is sufficiently high.

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JEL: K41, D82

1. Introduction

In this paper we consider the dynamics of a three-party bargaining problem wherein two of the parties can form a coalition to bargain against the third party. The coalition formation is hampered by the private information of the two potential coalition members and the possible strategic interference of the third party. Furthermore, we assume that there is imperfect information with regards to the number of parties who may be available to form a coalition. Learning plays an important role and causes a tradeoff between acting early to encourage further entry and waiting to observe if others are present.

Our context is the dynamic aggregation of lawsuits. A now-familiar example is the evolution of lawsuits in the case of abuse of minors by priests of the Catholic Church, both in the U.S. and (now) worldwide. Some victims were aware of their harm, but did not come forward initially either because the personal costs were too high and/or they thought they were unlikely to be believed (and thus, not likely to be successful in a lawsuit). Many did come forward, however, once others had set the dynamic process in motion; in some cases they joined existing suits[1] and in others they filed separate suits, but the fact that there were multiple victims alleging harm made each of them more likely to prevail. Moreover, since the defendant in civil suits was often the archdiocese (rather than the individual priests themselves, who were essentially judgment-proof), it is plausible that the defendant was also unaware initially as to how many victims there were. Some victims were actually unaware that they had been harmed in this manner, either because they were so young at the time that their memories were hazy or because they had repressed the memories. When other

[1] "In March [2002] a former Salem man, James Hogan, filed a lawsuit against the Boston archdiocese and New Hampshire Bishop McCormack, alleging that in the 1960s McCormack – who was assigned to St. James's in Salem at the same time Birmingham was – saw Birmingham taking him to his rectory bedroom and did nothing to stop it. That lawsuit was later amended to include an additional thirty-nine alleged victims." (The Investigative Staff of the Boston Globe, 2002, p. 59).

victims came forward, these "unaware" victims were able to recall their own experiences and come forward as well. Finally, there is ample evidence of the use of confidential settlements intended to preempt the publicity that would lead to more suits by more victims.

In what follows we will express the analysis in the more neutral setting of products liability, though the broader application to a variety of tortious behavior should be obvious. Thus, consider a firm that produces a product that might cause harm to those exposed to the product. A harmed individual may consider bringing a lawsuit against the firm in order to recover damages and, if a number do so, a combined lawsuit may arise; this is known formally as "permissive joinder" of the lawsuits.[2] In this paper we model the dynamic process by which such a joint lawsuit may form; we also examine actions a defendant may employ that may affect its formation. In our model a defendant faces zero, one, or two potential plaintiffs who have been harmed by his product;[3] neither the defendant nor any potential plaintiff knows (*ex ante*) how many victims have actually been harmed and, before filing, a plaintiff's level of harm is his private information. A harmed plaintiff can choose when to file (which involves a cost), and may later choose to drop the suit; if two suits are eventually filed (and neither, in the intervening time, has been settled) then a joint suit is formed whose members benefit from reduced court costs as well as an increased likelihood of winning the case against the defendant firm. Our benchmark model shows that we can partition the interval of levels-of-harm (types) into a maximum of five distinct sets of potential plaintiff types: 1) types who will never file suit; 2) types who will wait to see if others file, and only file if some other victim

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[2] There are a number of means, both formal and informal, whereby suits by multiple parties may be aggregated into a single action. We briefly discuss the variety of legal procedures in Section 2.

[3] We restrict attention to a maximum of two plaintiffs so as to focus attention on the primary forces of interest and to avoid inessential combinatorics. Formally, the model could be extended to a larger number of potential plaintiffs.

does; 3) types who will file early, but then drop the suit if no one else “joins the bandwagon;” 4) types who file early, and will pursue the suit if no other victim has also filed, albeit with “regret” (that is, if given the opportunity to recover the cost of filing by withdrawing the suit, they would do so); and 5) types who will file early and pursue the suit without regret even if no other plaintiff joins the bandwagon. In the main text we analyze a two-period model; in the Appendix we show that one could allow for an arbitrary number of periods, but that two periods suffices to characterize the equilibrium of interest.

Using the basic two-period model we then consider a number of questions. What will happen if the defendant can choose to settle preemptively with a single plaintiff who has filed in the first period, rather than wait to settle with that plaintiff until the end of the second period? From the defendant’s perspective, delay may result in facing two plaintiffs, and settlement in the first period may (or may not) eliminate this possibility. How does the availability of such a preemptive strategy affect initial and follow-on suits? What are the parties’ preferences over the alternatives of preemptive versus deferred settlement?

Within the context of preemptive settlement we first examine the impact of “data suppression” (which may arise either from confidentiality or policy) on settlements and on the dynamics of case filing. Data suppression involves the limitation of follow-on suits to not be able to employ the particulars of earlier cases to improve their individual likelihood of winning (for example, no follow-on suit could rely upon a “pattern of behavior”). We show that the partition of suits outlined above is affected, and that some would-be “waiters” (item 2 above) switch to filing early, resulting in a “gold rush,” while the remainder do not file in equilibrium. In the original setup, these latter types waited and then filed in a later period if a victim had filed in the early period; now settlement in the first period means that any plaintiff type who waits does not file suit.

We further find that, in general, plaintiffs prefer deferred settlement over preemptive settlement. While more suits will be filed earlier than if settlement is deferred, it is ambiguous whether (in general) the overall number of suits is increased or decreased; in the case of the uniform distribution of damages we find that the *ex ante* expected number of suits is greater when preemptive settlement is possible. One might expect that the defendant would always prefer to have the option to make a preemptive settlement offer, but numerical experiments with uniformly-distributed levels of harm show that the defendant can prefer deferred settlement, too. In general, however, without a credible commitment to defer settlement the defendant cannot resist the temptation to make preemptive settlement offers.

We then consider the contrasting environment wherein data is not suppressed ("data availability") so that a later (follow-on) suit can free-ride on the particulars of an earlier suit (even if that earlier suit was settled) in order to enhance the later suit's likelihood of winning at trial; an example occurs when epidemiological data is used to pursue a suit against a drug manufacturer. We find that a gold rush is still the equilibrium outcome unless the availability of earlier case data contributes sufficiently strongly to a later-filed case's likelihood of winning. Thus, the presence of the opportunity to settle preemptively is a powerful inducement for cases to be filed early.

We also consider the possibility that one or both victims are unaware that the defendant was the cause of the harm suffered; perhaps they assume that their harm arose due to bad luck or due to their actions alone. For expositional convenience, we refer to the initial analysis as the "fully-aware" case (with or without preemptive settlement), and this portion of the analysis as the "partially-unaware" case (again, with or without preemptive settlement). Such heterogeneity of awareness of the source of harm, especially in the case of a mass-marketed product (or mass exposure), is quite realistic and it provides a role for attorneys that has been much remarked-upon in the lay and law literatures (see Nagareda, 2007): an attorney for an initial (aware) plaintiff could try to seek out other victims, make them aware of the possible source of harm, and encourage them to file lawsuits as well.[4] How does the degree of "unawareness" affect the formation of joint suits? What now happens if the defendant can offer a preemptive settlement to an "early, aware filer" that precludes that filer's attorney from reaching out to other potential plaintiffs (as a condition for a confidential settlement)? In general we find that allowing for partial unawareness results in a set of waiting types of a size that is intermediate between that of the benchmark (no-settlement) model and that of the previously-described preemptive offer model for the fully-aware case. Moreover, increasing the degree of unawareness results in a set of "aware waiters" which varies smoothly and parametrically between the two fully-aware waiter-sets described earlier. Similar to the (fully-aware) preemptive analysis described above, allowing preemptive settlement in the partial-awareness setting means that only suits filed in the first period will be filed at all, since the confidentiality of settling an early suit means that otherwise unaware litigants are never made aware.[5] Since a settlement negotiation that fails releases the aware, early-filing plaintiff's attorney to seek other potential plaintiffs (so as to form a joint suit), the equilibrium preemptive settlement offer is increasing in the degree of unawareness. In contrast with the fully-aware case, we show that

[4] Unawareness also might reflect latency of the harm, as might occur with a pharmaceutical product that affects the later health of either the product's consumers or, possibly, their offspring. We do not attempt to address latency issues comprehensively, but the result that settlement in this setting (which is likely to be confidential) works to "let sleeping dogs lie" is certainly suggestive.

[5] Settlements that are not confidential, or where the confidentiality is ineffective or subsequently lifted, could lead to filings by previously-unaware victims; we delay consideration of this to a future paper.

(in general) for a sufficiently low fraction of aware victims, the defendant strictly prefers to have the option to make preemptive settlements.

This paper does not attempt to model the effect that strategic interference with a dynamic arrival process would have on the level of *ex ante* care-taking by either plaintiffs or defendants; this is beyond the scope of this paper. However, the possibility of preemptive settlement offers may reduce care-taking by defendants, especially in the partially aware case. Our primary focus is on understanding the formation of a bargaining coalition in a dynamic setting wherein the opposing side can intervene and influence the formation process. A consideration of what policy interventions might be desirable (and implementable) in the settlement context is discussed in the final section of the paper.

Plan of the Paper

In Section 2 we provide a brief overview of the primary legal procedures (both formal and informal) used to aggregate lawsuits and we provide a brief review of related economic literature. In Section 3 we provide the model set-up and analysis for the benchmark case in which no settlement is allowed. Section 4 provides relevant details and results for the preemptive-settlement strategy in the fully-aware case when there is data suppression and when there is data availability (that is, later cases can free-ride on earlier case particulars). Section 5 considers the partially-unaware case, both when there is no settlement and when there is confidential settlement. Finally, Section 6 provides a summary as well as implications we draw for appropriate policy with regard to settlements. An Appendix with the most significant supporting material and a Technical Appendix (available at http://XXX) with other details augment the main text.

2. Background on Procedural Aggregation of Lawsuits and Review of Related Literature

Procedural Aggregation of Suits by Different Parties

There are several procedural methods by which lawsuits by different parties making related claims of the same defendant can be aggregated formally; the following discussion draws heavily on Erichson (2000). "Permissive joinder" allows multiple plaintiffs to voluntarily combine their suits into a single suit. Cases pending in the same court can be aggregated through "consolidation" for purposes of judicial economy, while cases pending in different federal courts can be transferred to a single federal court for "multi-district litigation" (this is essentially consolidation of federal court cases for pre-trial proceedings only). Finally, a "class action" lawsuit involves a suit by a representative plaintiff on behalf of many others (who are ultimately bound by the outcome if they do not opt out). Generally, permissive joinder is the root from which the other aggregation procedures have sprung.

Such aggregate suits may follow the filing of many individual suits, though class actions are often initiated by one or more attorneys following the disclosure of, for example, a securities law violation. In this latter case, the identity of those harmed is ascertainable (i.e., all shareholders as of the date of the violation) and damages are proportional to the number of shares held. Finally, as Erichson demonstrates, even when there is no formal aggregation of suits, there is often substantial informal aggregation: "Plaintiffs' lawyers work together to plan strategy, conduct discovery, hire experts, develop scientific evidence, conduct jury focus groups, and join efforts in countless other ways." (2000, p. 388-389).[6] Our model is best thought of as one of permissive joinder, as we focus

[6] Working groups sponsored by the American Trial Lawyers Association include (among others, see Erichson, 2000, pp. 394-395 for a long list): cardiac devices; child sex abuse; fen-phen; firearms and ammunition; herbicides and pesticides; lead paint; nursing homes; and vaccines.

on victim-driven lawsuits and we wish to allow aggregation of claims if multiple suits arise.

Related Literature

The previous literature on the economic analysis of lawsuit aggregation falls into two categories. One category involves static models of coalition-formation among a known collection of victims. Che (1996, 2002) examines how plaintiffs with heterogeneous claims form a coalition for the purpose of negotiating with a common defendant. Che and Spier (2008) provide a model with multiple victims who enjoy scale economies in litigation costs if they proceed jointly. They show that the defendant can exploit coordination failure among the plaintiffs to reduce his expected payment. Indeed, if some consolidation of cases is required in order for trial to be credible, then by offering a critical number of them an amount sufficient to induce settlement, the remaining victims' joint suit can be undermined. Instead, we assume that plaintiffs in a joint suit can coordinate their settlement decisions, allowing them to resist this unraveling process. We base this on the discussion in Erichson (2003, especially pages 524-525), who observes that: 1) frequently the plaintiffs have a common lawyer; and 2) when there are multiple lawyers with similarly-situated clients, they work closely together to coordinate strategy and effort.

Our focus is on the dynamics of suit-arrival and joint-suit formation, when each victim has imperfect information about the existence of other victims and private information about their own damages; this is more closely-related to the second category of previous literature. Kim (2004) and Deffains and Langlais (2009) provide dynamic models with exogenous timing. In both of these models there are two (potential) plaintiffs with known levels of harm. Plaintiff 1 has the opportunity to file suit in period 1; Plaintiff 2 has the opportunity to file suit and join Plaintiff 1 in period 2. If the plaintiffs join their suits then they can pool their information/evidence and improve their likelihood of winning at trial and lower their per-person litigation costs. In the third period, the defendant makes a take-it-or-leave-it offer to plaintiffs in any extant suits. Kim (2004) shows that a Plaintiff 1 with "weak" evidence – such that a stand-alone suit would have a negative expected value – would find it optimal to file suit if it is sufficiently likely that she would be joined by a second plaintiff. Deffains and Langlais (2009) argue that a joint suit allows an early plaintiff to benefit from both scale economies in litigation and information sharing with a later plaintiff. They do not characterize all Nash equilibria for all parameter values; rather, they determine sufficient conditions for a joint suit to form.

Our model is quite different from those of Kim, and Deffains and Langlais, although it shares some basic features. Common features to the three models are: there are two potential victims, and suits involving two plaintiffs are expected to enjoy a higher likelihood of prevailing against the defendant and lower litigation costs per plaintiff. Differences include: in our model, neither plaintiff has private information regarding the defendant's liability, and each plaintiff has private information about damages. A crucial difference is that we do not pre-specify the order of moves (nor is any plaintiff's ability to file contingent on another's filing); either plaintiff can file at any time. Private information about damages introduces strategic motives to file versus wait; filing early can provoke follow-on lawsuits while waiting can allow learning about the likelihood of another plaintiff. Finally, we also allow the defendant to settle early with an early filer in order to preempt (or at least discourage) follow-on suits, and demonstrate that this encourages early filing.

Marceau and Mongrain (2003) provide a model with endogenous timing wherein victims with different levels of (observable) damages decide whether to initiate a costly joint suit. Filing a joint suit privately provides a public good to all of the other plaintiffs; once a joint suit is filed by an individual plaintiff, all of the other plaintiffs are included without cost. This results in a war of attrition,[7] wherein each plaintiff would prefer to wait and let someone else initiate the joint suit. In our model, an individual victim chooses to file suit (at a cost) or not. On the other hand, whenever two victims have filed suit, under our maintained assumptions it is always optimal for them to join their suits; we do not include a cost of combining their suits, but it would be optimal for them to do so even at a (sufficiently small) additional cost. Our payoff structure does not result in a war of attrition. Rather, an individual files early in anticipation that there may be another (lower-damaged) plaintiff who will be motivated to join an existing suit (i.e., to get on the bandwagon) but who would not be willing to start the bandwagon rolling. Finally, we allow suits to be resolved by settlement; in particular, the defendant may settle with an early filer so as to preempt or discourage follow-on suits.

Our analysis draws upon previous work by Farrell and Saloner (1985). They consider agents deciding when (if ever) to adopt a new technology in the presence of "network externalities" (i.e., the value of adopting is higher when there are more adopters). Assuming that two potential adopters have private information about their own values of adoption, they show that equilibrium behavior resembles a "bandwagon" in which a potential adopter with a sufficiently high value adopts immediately, one with an intermediate value waits and adopts only if the other adopted previously, and one with a sufficiently low value never adopts the new technology. They are particularly interested in whether there can be insufficient or excess adoption in equilibrium (both are possible). Our model also exhibits network externalities in the sense that the value of filing suit is higher if

[7] Choi (1998) provides a model in which two potential infringers can enter a patentee's market at any time. Under different parameter regimes he obtains a war of attrition or a "racing game" (wherein each prefers to be the first entrant). Under neither parameter regime does the equilibrium result in a bandwagon.

there are more filers. This results in an endogenous-timing equilibrium of the same form, but the models are quite different in several other ways (besides the obvious difference in the application). First, in their model it is common knowledge that there are two potential adopters; in our model the number of harmed victims is a random variable whose distribution is common knowledge. Second, in their model an adopter would never want to switch back (in equilibrium). In our model, there are some plaintiff types who file early, but subsequently drop their cases (in order to avoid litigation costs) if not joined by another plaintiff. Third, their game is entirely between the two potential adopters; our game involves a strategic defendant in addition to the two potential plaintiffs. Settlement between the defendant and an early plaintiff can disrupt the bandwagon's development, and we find that equilibrium in this case resembles a "gold rush" in the sense that the anticipation of preemptive settlement increases the likelihood of filing in the first period.

3. Model Set-up and Analysis

3.1 Basic Notation

We assume that it is common knowledge that there are two potential plaintiffs, denoted P_i and P_j (we will refer to P_i as "him" and P_j as "her").[8] These are "potential" plaintiffs in that we will allow for the realized number of victims to be 0, 1 or 2. Let π_n denote the probability that exactly n individuals are harmed, for n = 0, 1, 2. Conditional on being harmed himself, P_i updates his beliefs about the likelihood that there is another potential plaintiff out there.[9] Let q_n be victim i's

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[8] While our analysis is, formally, limited to a maximum of two individual victims, this could be extended to two groups of victims (think of two towns with water tables affected by nearby gas station tank leakages; for example, see *Ashcraft v. Conoco, Inc.*, 1998 U.S. Dist. LEXIS 4092) with aggregate damages for a group used where we consider individual damages; we return to discuss this further in Section 6.

[9] Multiple (or mass) torts can arise from the use of a defectively-designed mass-marketed product (e.g., a vaccine, a pharmaceutical product, or an automobile) or from environmental exposure (e.g., to runoff from herbicide or pesticide use by others).

conditional probability that there are exactly n victims, given that he himself is a victim; thus $q_0 = 0$, $q_1 = \pi_1/(\pi_1 + 2\pi_2)$, and $q_2 = 2\pi_2/(\pi_1 + 2\pi_2)$. Victim j conducts a similar updating exercise upon learning that she was harmed.

P_i's harm is denoted δ_i, and P_j's harm is denoted δ_j, where δ_i and δ_j are drawn independently from the common distribution $H(\delta)$ with positive and continuous density $h(\delta)$ on the interval $[0, \infty)$. We assume that each victim's damages are his or her own private information at the point of filing suit. However, at the point of resolution (i.e., trial or settlement negotiations with the defendant), damages are observable/verifiable through either the trial mechanism itself or through pre-trial discovery. For simplicity, we assume that the damages, conditional on being harmed, are drawn independently but, as long as knowledge of one's own damages maintains the same support over the other potential victim's damages, we conjecture that the same basic dynamic picture would emerge if the plaintiffs' damages were correlated.

By separating the number of victims harmed from the distribution of damages given harm, we are able to incorporate any correlation between the existence of the two possible victims in a very simple manner. Some special cases include: 1) if each potential victim has an independent probability (say, π) of being harmed, then $\pi_1 = 2\pi(1 - \pi)$ and $\pi_2 = (\pi)^2$; 2) if the events of being harmed are perfectly positively correlated, then $\pi_1 = 0$; and (3) if the events of being harmed are perfectly negatively correlated, then $\pi_1 = 1$. Comparative statics are easier to express and our formulation also allows us to intuitively handle an important issue we address in Section 5 below, where we allow for victims to be either aware or unaware of the source of their harm; thus, having each victim unaware as to whether other victims exist (independent of whether they are aware of whether they themselves have been harmed) seems most consistent with this particular problem context.

Upon filing suit, which entails a filing cost of $f > 0$, a victim becomes a plaintiff; as will become clear below, we allow a plaintiff to subsequently drop his suit (without recovering any sunk costs). We view this cost as not only the monetary expense of filing a suit, but also the disutility of suing; this latter cost may be small or large. We assume that the likelihood that the defendant, denoted D, is found liable at trial is increasing in the number of plaintiffs in a joint suit.[10] This may reflect, for instance, the information sharing or joint strategizing among attorneys (as described by Erichson, 2000) or the use of population-based liability determination (Daughety and Reinganum, 2010).[11] Let L_n denote the likelihood that D will be found liable at trial if there are n plaintiffs in a joint suit, for n = 0, 1, 2; based on the foregoing discussion it is sufficient to simply posit that $L_2 > L_1 > L_0 = 0$. Should the defendant be found liable at trial, the plaintiffs are awarded their actual damages and then pay their individual shares of the litigation cost; thus, we consider joint suits that focus on the common attribute of the defendant's liability. The litigation cost (at trial) per plaintiff, denoted c_n, for n = 1, 2, is assumed to decline with the number of plaintiffs, reflecting scale economies in litigation; thus, $c_2 < c_1$.

There are two periods during which victims can file suit;[12] each victim can file suit in either period 1 or in period 2, but no further suits can be filed after period 2. This assumption simplifies the exposition but it is not crucial: there can be an arbitrary number of periods during which suit

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[10] We also consider the case wherein there is an informational spillover outside of pure joinder in Section 4.2

[11] Daughety and Reinganum (2010) show that, especially in the context of multiple (or mass) torts settings, cause or fault may rely on statistical evidence based on aggregate data (in the absence of being able to rely upon a clear causal chain); in this case the likelihood of liability generally increases in the frequency of harm. Because of this dependence, it is rational for a harmed Bayesian plaintiff to update any given prior distribution on defendant liability to a posterior distribution that first-order-stochastic-dominates the prior.

[12] We abstract from discounting in the analysis.

can be filed, and the results will continue to hold exactly as stated; the details of this analysis can be found in the Appendix. In period 1, a victim must choose between filing suit immediately and waiting until period 2; if two victims file in period 2, then it will be optimal for them to join their suits (to take advantage of evidence-based externalities and scale economies in litigation). As discussed earlier in Section 2, we assume that whenever two plaintiffs join their suits, they can coordinate all subsequent actions. A victim who waits in period 1 is assumed to observe any filing (and settlement) that occurred in period 1; this victim then behaves optimally in period 2. In particular, this may entail joining a plaintiff who filed in period 1 (and is available to be joined, either because settlement was not allowed or because it was not successful), filing alone, or foregoing the suit altogether.

Throughout the paper we will be characterizing equilibria with a particular structure, known as bandwagon equilibria (see Farrell and Saloner, 1985). Note that, if there are only two periods, then any Perfect Bayesian equilibrium must be a bandwagon equilibrium; for a proof of this claim, see the Technical Appendix. We implement this concept via the following two definitions.

Definition 1. A bandwagon strategy for victim k is summarized by two critical values, denoted $\underline{\delta}_k$ and $\bar{\delta}_k$, with $\bar{\delta}_k \geq \underline{\delta}_k$, and is denoted as $\{\underline{\delta}_k, \bar{\delta}_k\}$, such that:

(a) if $\delta_k \geq \bar{\delta}_k$, then victim k files suit in period 1;

(b) if $\underline{\delta}_k \leq \delta_k < \bar{\delta}_k$, then victim k waits in period 1 and files suit in period 2 only if another victim has already filed suit (and is available to be joined);

(c) if $\delta_k < \underline{\delta}_k$, then victim k never files suit.

Definition 2. A symmetric bandwagon equilibrium (SBE) is a pair of values $\{\underline{\delta}, \bar{\delta}\}$, with $\bar{\delta} \geq \underline{\delta}$, such that the strategies $\{\underline{\delta}_i, \bar{\delta}_i\} = \{\underline{\delta}, \bar{\delta}\}$ and $\{\underline{\delta}_j, \bar{\delta}_j\} = \{\underline{\delta}, \bar{\delta}\}$ are mutual best responses.

3.2 Equilibrium Dynamics when No Settlements are Possible

In the benchmark analysis we assume that no settlements are possible, so if a victim files suit in period 1 then he or she is thereafter available to be joined by a victim who files in period 2 (of course, it is also possible that both file in period 1 and form the joint suit immediately). The expected return from trial to a plaintiff who has filed suit is the expected damages award (where the realized amount awarded is equal to the level of harm incurred) minus the plaintiff's court costs. Note that if a plaintiff is not joined by another plaintiff, the *interim* expected value from proceeding with the suit could now be negative, prompting the plaintiff who has filed to drop the case (which we allow).

In this subsection we discuss the characterization of a victim's best response function and the derivation of the symmetric bandwagon equilibrium, as well as some associated comparative statics; the details are in the Appendix. To help with notational conventions in later sections, where we modify the no-settlement assumption, we will use a superscript "N" on the variables and functions of interest, when needed. In period 1, a victim can choose to file suit at a cost of f, or wait. After the first period, there may be a plaintiff who has already filed suit or there may be no such plaintiff. Thus, in the second period an optimal strategy for a plaintiff who waited consists of a decision rule specifying whether or not to file suit contingent on how many other plaintiffs (0 or 1) have already filed.

Note that the value of filing suit is highest for any victim when another victim has already filed suit, in which case a victim with damages δ will anticipate the payoff $L_2\delta - c_2 - f$ should he or she file suit. If this is negative, then this victim will never file suit. Thus, it is clear that the lower critical value in a bandwagon equilibrium is given by $\underline{\delta} \equiv (c_2 + f)/L_2$, as no victim with damages below $\underline{\delta}$ would expect a non-negative return from filing suit. Therefore, in what follows, we need only characterize the equilibrium value $\bar{\delta}$. The upper threshold value, $\bar{\delta}$, will potentially change as we modify the model, and we will superscript it as needed; we also note that the lower threshold, $\underline{\delta}$, is the same for all model variants, so we do not superscript it.

Suppose that victim j employs a bandwagon strategy $\{\underline{\delta}, \bar{\delta}_j\}$. We will characterize victim i's best response, beginning with period 2. If victim i filed suit in period 1, then he has no further action to take (except, possibly, to drop his suit later if he is not joined). Suppose that victim i did not file suit in period 1. If victim j filed suit in period 1, then victim i will file suit in period 2 only if $L_2\delta_i - c_2 - f \geq 0$; that is, only if $\delta_i \geq \underline{\delta}$. If victim j did not file suit in period 1, then victim i does not expect victim j to file suit in period 2. This is because either victim j does not exist or, if she does exist, she has $\delta_j < \bar{\delta}_j$ and therefore she was waiting for victim i to file; in either case, she will not file in period 2 (since she is playing a bandwagon strategy). Hence, victim i expects to proceed alone and thus he will file in period 2 only if $L_1\delta_i - c_1 - f \geq 0$. Let $\delta_1 \equiv (c_1 + f)/L_1$; this is the marginal plaintiff-type who would just be willing to file suit on a purely stand-alone basis. Then victim i will file suit in period 2 (alone) only if $\delta_i \geq \delta_1$. Note for future purposes that $\delta_1 > \underline{\delta}$, due to the earlier assumptions on the parameters c_n and L_n.

Now consider victim i's decision problem in period 1. Since we know that victim i will never file suit if $\delta_i < \underline{\delta}$, we need only consider $\delta_i \geq \underline{\delta}$. Given the continuation payoffs described above, we can write victim i's <u>payoff from waiting in period 1</u>, W^N, as:

$$W^N(\delta_i, \bar{\delta}_j) \equiv q_2[1 - H(\bar{\delta}_j)][L_2\delta_i - c_2 - f] + [1 - q_2 + q_2H(\bar{\delta}_j)][\max\{L_1\delta_i - c_1 - f\,, 0\}]. \qquad (1)$$

The first term reflects the probability that victim j exists and has damages that would induce her to file in period 1 (using her bandwagon strategy), while the second term reflects the probability that victim j either does not exist or that she exists but has damages that would induce her to wait in period 1 rather than file.

On the other hand, victim i's payoff from filing in period 1, F^N, is given by:

$$F^N(\delta_i, \bar{\delta}_j) \equiv q_2[1 - H(\underline{\delta})][L_2\delta_i - c_2 - f] + [1 - q_2 + q_2H(\underline{\delta})][\max\{L_1\delta_i - c_1, 0\} - f]. \qquad (2)$$

To see why, notice that if victim i files in period 1, then regardless of what else happens he will pay the fee f. If victim j exists (this occurs with probability q_2), then she will also file in period 1 if $\delta_j \geq \bar{\delta}_j$ and she will wait in period 1 but will file in period 2 (joining victim i) if $\underline{\delta} \leq \delta_j < \bar{\delta}_j$. Thus, victim j will ultimately file with probability $1 - H(\underline{\delta})$, in which case victim i will receive the payoff $L_2\delta_i - c_2 - f$. On the other hand, if either there is no victim j (which occurs with probability $1 - q_2$) or if there is a victim j but her damages are less than $\underline{\delta}$ (which occurs with probability $q_2H(\underline{\delta})$), then victim j will never file. In this case, victim i will decide between dropping his case and receiving 0 or continuing and receiving $L_1\delta_i - c_1$.[13] Note that $F^N(\delta_i, \bar{\delta}_j)$ is actually independent of $\bar{\delta}_j$.

Let $Z^N(\delta_i, \bar{\delta}_j) \equiv F^N(\delta_i, \bar{\delta}_j) - W^N(\delta_i, \bar{\delta}_j)$ denote the net value of filing in period 1 (net of the value of waiting and then behaving optimally in period 2). Then, after some manipulation:

$$Z^N(\delta_i, \bar{\delta}_j) = q_2[H(\bar{\delta}_j) - H(\underline{\delta})][L_2\delta_i - c_2 - f] + [1 - q_2 + q_2H(\underline{\delta})][\max\{L_1\delta_i - c_1, 0\} - f]$$
$$- [1 - q_2 + q_2H(\bar{\delta}_j)][\max\{L_1\delta_i - c_1 - f, 0\}]. \qquad (3)$$

In the Appendix we determine victim i's best response to victim j's bandwagon strategy $\bar{\delta}_j$ (having already established that $\underline{\delta}_i = \underline{\delta}_j = \underline{\delta} = (c_2 + f)/L_2$). There we show that: 1) victim i's best response to a bandwagon strategy is itself a bandwagon strategy; and 2) that victim i's best response is downward-sloping and crosses the 45°-line once, so that a symmetric equilibrium exists and is unique. We summarize the resulting SBE as follows.

[13] In contrast, since plaintiffs in a joint suit coordinate their actions, neither will drop his/her suit.

Proposition 1. $\{\underline{\delta}, \bar{\delta}^N\}$ is the unique SBE with no settlement, with $\underline{\delta} = (c_2 + f)/L_2$, and $\bar{\delta}^N$ the unique solution to $Z^N(\delta, \delta) = 0$. Moreover, $\bar{\delta}^N \in (\underline{\delta}, \delta_1)$, where $\delta_1 \equiv (c_1 + f)/L_1$.

That is, there is a unique set of "waiting types," $[\underline{\delta}, \bar{\delta}^N)$; any victim with a type in this set waits in period 1 and files in period 2 only if some other victim has filed in period 1.

The fact that $\bar{\delta}^N < \delta_1$ means that (in equilibrium) there will be some types of victim i that will file in the first period, but will regret having filed in period 1 if not joined in period 2 by another plaintiff. It remains to characterize when there will actually be cases that are filed in period 1 and subsequently dropped in period 2 when a second plaintiff fails to materialize; that is, when is $\bar{\delta}^N < \delta_Q \equiv c_1/L_1$? Unfortunately, since (for general H) $\bar{\delta}^N$ is implicitly defined by $Z^N(\bar{\delta}^N, \bar{\delta}^N) = 0$, an explicit condition is not generally possible. However, as shown in the Technical Appendix, there always exists a value of f, denoted as f_{NQ}, such that $\bar{\delta}^N$ (>, =, <) δ_Q as f (>, =, <) f_{NQ}. The SBE in this case is illustrated in Figure 1. Both $F^N(\delta_i, \bar{\delta}^N)$ and $W^N(\delta_i, \bar{\delta}^N)$ are piecewise linear, as shown, with

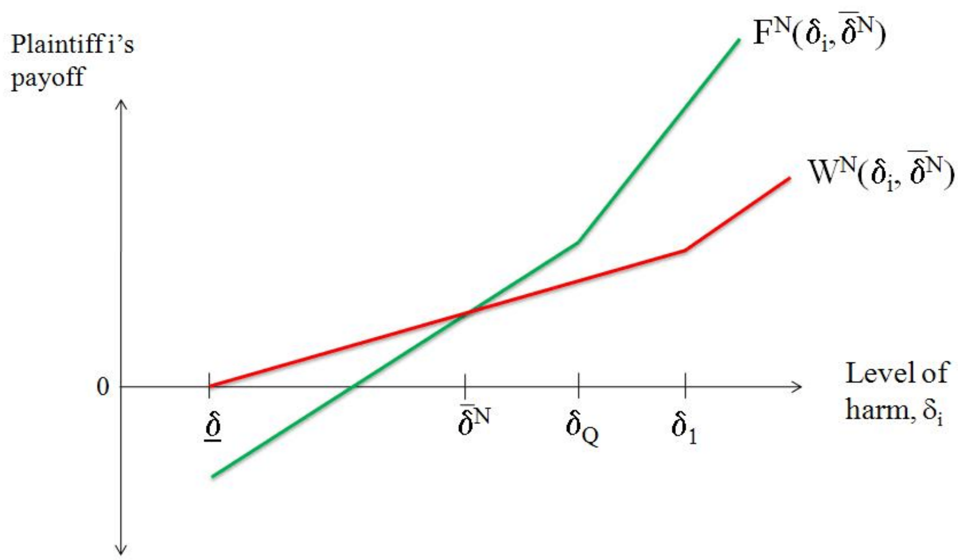

Figure 1: Illustration of No-Settlement SBE

$F^N(\delta_i, \bar{\delta}^N)$ having a kink at δ_Q, beyond which it is optimal to continue alone, while $W^N(\delta_i, \bar{\delta}^N)$ has a kink at δ_1, beyond which it is optimal to file alone. The two functions cross at $\delta_i = \bar{\delta}^N$.

Since the outcome wherein there are victim types who file but then drop the suit (which only occurs if $\bar{\delta}^N < \delta_Q$) is of interest, we examine it at some length. Most of our results do not depend upon $f < f_{NQ}$; therefore, we will specifically note when particular results rely on this assumption. The following proposition summarizes the partitioning of the possible levels of harm $[0, \infty)$ and Figure 1 below illustrates the dynamics of joint suit formation when no settlements are possible.

<u>Proposition 2</u>. In the SBE $\{\underline{\delta}, \bar{\delta}^N\}$, victim i takes the following actions, depending on the harm δ_i:

a) $\delta_i \in [0, \underline{\delta}) \Rightarrow$ never file;

b) $\delta_i \in [\underline{\delta}, \bar{\delta}^N) \Rightarrow$ wait in period 1, file in period 2 only if another victim filed in period 1;

c) (i) $f < f_{NQ}$ and $\delta_i \in [\bar{\delta}^N, \delta_Q) \Rightarrow$ file in period 1, drop in period 2 only if no other victim filed in period 1 or 2;

(ii) $f < f_{NQ}$ and $\delta_i \in [\delta_Q, \infty) \Rightarrow$ file in period 1, continue to sue in period 2;

(iii) $f \geq f_{NQ}$ and $\delta_i \in [\bar{\delta}^N, \infty) \Rightarrow$ file in period 1, continue to sue in period 2.

Figure 2 illustrates the partitioning of the type space $[0, \infty)$, showing the actions taken in

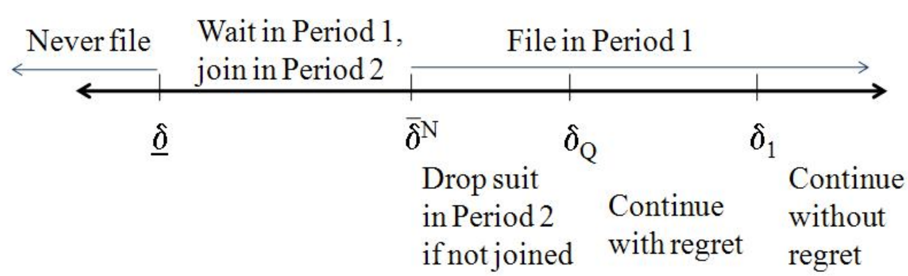

Figure 2: Partitioning the Level of Harm Under No Settlement

equilibrium; we have assumed $\bar{\delta}^N < \delta_Q$ for the illustration, but if this does not hold (that is, if $f \geq f_{NQ}$), then the region shown between $\bar{\delta}^N$ and δ_Q would not appear.

Comparative Statics

The following comparative statics results are shown in the Technical Appendix: 1) $\underline{\delta}$ is increasing in f and c_2, decreasing in L_2, and independent of q_2; and 2) $\bar{\delta}^N$ is increasing in f and c_2, and decreasing in L_2 and q_2. Taking these results as a whole, if we consider $[\underline{\delta}, \bar{\delta}^N)$ as a "window for waiting," then an increase in the filing cost, f, shifts both the bottom and the top of the window "to the right" (though not necessarily uniformly): more types will never file, and some types who would have filed in period 1 before the increase in f now wait. Similarly, a reduction in the scale-economies in litigation costs due to coordination of the suits (that is, an increase in c_2, which reduces $c_1 - c_2$), yields a similar (potentially non-uniform) rightward shift of the window. Note that this is because the value of waiting drops, but the value of filing in the first period falls by yet more, so that the previous marginal type, $\bar{\delta}^N$, now strictly wishes to wait. If L_2 increases instead, then the window shifts left (again, not necessarily in a uniform manner): there is increased value to joining with another plaintiff, if she exists, so some of the types who would never have filed before now join the window, while some near the top of the window now file in period 1 (for small changes in L_2 and for $f < f_{NQ}$, this means that if no other victim files in period 1 or 2, then this lone plaintiff will drop the suit; if $f \geq f_{NQ}$, then this plaintiff will pursue the case to resolution). Alternatively, if forming a joint suit obtains the benefit of the cost improvement $c_1 - c_2$, but no change in the likelihood of liability (i.e., L_2 equals L_1), then the comparative statics imply that more plaintiff types never file ($\underline{\delta}$ increases) and some types that would have filed in the first period now choose to wait ($\bar{\delta}^N$ increases). Finally, an increase in q_2 does not affect the bottom of the window (since $\underline{\delta}$ is independent of q_2), but it does shift the top of the window to the left: since there is a higher likelihood of a second plaintiff, the type just willing to file in the first period (that is, the previous marginal type $\bar{\delta}^N$) is less worried about being a lone filer, so he now strictly prefers to file early.

4. Preemptive Settlement

In the analysis of Section 3 no settlement was allowed; all filed cases that were pursued went to trial, sometimes singly and sometimes via a joint suit. Instead, now consider the possibility of settlement offers made by D. In what follows, we assume that D has no private information about the realized number of victims. Rather, D starts with the same prior beliefs about the likelihood of 0, 1 or 2 victims.[14] Moreover, suppose that D expects the plaintiffs to use bandwagon strategies. Then D will update his beliefs about the number of victims in the same way as do the plaintiffs; this is described in detail below.

Suppose that (at the point of bargaining) damages are common knowledge and that D need only offer what that plaintiff could expect from continuing with the suit.[15] Specifically, D can induce plaintiff i to settle by offering the amount $\max\{L_1\delta_i - c_1, 0\}$ if plaintiff i is the sole plaintiff. If there are two plaintiffs, then D needs to offer the amount $L_2\delta_i - c_2$ to plaintiff i and the amount $L_2\delta_j - c_2$ to plaintiff j. Damages are assumed to be common knowledge at this stage because the process of filing a claim (including a specification of damages) and subsequent discovery are assumed sufficient to reveal the level of harm the plaintiff has suffered. It is immediate that D will prefer settlement at the end of the second period to no settlement since D's offer will deduct the plaintiff's

[14] We assume that D knows the identities of both potential victims (e.g., they bought the product from D), but D does not know if either or both have been harmed until they file suit. In Section 5, D would not choose to contact any of the potential victims, which we assume here as well. Finally, we assume that while each potential victim knows that there may be another victim, no potential victim knows the identity of any other potential victim.

[15] See Schwartz and Wickelgren (2009) for an argument supporting this reduced form in complete information, two-party settlement negotiation, even if bargaining can take place over an infinite horizon.

court costs from the damages and D will save his court costs. This further means that the plaintiff will be indifferent between no settlement and settlement at the end of the second period. "Deferred settlement" will refer to any settlement (with one or two plaintiffs) that could as well have happened at the end of period 2. That is, if both plaintiffs file in period 1, or one plaintiff files in period 1 and a second files in period 2, or if one or both were to file in period 2, we will refer to any subsequent settlement as a deferred settlement. Since deferred settlement does not affect the plaintiff's payoffs, the SBE is the same under no settlement and under deferred settlement.

In this section we modify the analysis in Section 3 by allowing D to make a settlement offer to a plaintiff who files alone in the first period; we will refer to this as "preemptive settlement."[16] We consider two alternatives concerning the information that is embodied in an early-filing, lone suit. In the first alternative, we assume that a later-filing plaintiff (that is, a lone filer in the second period) cannot improve their likelihood of winning against the defendant (if the first plaintiff settled). Thus, while two plaintiffs together can achieve a reduction in costs and an improvement in the likelihood of finding the defendant liable, this is not true for a lone follow-on suit. The source of this disparity could be that the first suit settled confidentially or that courts have a policy of restricting follow-on suits to their merits alone.[17] We refer to this as "data suppression." The second alternative allows the follow-on suit to improve its likelihood of winning due to a previously-filed suit's presence (even if that suit settled). Thus, for example, if the second suit has developed information on the effect of a drug on the plaintiff, and that plaintiff can refer to data on the effect

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[16] Che and Yi (1993), Yang (1996), Choi (1998), and Daughety and Reinganum (1999, 2002) all consider settings wherein a party (a "defender") sometimes chooses to settle with an early "attacker" in a manner which suppresses information that might be useful to potential later attackers. All of these papers consider sequential rather than joint suits so there is no possibility of coalition formation.

[17] For an analysis of bargaining over both money and confidentiality, see Daughety and Reinganum (1999, 2002).

of the same drug on the earlier plaintiff, then we refer to this as a case of "data availability." We consider the contrast of data suppression and data availability to sharpen our understanding of the impact of preemptive settlement.

4.1 Equilibrium Dynamics when Data-Suppressing Settlements are Possible

Now suppose it is common knowledge that, at every stage, D can offer a settlement to any plaintiff who has filed suit; we assume that settlement negotiation occurs at the end of each period. Moreover, suppose that first-period settlements involve data-suppression in the sense that any plaintiff who files in period 2 cannot enjoy either an evidence-related externality (i.e., she cannot rely on the existence of the other plaintiff to improve her odds of winning) or a cost-sharing externality with a plaintiff who filed but settled in the first period. We use a superscript "S" on the relevant functions and variables to indicate the we are considering the case of preemptive settlement with data suppression.

As before, we know that victim i will never file suit if $\delta_i < \underline{\delta}$, and thus we need only consider $\delta_i \geq \underline{\delta}$. Let $s_n^t(\delta)$ denote the settlement offered to a plaintiff with damages δ at the end of period t when n plaintiffs have filed suit; t = 1, 2; and n = 1, 2. If both plaintiffs file in period 1, we assume that they do not suffer from coordination failure; that is, P_i can extract a settlement of $s_2^1(\delta_i) \equiv L_2\delta_i - c_2$ and P_j can extract a settlement of $s_2^1(\delta_j) \equiv L_2\delta_j - c_2$. If victim i files alone in the second period, he receives a settlement of only $s_1^2(\delta_i) \equiv \max\{L_1\delta_i - c_1, 0\}$. Finally, if only one victim (say, victim i) files in period 1, then D need only offer him his expected continuation value (computed below).

Suppose P_i learns that he filed alone in period 1; he uses this observation to update his beliefs about a potential victim j. Since P_i and D have the same prior information and both learn that P_i filed alone in period 1, both P_i and D are trying to assess the likelihood that a potential victim j was harmed and will follow in period 2, given that (potential) victim j did not file in period 1. This latter event occurs if either: 1) there is no victim j; or 2) there is a victim j, but she has damages $\delta_j < \bar{\delta}_j$. These events have combined probability $[1 - q_2 + q_2 H(\bar{\delta}_j)]$. Thus, upon learning that P_i alone filed in period 1, P_i and D anticipate that P_i will be joined by P_j in period 2 with probability $q_2[H(\bar{\delta}_j) - H(\underline{\delta})]/[1 - q_2 + q_2 H(\bar{\delta}_j)]$ and would ultimately receive a settlement of $s_2^2(\delta_i) \equiv L_2\delta_i - c_2$. On the other hand, P_i and D anticipate that P_i will not be joined by a P_j in period 2 with probability $[1 - q_2 + q_2 H(\underline{\delta})]/[1 - q_2 + q_2 H(\bar{\delta}_j)]$, and therefore P_i would ultimately receive a settlement of $s_1^2(\delta_i) \equiv \max\{L_1\delta_i - c_1, 0\}$. Combining these gives P_i's expected continuation value if he filed alone in period 1; if D can make a take-it-or-leave-it settlement offer, this is what D must offer to induce P_i to settle. Since this will depend on the bandwagon strategy being played by a possible P_j (which is taken as given by both P_i and D), we denote this amount by $s_1^1(\delta_i, \bar{\delta}_j)$.

$$s_1^1(\delta_i, \bar{\delta}_j) \equiv \{q_2[H(\bar{\delta}_j) - H(\underline{\delta})]/[1 - q_2 + q_2 H(\bar{\delta}_j)]\}[L_2\delta_i - c_2]$$
$$+ \{[1 - q_2 + q_2 H(\underline{\delta})]/[1 - q_2 + q_2 H(\bar{\delta}_j)]\}[\max\{L_1\delta_i - c_1, 0\}]. \qquad (4)$$

Note that, given any bandwagon strategy for a possible P_j, at the end of period 1 it is always in D's interest to induce P_i to settle, since otherwise D expects to have to pay P_i's continuation value plus the expected settlement payment to P_j, which is given by $\{q_2[H(\bar{\delta}_j) - H(\underline{\delta})]/[1 - q_2 + q_2 H(\bar{\delta}_j)]\}[L_2 E(\delta_j | \delta_j \in [\underline{\delta}, \bar{\delta}_j)) - c_2]$. By inducing P_i to settle, D will discourage further suits, at least to some extent, because the evidence externalities and scale economies in litigation costs will be unavailable to P_j. Thus, without a credible commitment to defer settlement, when confronted with a lone filer in period 1, D cannot resist settling the suit.

Now consider P_i's optimal decision in period 1, anticipating that D will settle any lone suits filed in period 1. If P_i waits in period 1, he does not expect to be able to join another plaintiff in period 2; either P_j does not exist, or she exists but did not file suit (in which case she was waiting to follow P_i and will not file in period 2 since P_i did not file in period 1), or she exists and filed suit in period 1 but settled her suit. Thus, if P_i waits in period 1, then he will file suit in period 2 only if $\delta_i \geq \delta_1$. P_i's expected payoff from waiting in period 1 is:

$$W^S(\delta_i, \bar{\delta}_j) = \max\{L_1\delta_i - c_1 - f, 0\};$$

that is, unlike the benchmark model, the payoff from waiting is independent of $\bar{\delta}_j$. P_i's expected payoff if he files in period 1 is:

$$F^S(\delta_i, \bar{\delta}_j) = q_2[1 - H(\bar{\delta}_j)][L_2\delta_i - c_2 - f] + [1 - q_2 + q_2H(\bar{\delta}_j)][s_1^1(\delta_i, \bar{\delta}_j) - f]$$

$$= q_2[1 - H(\underline{\delta})][L_2\delta_i - c_2 - f] + [1 - q_2 + q_2H(\underline{\delta})][\max\{L_1\delta_i - c_1, 0\} - f]. \quad (5)$$

Note that $F^S(\delta_i, \bar{\delta}_j)$ is exactly the same as $F^N(\delta_i, \bar{\delta}_j)$ and thus is independent of $\bar{\delta}_j$. These expressions are equal because of the assumption that D needs only to offer P_i's continuation value in settlement.

Let $Z^S(\delta_i, \bar{\delta}_j) \equiv F^S(\delta_i, \bar{\delta}_j) - W^S(\delta_i, \bar{\delta}_j)$ denote the net value of filing in period 1 (net of the value of waiting and then behaving optimally in period 2) in the preemptive settlement regime. Then:

$$Z^S(\delta_i, \bar{\delta}_j) = q_2[1 - H(\underline{\delta})][L_2\delta_i - c_2 - f]$$

$$+ [1 - q_2 + q_2H(\underline{\delta})][\max\{L_1\delta_i - c_1, 0\} - f] - \max\{L_1\delta_i - c_1 - f, 0\}. \quad (6)$$

In the Appendix we provide details about the derivation of the equilibrium threshold, denoted as $\bar{\delta}^S$. There we show that $\bar{\delta}^S < \bar{\delta}^N$; that is, more victim types will file in period 1 in the preemptive settlement regime than when no (or only deferred) settlements are possible. On the other hand, there will be no follow-on suits (in equilibrium) in the settlement regime because there will be no non-settled suit to join, while victims with $\delta \in [\underline{\delta}, \bar{\delta}^N)$ will file follow-on suits when no settlement is possible. Thus, in equilibrium, types in $[0, \bar{\delta}^S)$ will not file while types in $[\bar{\delta}^S, \infty)$ will file in period 1 and will settle with D for $s_1^1(\delta_i, \bar{\delta}^S)$ if no other victim filed, or for $L_2\delta_i - c_2$ should two victims have filed. We summarize our results in the following proposition.

Proposition 3. $\{\underline{\delta}, \bar{\delta}^S\}$ is the unique SBE with preemptive settlement when data is suppressed, where $\bar{\delta}^S$ uniquely satisfies $Z^S(\bar{\delta}^S, \bar{\delta}^S) = 0$; moreover, $\underline{\delta} < \bar{\delta}^S < \bar{\delta}^N$. In equilibrium:

a) victim i takes the following actions, depending on the level of harm incurred:

i) $\delta_i \in [0, \underline{\delta}) \Rightarrow$ never file;

ii) $\delta_i \in [\underline{\delta}, \bar{\delta}^S) \Rightarrow$ wait in period 1; file in period 2 only if another victim has filed in period 1 and not settled (in which case, accept any settlement offer of at least $L_2\delta_i - c_2$);

iii) $\delta_i \in [\bar{\delta}^S, \infty) \Rightarrow$ file in period 1; if no other victim has filed, accept any settlement offer of at least $s_1^!(\delta_i, \bar{\delta}^S)$;

iv) $\delta_i \in [\bar{\delta}^S, \infty) \Rightarrow$ file in period 1; if another victim has also filed, accept any settlement offer of at least $L_2\delta_i - c_2$;

b) D makes the following offers if at least one victim has filed in period 1:

i) if only one victim has filed, offer $s_1^!(\delta_i, \bar{\delta}^S)$;

ii) if two victims have filed, offer victim k the amount $L_2\delta_k - c_2$.

Figure 3 below illustrates the functions $F^S(\delta_i, \bar{\delta}^S)$ and $W^S(\delta_i, \bar{\delta}^S)$, as well as the earlier payoff to waiting $W^N(\delta_i, \bar{\delta}^N)$, and the earlier payoff to filing in the first period since $F^S(\delta_i, \bar{\delta}^S) = F^N(\delta_i, \bar{\delta}^N)$.

Preferences Over Preemptive versus Deferred Settlement

As remarked upon earlier, deferred settlement (wherein settlement can only occur at the end of period 2) is preferred by the defendant to no settlement and plaintiffs are indifferent between deferred and no settlement. The plaintiff always (weakly) prefers deferred to preemptive settlement and, for some sets of victim types, strictly prefers deferred to preemptive settlement. Figure 3

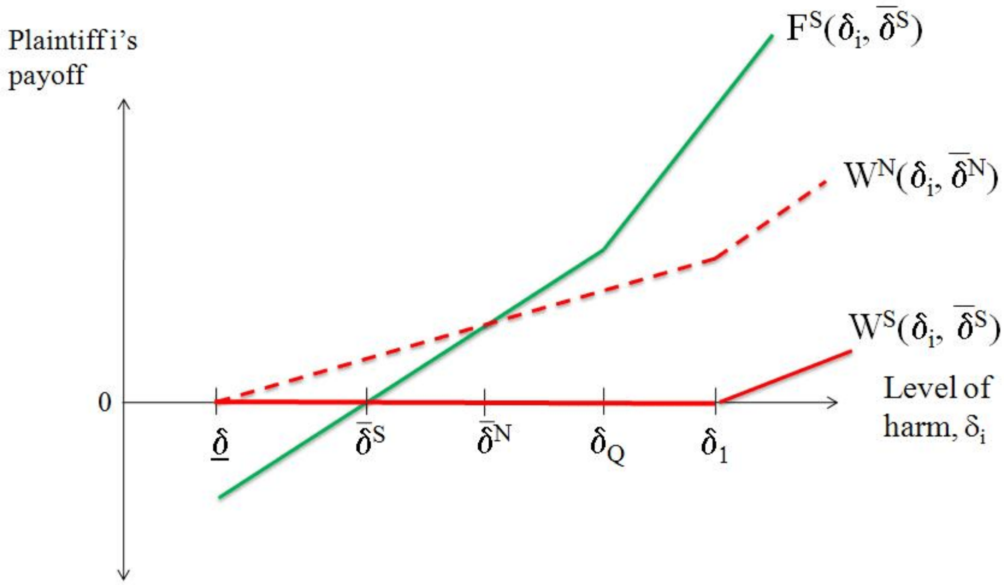

Figure 3: Illustration of Preemptive-Settlement SBE

provides an intuitive understanding as to why and when a plaintiff prefers deferred to preemptive settlement. To see this, note that the plaintiff's equilibrium payoff is the upper contour in the diagram (that is, the maximum of the $F^N = F^S$ and W^N curves for the benchmark case versus the maximum of the F^S and W^S curves for the preemptive settlement case), so that plaintiff i strictly prefers deferred settlement for $\underline{\delta} \leq \delta_i < \bar{\delta}^N$, and weakly prefers deferred settlement otherwise. We provide a formal proof of this in the Technical Appendix and summarize this result in the following proposition.

Proposition 4.

(a) Every plaintiff type always weakly prefers deferred settlement to preemptive settlement, and plaintiff types in $[\underline{\delta}, \bar{\delta}^N)$ strictly prefer deferred settlement to preemptive settlement;

(b) For any distribution H, plaintiffs strictly prefer (in expectation) deferred settlement to preemptive settlement.

Part (b) of the proposition follows immediately from part (a), since the density of H is assumed to be positive everywhere on its support. Thus, in expectation, the plaintiff always strictly prefers deferred settlement to preemptive settlement. Moreover, there is no realized level of harm wherein the plaintiff would strictly prefer preemptive settlement to deferred settlement.

One might normally expect that the defendant's preferences would be opposed to those of the plaintiffs, but this need not be true. While (algebraically) the conditions for the defendant's preferences are ambiguous, computational techniques (maintaining the assumption that $f < f_{NQ}$) applied to explore a set of examples employing various uniform distributions,[18] yields that D strictly prefers deferred settlement to preemptive settlement. Essentially, the anticipation of preemptive settlement causes plaintiffs to file more often in period 1, so much so that the expected number of suits filed is higher when preemptive settlement is possible.[19] Thus, D spends more on settlements and plaintiffs spend more on filing suits under preemptive settlement. Both parties would prefer the bandwagon that arises under deferred settlement to the gold rush that arises under preemptive settlement. However, without the ability to pre-commit not to settle preemptively, we know (see the discussion above of the preemptive settlement offer) that D will choose to offer a preemptive settlement. Thus, the equilibrium outcome (that is, without pre-commitment to defer) will involve the use of preemptive settlement by D should a lone plaintiff file in period 1. Finally, we note that in Section 5 we find conditions under which the defendant <u>does</u> strictly prefer preemptive settlement to deferred settlement, independent of the distribution of harm. These conditions reflect the

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[18] Note that, since the example uses the uniform distribution, we have assumed a maximum possible value of δ, which is chosen so that it exceeds δ_1.

[19] In fact, for any uniform distribution, and assuming that $f < f_{NQ}$ (so that $\bar{\delta}^N < \delta_Q$), one can show that the expected number of suits filed is higher under preemptive settlement than under deferred settlement (see the Technical Appendix for details).

possibility (explored in that Section) that some victims may not be aware of the source of their harm.

4.2 Equilibrium Dynamics when Preemptive Settlement Does Not Suppress Data

We now modify the foregoing in the following way: if one victim files in the first period and settles, and a second victim waits until the second period, then the second victim anticipates winning her case against D with probability L, where $L_2 \geq L \geq L_1$. This variation is important, as the question of whether and when to allow plaintiffs to piggy-back their cases on possibly available evidence of previous harms (in cases not simultaneously before a court) is an important policy question that we return to in Section 6; here we pursue the analysis. The arbitrary level of the likelihood L allows a number of possible interpretations. If $L = L_2$, then this might reflect no confidentiality associated with the earlier settlement in conjunction with legal cognizance of "pattern of behavior" (or at least of merging data on legal cause).[20] If $L_2 > L > L_1$, then L might reflect the possibility that reliance on data from past cases might be subject to a (currently uncertain) decision by the trial court. Finally, $L = L_1$ ties the analysis to that of the previous section as it corresponds to data suppression. We use a superscript "A" on the relevant functions and variables to indicate the we are considering the case of preemptive settlement with data availability.

The special treatment for a second-period lone filer (i.e., that D's likelihood of liability is L) who is able to free-ride on the data associated with a first-period filer is irrelevant to the expected payoff to plaintiff P_i from filing in the first period, which is therefore the same as under data suppression. This is because the preemptive settlement offer made by a D to a lone first-period filer will also be the same as under data suppression: P_i's possible outcomes if he rejects D's preemptive

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[20] Recall from the background discussion in Section 2 that the plaintiffs' lawyers may informally coordinate (this is even sometimes organized through interest group discussions and organizations), thereby raising the likelihood that any particular case wins at trial.

offer is that either a second victim sues in period 2 (and therefore the likelihood of liability is L_2) or no other victim shows up in period 2 (and therefore the likelihood of liability is L_1). Thus,

$$F^A(\delta_i, \bar{\delta}_j) = q_2[1 - H(\underline{\delta})][L_2\delta_i - c_2 - f] + [1 - q_2 + q_2H(\underline{\delta})][\max\{L_1\delta_i - c_1, 0\} - f]. \quad (7)$$

That is, $F^A(\delta_i, \bar{\delta}_j) = F^S(\delta_i, \bar{\delta}_j) = F^N(\delta_i, \bar{\delta}_j)$ and, once again, this payoff is independent of $\bar{\delta}_j$.

There is a significant effect, however, on the value of waiting to file and then proceeding optimally, $W^A(\delta_i, \bar{\delta}_j)$, which now must account for the (possibly) increased likelihood of D's liability, L, if P_j has previously filed and settled in period 1:

$$W^A(\delta_i, \bar{\delta}_j) = q_2[1 - H(\bar{\delta}_j)][\max\{L\delta_i - c_1 - f, 0\}] + [1 - q_2 + q_2H(\bar{\delta}_j)][\max\{L_1\delta_i - c_1 - f, 0\}]. \quad (8)$$

Let $Z^A(\delta_i, \bar{\delta}_j) \equiv F^A(\delta_i, \bar{\delta}_j) - W^A(\delta_i, \bar{\delta}_j)$ denote the <u>net</u> value of filing in period 1 (net of the value of waiting and then behaving optimally in period 2) in the preemptive settlement regime with no data suppression. Then:

$$Z^A(\delta_i, \bar{\delta}_j) = q_2[1 - H(\underline{\delta})][L_2\delta_i - c_2 - f] + [1 - q_2 + q_2H(\underline{\delta})][\max\{L_1\delta_i - c_1, 0\} - f]$$
$$- \left[q_2[1 - H(\bar{\delta}_j)][\max\{L\delta_i - c_1 - f, 0\}] + [1 - q_2 + q_2H(\bar{\delta}_j)][\max\{L_1\delta_i - c_1 - f, 0\}]\right]. \quad (9)$$

We provide the precise details of the equilibrium and the associated analysis in the Appendix, and here focus on the implications of the results. The critical issue is that the nature of the equilibrium is determined by whether $\bar{\delta}^S$ exceeds, equals, or is less than $(c_1 + f)/L_2$. If $\bar{\delta}^S \le (c_1 + f)/L_2$, then the solution to $Z^A(\delta, \delta) = 0$, denoted as $\bar{\delta}^A$, is equal to $\bar{\delta}^S$: the equilibrium involves exactly the same gold rush as when data is suppressed and those types in $[\underline{\delta}, \bar{\delta}^A)$ again choose not to file in the second period, even though another plaintiff filed in period 1 (since that plaintiff settled). However, if L_2 is sufficiently greater than L_1 (that is, if $\bar{\delta}^S > (c_1 + f)/L_2$), then $\bar{\delta}^A > \bar{\delta}^S$. Now types in $[\bar{\delta}^S, \bar{\delta}^A)$ do not file in period 1 and wait instead; moreover, even if another victim filed and settled in period 1, types in $[(c_1 + f)/L_2, \bar{\delta}^A)$ will file in period 2. The effect of alternative values for

L can be seen by examining Figure 3 above and observing that the first portion of the third term on the right-hand-side of equation (9) above only influences the intersection of the associated F- and W-functions if L is sufficiently large to cause the first portion of the third term to be positive when $\delta_i = \bar{\delta}^S$; that is, this only occurs if $\bar{\delta}^S > (c_1 + f)/L$. Notice that it may be impossible for this latter condition to hold, since it is quite possible that $\bar{\delta}^S \leq (c_1 + f)$, meaning that there is no value of $L_2 \leq 1$ such that $\bar{\delta}^S > (c_1 + f)/L_2$. When this occurs, no policy of data availability can have an effect on the dynamics of the process different from that which occurs with data suppression.

5. Equilibrium Dynamics when Some Victims are Unaware of the Source of Harm

We now reconsider both the benchmark model and the D-preemptive settlement analysis, except now we assume that the fraction $\rho \in (0, 1]$ represents the likelihood that a victim realizes that his or her harm is due to the defendant's actions. This fraction is exogenous to the analysis and is fixed at the beginning of period 1. Since we have previously provided extensive detail on the derivation of the value of waiting or filing in the first period, and the derivation of the symmetric equilibrium, we relegate the detailed descriptions of the analysis to the Appendix. In what follows we provide the essential elements and the relevant summarizing propositions.

Analysis of Partially-Unaware Case when Preemptive Settlement is Not Possible

First, suppose that no (or only deferred) settlements are possible. A victim who is unaware always "waits" in period 1. However, if a suit is filed in period 1, then those victims who were previously unaware become aware with probability 1; however, if no suit is filed in period 1 then unaware victims are assumed to remain unaware in period 2. We view this as a way to represent the activities of a plaintiff's attorney. If that attorney files the suit for an aware victim, then upon noting that no other suit has been filed, the attorney will endeavor to find out if a second victim exists and to encourage them to file. If no victim comes forward in period 1, then no attorney is triggered to hunt for a second victim, so any unaware victims remain unaware.

Consider the decision problem of a victim who is aware that D is responsible (but who understands that any other potential victim may be aware only with probability ρ). By waiting in period 1, victim i expects to receive a payoff of:

$$W^N_\rho(\delta_i, \bar{\delta}_j) \equiv \rho q_2[1 - H(\bar{\delta}_j)][L_2\delta_i - c_2 - f]$$
$$+ [1 - q_2 + (1 - \rho)q_2 + \rho q_2 H(\bar{\delta}_j)][\max\{L_1\delta_i - c_1 - f, 0\}]. \quad (13)$$

Now suppose that victim i files suit in period 1. Then he expects to receive a payoff of:

$$F^N_\rho(\delta_i, \bar{\delta}_j) \equiv \rho q_2[1 - H(\bar{\delta}_j)][L_2\delta_i - c_2 - f]$$
$$+ \{(1 - \rho)q_2[1 - H(\bar{\delta}_j)] + q_2[H(\bar{\delta}_j) - H(\underline{\delta})]\}[L_2\delta_i - c_2 - f]$$
$$+ [1 - q_2 + q_2 H(\underline{\delta})][\max\{L_1\delta_i - c_1, 0\} - f].$$

Upon collecting terms, we note that $F^N_\rho(\delta_i, \bar{\delta}_j)$ is the same as $F^N(\delta_i, \bar{\delta}_j)$ for all ρ; the value of filing suit (for an aware victim) is independent of the likelihood that the other victim is aware. That is:

$$F^N_\rho(\delta_i, \bar{\delta}_j) \equiv q_2[1 - H(\underline{\delta})][L_2\delta_i - c_2 - f] + [1 - q_2 + q_2 H(\underline{\delta})][\max\{L_1\delta_i - c_1, 0\} - f]. \quad (14)$$

Let $Z^N_\rho(\delta_i, \bar{\delta}_j) \equiv F^N_\rho(\delta_i, \bar{\delta}_j) - W^N_\rho(\delta_i, \bar{\delta}_j)$ denote the <u>net</u> value of filing in period 1 (net of the value of waiting and then behaving optimally in period 2), for $\rho \in (0, 1]$. The SBE period 1 filing threshold is given by $\bar{\delta}^N_\rho \in (\underline{\delta}, \delta_1)$ such that $Z^N_\rho(\bar{\delta}^N_\rho, \bar{\delta}^N_\rho) = 0$. Since $F^N_\rho(\delta_i, \bar{\delta}_j)$ is independent of ρ and $W^N_\rho(\delta_i, \bar{\delta}_j)$ is increasing in ρ, it follows that $\bar{\delta}^N_\rho$ is an increasing function of ρ which converges to $\bar{\delta}^N$ as $\rho \to 1$. Moreover, since $F^N_\rho(\delta_i, \bar{\delta}_j) = F^N(\delta_i, \bar{\delta}_j)$ and, as seen in Section 4.1 above, $F^N(\delta_i, \bar{\delta}_j) = F^S(\delta_i, \bar{\delta}_j)$, it follows that $\bar{\delta}^N_\rho$ converges to $\bar{\delta}^S$ as $\rho \to 0$. Thus, the "window of waiting" is a set intermediate between the fully-aware preemptive settlement waiting-set and the fully-aware deferred settlement waiting-set of the benchmark model. We summarize our results in the following proposition, which parallels Proposition 2.[21]

Proposition 5. $\{\underline{\delta}, \bar{\delta}^N_\rho\}$ is the unique SBE without preemptive settlement but with partially unaware victims, where $\bar{\delta}^N_\rho$ uniquely satisfies $Z^N_\rho(\bar{\delta}^N_\rho, \bar{\delta}^N_\rho) = 0$; moreover, for $\rho \in (0, 1)$, $\bar{\delta}^N_\rho \in (\bar{\delta}^S, \bar{\delta}^N)$. In equilibrium:

a) a victim i who is aware in period 1 takes the actions specified in Proposition 2, wherein $\bar{\delta}^N_\rho$ replaces $\bar{\delta}^N$ and $f_{NQ\rho}$ replaces f_{NQ} in Proposition 2's statements.

b) a victim i who is unaware in period 1 "waits" in period 1 and files in period 2 only if $\delta_i \geq \underline{\delta}$ and another victim has filed in period 1.

Analysis of Partially-Unaware Case when Preemptive Settlement is Possible

Now suppose it is common knowledge that, at every stage, D can offer a settlement to any plaintiff who has filed suit. As before, suppose that (at the point of bargaining) damages are common knowledge and that D need only offer what that plaintiff could expect from continuing with her suit. In addition to data suppression, however, now first-period settlements involve a promise not to alert any victims who are unaware of the defendant's involvement in their harm. As in Section 4.1, if only one victim (say, victim i) files in period 1, then D need only offer him his expected continuation value (from not settling), which is computed below. This continuation value will depend on ρ; we denote this amount by $s^1_{1\rho}(\delta_i, \bar{\delta}_j)$.

$$s^1_{1\rho}(\delta_i, \bar{\delta}_j) \equiv \Big\{\big[q_2(1 - \rho)[1 - H(\bar{\delta}_j)] + q_2[H(\bar{\delta}_j) - H(\underline{\delta})]\big]/[1 - q_2 + q_2(1 - \rho) + \rho q_2 H(\bar{\delta}_j)]\Big\}[L_2\delta_i - c_2]$$

$$+ \Big\{[1 - q_2 + q_2 H(\underline{\delta})]/[1 - q_2 + q_2(1 - \rho) + \rho q_2 H(\bar{\delta}_j)]\Big\}[\max\{L_1\delta_i - c_1, 0\}]. \quad (15)$$

P_i's expected payoff from waiting in period 1 is:

[21] The cutoff for f used in part of this proposition, $f_{NQ\rho}$, is the parallel notion for the relationship between $\bar{\delta}^N_\rho$ and δ_Q as f_{NQ} is for the relationship between $\bar{\delta}^N$ and δ_Q; see the discussion of the earlier notion in Section 3.

$W^S_\rho(\delta_i, \bar{\delta}_j) = \max\{L_1\delta_i - c_1 - f, 0\}$.

Note that $W^S_\rho(\delta_i, \bar{\delta}_j) = W^S(\delta_i, \bar{\delta}_j)$. On the other hand, P_i's expected payoff if he files in period 1 is:

$$F^S_\rho(\delta_i, \bar{\delta}_j) = \rho q_2[1 - H(\bar{\delta}_j)][L_2\delta_i - c_2 - f] + [1 - q_2 + q_2(1 - \rho) + \rho q_2 H(\bar{\delta}_j)][s^1_{1\rho}(\delta_i, \bar{\delta}_j) - f]$$

$$= q_2[1 - H(\underline{\delta})][L_2\delta_i - c_2 - f] + [1 - q_2 + q_2 H(\underline{\delta})][\max\{L_1\delta_i - c_1, 0\} - f]. \quad (16)$$

Thus, $F^S_\rho(\delta_i, \bar{\delta}_j)$ is exactly the same as $F^S(\delta_i, \bar{\delta}_j)$ (and $F^N_\rho(\delta_i, \bar{\delta}_j)$ and $F^N(\delta_i, \bar{\delta}_j)$). The value of filing in period 1 is independent of ρ and is the same whether or not settlement is deferred. All of these expressions are equal because of the assumption that D needs only to offer P_i's continuation value in settlement. Since $F^S_\rho(\delta_i, \bar{\delta}_j)$ and $W^S_\rho(\delta_i, \bar{\delta}_j)$ are independent of ρ, their difference $Z^S_\rho(\delta_i, \bar{\delta}_j) \equiv F^S_\rho(\delta_i, \bar{\delta}_j) - W^S_\rho(\delta_i, \bar{\delta}_j)$ is also independent of ρ, as is the solution $\bar{\delta}^S_\rho$ to the equation $Z^S_\rho(\delta, \delta) = 0$. That is, when settlement is possible at every stage, the period 1filing threshold is $\bar{\delta}^S_\rho = \bar{\delta}^S$ for all ρ. From the foregoing, the following observation on the settlement in period 1 can be shown.

<u>Remark</u>: Since $\bar{\delta}^S_\rho$ is independent of ρ, the settlement from filing alone in period 1, $s^1_{1\rho}(\delta_i, \bar{\delta}^S_\rho)$, is decreasing in ρ.

Alternatively put, when settlement is possible at every stage, P_i expects to receive a higher settlement offer the lower is the likelihood ρ that P_j is aware; this is because there is likely to be a higher fraction of P_js with viable suits among those waiting in period 1 (and P_i can bring on these follow-on suits by declining to settle). In settling, P_i (or his attorney) agrees not to alert any victim who is unaware. This sort of concession is essential to the notion of a confidential settlement agreement, in that the most effective mechanism for bringing new cases to the fore is for the lawyer in the instant case to go out searching for them. Thus, P_i capitalizes on P_j's lack of awareness by extracting a higher settlement offer from D. These results are formalized in the following proposition, which directly parallels Proposition 3.

Proposition 6. $\{\underline{\delta}, \bar{\delta}^S_\rho\}$ is the unique SBE with preemptive settlement and partially unaware victims, where $\bar{\delta}^S_\rho$ uniquely satisfies $Z^S_\rho(\bar{\delta}^S_\rho, \bar{\delta}^S_\rho) = 0$; moreover, $\bar{\delta}^S_\rho = \bar{\delta}^S$ for all ρ. In equilibrium:

a) an aware victim i takes the actions specified in Proposition 3, substituting the equilibrium settlement offer of $s^1_{1\rho}(\delta_i, \bar{\delta}^S)$ for $s^1_1(\delta_i, \bar{\delta}^S)$; the offer $s^1_{1\rho}(\delta_i, \bar{\delta}^S)$ is decreasing in ρ.

b) a victim i who is unaware in period 1 "waits" in period 1 and files in period 2 only if $\delta_i \geq \underline{\delta}$ and another victim has filed but not settled in period 1.

c) D makes the following offers if at least one victim has filed in period 1:

i) if only one victim has filed, offer $s^1_{1\rho}(\delta_i, \bar{\delta}^S)$;

ii) if two victims have filed, offer victim k the amount $L_2\delta_k$ - c_2.

Preferences Over Preemptive versus Deferred Settlement

It is straightforward to show that, as earlier, potential victims strictly (*ex ante*) prefer deferred to preemptive settlement. It is possible to show that (independent of the form of H) for sufficiently small positive levels of ρ, the defendant strictly (*ex ante*) prefers preemptive settlement; the details are provided in the Technical Appendix. This is because when ρ is small, D's option to make a preemptive settlement results in a very low likelihood of a gold rush, while in the rare event of a lone suit filed in period 1, settlement can suppress any viable follow-on suit which would otherwise be filed. Recall that earlier, relying on computational means (with ρ = 1), we found that there were conditions wherein the defendant's preferences over the two alternatives were aligned with those of the plaintiffs. However, for small enough ρ, the parties' preferences will conflict.

6. Summary, Policy Implications, and Potential Extensions

Summary

Focusing on the context of the aggregation of lawsuits, we consider the dynamics of a three-party bargaining problem wherein two of the parties (two potential plaintiffs) can form a coalition to bargain against the third party (the defendant); the coalition formation is hampered by the private information of the two plaintiffs and possible strategic interference by the defendant. The endogenously-determined arrival process for the plaintiffs involves learning and considers the tradeoff between acting early (and potentially inducing others to follow) and waiting to see if others will enter.

There is a symmetric equilibrium in "bandwagon" strategies wherein a victim with sufficiently high damages files in period 1, a victim with intermediate damages waits in period 1 and files in period 2 only if another victim has filed and is available to be joined, and a victim with sufficiently low damages never files suit. In a portion of the parameter space, types will file, but later drop, their suits. As shown in the Technical Appendix, for the two-period case, any Perfect Bayesian equilibrium of this game must be a bandwagon equilibrium.

When settlements are not permitted (or if settlements are deferred), then suits are filed in both periods along the equilibrium path. When preemptive settlements are allowed and the defendant only needs to offer a plaintiff's continuation value to induce settlement, then the defendant cannot resist the temptation to settle in every period. In this case, there is never another plaintiff to be joined in period 2 and hence no value to waiting if there is data suppression. Thus, the bandwagon is more of a "gold rush" when preemptive settlement is allowed.

Potential plaintiffs strictly prefer deferred settlement to preemptive settlement on an *ex ante* basis in both the fully-aware and the partially-unaware cases. In the fully-aware analysis we find (via extensive numerical computation using a uniform distribution of damages) the rather surprising result that the defendant can also strictly prefer deferred settlement to preemptive settlement, and thus deferred settlement can be Pareto-superior to preemptive settlement. If the defendant could make a credible commitment *ex ante* not to engage in preemptive settlement, then plaintiffs would not rush to file in period 1, but would rather follow the more deliberate two-period filing process. Under any uniform distribution the defendant would face a lower *ex ante* expected number of suits under deferred settlement; thus the defendant would save on settlements while the plaintiffs would save on filing costs. A commitment mechanism would be necessary, however, since this policy suffers from time inconsistency: once first-period filing had occurred, the defendant would have an incentive to settle preemptively with a lone, early filer in order to discourage further suits that would be filed in period 2 if a previous plaintiff were available to be joined. In contrast, we find that if the fraction of aware victims is sufficiently low then (independent of the form of the distribution, H) the defendant will strictly prefer having the option to make a preemptive settlement offer.

We further examined the effect of allowing preemptive settlement by considering what happens if second-period lone filers can free-ride on the data associated with a first-period lone filer who settled (the data availability case, which allows an inter-plaintiff positive externality). We showed that only if the gain in the likelihood of liability that data-sharing might yield was sufficiently high would the equilibrium shift from one of a gold rush to one wherein there were some types that would wait and then file later (if a victim had filed previously, even if that victim had settled with the defendant). Thus, preemptive settlement has a very strong effect, and second-period filing will only occur (if at all) when the data from the first-period filer's case is available and the plaintiff's gain from having that data available is sufficiently great (and that bar might not be possible to meet).

Finally, when preemptive settlement is allowed and victims are partially unaware, the first victim/attorney pair can be induced to eschew outreach (thus leaving unaware victims in the dark) in exchange for a settlement. Since the likelihood of a follow-on suit (that can be triggered by not settling) is an increasing function of the fraction of unaware victims, the settlement offered to the first victim/attorney pair is also an increasing function of the fraction of unaware victims. Thus, the first victim/attorney pair receives a higher settlement offer in exchange for "selling out" a victim who is potentially unaware that the defendant is responsible for her harm.

Policy Implications

It has long been observed that the costs of using the legal system may cause victims to fail to pursue valid cases. Permissive joinder and its progeny (as discussed in Section 2) capitalize on potential inter-plaintiff externalities due to reduced per-plaintiff litigation costs and increased per-plaintiff likelihood of recovery at trial. This, in turn, may lead to increased incentives for potential tortfeasors to take more care. As we have shown, defendants have the strategy of using preemptive settlement offers to alter or suppress the stream of potential lawsuits. This raises three policy issues.

First, as we saw in Section 4.1, anticipation of preemptive settlement when all plaintiffs know the source of their harm leads to an increased flow of cases into the first period. While we do not have general distributional results, if damages are uniformly distributed then this translates into increased expected trial costs. This alone suggests that some judicial caution concerning settlement may be called for; a court might find it welfare-enhancing to have a policy that assures that any settlements which it is overseeing have been allowed to "mature" somewhat, so as to reduce the "gold rush" incentives that preemptive settlement induces. Plaintiffs will actually prefer such a policy and (as discussed earlier) at least in some portions of the parameter space, defendants might prefer this, too. Also note that, with preemptive settlement, while the set of suits that file in the first period expands, the set of suits that will never file also expands, eviscerating the benefits of joinder as a means for realizing inter-plaintiff externalities for some valid suits that might otherwise have been pursued.

Second, one alternative means for taming the gold rush would seem to be to allow for greater employment of data from other cases, including those that have settled. We termed this data availability. Ensuring data availability is not necessarily how the law currently operates. Confidential settlement agreements (see Daughety and Reinganum, 1999, 2000) limit parties and their lawyers from sharing information with those who are not a party to the agreement, meaning not only other potential litigants, but (for example) with public health authorities as well. One particularly well-known example involved leakage into the groundwater of carcinogenic chemicals from a Xerox plant near Webster, New York; the leakage contaminated some of the nearby wells (see Weiser, 1989, for details on this case). Xerox informed local residents about the leak but assured them that there were no long-term health risks. Two families with members who suffered health problems, including one who contracted a very rare form of cancer, sued Xerox. The confidential settlement (originally sealed by a court, but later revealed to be $4.75 million) that was concluded between Xerox and the two families cut out the local public health authorities as well as the neighbors, who apparently woke up one day to see moving vans moving the two families out of their homes.

As we showed in Section 4.2, data availability, which clearly has potential legal issues associated with it (How relevant are the other cases? If they have not come before a court, why should the data be available to show a defendant's liability for the harm in question?) may not be particularly useful in managing the dynamics of case filing and aggregation. We abstracted from the legal concerns to see what effects data availability might have on the dynamics under study. We showed that unless the increase in the defendant's likelihood of being held liable is sufficiently great, it may not cause some of the cases to wait-and-see rather than rush forward. Moreover, as shown, there may not be a possible level of liability-assessment increase that actually stops a gold rush. This suggests that reliance on this tool should be based on legal considerations and not strategic considerations of the sort analyzed here.

Finally, the analysis of the unaware case suggests that courts should be particularly wary of confidential settlements in the context of harms that might have occurred to parties not covered by any proposed settlement submitted for being sealed by a court (or enforced as a "contract of silence"). Elsewhere (Daughety and Reinganum, 2002, 2005) we have raised the issue of the potential welfare effects of confidential settlements. Such settlements have positive attributes, such as providing some compensation to some victims instead of potentially driving matters to a trial. However, one of the primary benefits to a defendant is the suppression of information, and in this paper we can see the interplay between awareness of the source of harm and the incentives to suppress information: in Section 5 we found that defendants would always prefer preemptive settlements if those settlements were confidential and if the likelihood of parties being aware of the source of their harm was small enough. This effectively disenfranchises a possibly large portion of victims, including possible victims with substantial harms; understanding that this might be the case may lead consumers to anticipate under- (or no) compensation for harms, reducing demands for otherwise useful products (e.g., drugs with side effects).

Potential Extensions

There are a number of possible extensions of this model. In particular, one could envision a larger number of potential plaintiffs. Although it is possible to extend this model directly, one would now want to allow as many periods as there are plaintiffs in order to allow the full dynamics to evolve. This would become quite combinatoric as there would be thresholds for filing that depend on exactly how many previous cases have been filed. Alternatively, consider the setting raised in Footnote 8, where two towns, each sited near a chain's gas station, suffer damages to their water supply due to leaks from the underground gasoline storage tanks at the service stations. A direct application of our model would entail letting δ_k be the sum of group (town) k's individual damages. This then suggests a further extension: one would like to allow for damages for each victim (or victim group) to be drawn from different distributions, thereby requiring characterization of an asymmetric bandwagon equilibrium. Another worthwhile modification would be to model explicitly conflicts of interest between a victim and his or her attorney and perhaps conflicts of interest among plaintiffs. Further, we have not attempted to consider how an induced gold rush might lead to anticipation of bankruptcy of the defendant (a type of "bank run"), leading to a more-intensified gold rush. Finally, alternative game forms that differ in terms of the information structure (e.g., asymmetric information at the time of bargaining) and the bargaining solution (e.g., the Nash bargaining solution) would provide additional insights and robustness checks.

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Appendix

Derivation of the Symmetric Bandwagon Equilibrium with No Settlement (Proposition 1)

We start by determining victim i's best response to victim j's bandwagon strategy $\bar{\delta}_j$ (having already established that $\underline{\delta}_i = \underline{\delta}_j = \underline{\delta} = (c_2 + f)/L_2$). First, suppose that $\bar{\delta}_j = \underline{\delta}$; this is a limiting case wherein victim j (if she exists) never waits strategically; she either files in period 1 or she never files. In this case $Z^N(\delta_i, \underline{\delta}) = [1 - q_2 + q_2H(\underline{\delta})][\max\{L_1\delta_i - c_1, 0\} - f - \max\{L_1\delta_i - c_1 - f, 0\}] < 0$ for $\delta_i < \delta_1$ and $Z^N(\delta_i, \underline{\delta}) = 0$ for $\delta_i \geq \delta_1$. Thus, a best response for victim i is to file in period 1 only if $\delta_i \geq \delta_1$ (we assume that a victim files suit when indifferent); otherwise it is optimal to wait in period 1 and proceed optimally (that is, file suit in period 2 if victim j filed in period 1 and $\delta_i \geq \underline{\delta}$). Notice that any victim who is willing to file alone in period 2 will (optimally) file in period 1.

Now consider any $\bar{\delta}_j > \underline{\delta}$; notice that $Z^N(\delta_i, \bar{\delta}_j) = q_2[H(\bar{\delta}_j) - H(\underline{\delta})][L_2\delta_i - c_2 - L_1\delta_i + c_1] > 0$ for all $\delta_i \geq \delta_1$. Thus, any victim i with $\delta_i \geq \delta_1$ will file suit in period 1. Next, consider $\delta_i \in [\underline{\delta}, \delta_1)$. Then

$$Z^N(\delta_i, \bar{\delta}_j) = q_2[H(\bar{\delta}_j) - H(\underline{\delta})][L_2\delta_i - c_2 - f] + [1 - q_2 + q_2H(\underline{\delta})][\max\{L_1\delta_i - c_1, 0\} - f], \qquad \text{(A1)}$$

since $\max\{L_1\delta_i - c_1 - f, 0\} = 0$. Therefore: (a) $Z^N(\underline{\delta}, \bar{\delta}_j) = -f[1 - q_2 + q_2H(\underline{\delta})] < 0$; (b) $Z^N(\delta_i, \bar{\delta}_j)$ is strictly increasing in its first argument; and (c) $Z^N(\delta_1, \bar{\delta}_j) > 0$. These facts imply that there is a unique value $\varphi(\bar{\delta}_j) \in (\underline{\delta}, \delta_1)$ such that $Z^N(\varphi(\bar{\delta}_j), \bar{\delta}_j) = 0$. A victim i with $\delta_i \geq \varphi(\bar{\delta}_j)$ will file in period 1 and a victim i with $\delta_i < \varphi(\bar{\delta}_j)$ will wait in period 1 (and file in period 2 only if $\delta_i \geq \underline{\delta}$ and there is another plaintiff to join).

Thus, victim i's best response can be characterized by a threshold value of δ_i; for simplicity (and with some abuse of terminology), we will refer to this threshold as victim i's best response. Let $\varphi(\bar{\delta}_j)$ denote victim i's best response to victim j's bandwagon strategy, which is summarized by $\bar{\delta}_j$. We have already concluded that $\varphi(\underline{\delta}) = \delta_1$ and that $\varphi(\bar{\delta}_j) \in (\underline{\delta}, \delta_1)$ for $\bar{\delta}_j > \underline{\delta}$. This implies that victim i's best response to a bandwagon strategy for victim j is itself a bandwagon strategy, because victim i will never wait in period 1 and then file suit in period 2 if victim j does not file suit in period 1; any victim i who would be willing to file suit alone in period 2 prefers to file suit in period 1.

To complete the description of the symmetric bandwagon equilibrium we need to find a threshold $\bar{\delta}$ such that $\bar{\delta} = \varphi(\bar{\delta})$. Since $\varphi(\underline{\delta}) = \delta_1$, there cannot be a SBE in which $\bar{\delta} = \underline{\delta}$. When $\bar{\delta} > \underline{\delta}$, since $Z^N(\bullet, \bullet)$ is continuous and strictly increasing in both its arguments, and since $\varphi(\bar{\delta}_j)$ is defined by $Z^N(\varphi(\bar{\delta}_j), \bar{\delta}_j) = 0$, it follows that $\varphi(\bar{\delta}_j)$ is a continuous and decreasing function so that there exists a unique value $\bar{\delta}^N \in (\underline{\delta}, \delta_1)$ such that $\bar{\delta}^N = \varphi(\bar{\delta}^N)$.

The Benchmark Model with Arbitrarily Many Periods

Instead of 2 periods, suppose there are arbitrarily many periods. We show that there exists a Nash Equilibrium in bandwagon strategies that involves the same threshold values as in the 2-period case. First, we need to modify slightly the definition of a bandwagon strategy to account for the fact that there are more than 2 periods. Part (b) of the definition becomes:

(b) if $\underline{\delta}_j \leq \delta_j < \bar{\delta}_j$, then victim j waits in period 1 and files suit in any subsequent period only if another victim has already filed suit (and is available to be joined).

A symmetric bandwagon equilibrium is, as before, a bandwagon strategy $\{\underline{\delta}, \bar{\delta}\}$, with $\bar{\delta} \geq \underline{\delta}$, that is a mutual best response. Moreover, the critical damages level below which a victim will never file remains $\underline{\delta} \equiv (c_2 + f)/L_2$.

Suppose that victim j employs a bandwagon strategy $\{\underline{\delta}, \bar{\delta}_j\}$. We will characterize victim i's best response, beginning with period 2. If victim i filed suit in period 1, then he has no further action to take. Suppose that victim i did not file suit in period 1. If victim j filed suit in period 1, then victim j has no further action to take and nothing will change in the future; thus victim i will file suit in period 2 (following victim j) if $L_2\delta_i - c_2 - f \geq 0$ (that is, if $\delta_i \geq \underline{\delta}$) and otherwise he will never file.

Now suppose that neither victim filed in period 1. If victim j did not file suit in period 1, then victim i does not expect victim j to file suit in period 2; moreover, unless victim i files suit he does not expect victim j to file suit in any subsequent period. This is because either victim j does not exist or, if she does exist, she has $\delta_j < \bar{\delta}_j$; the combined probability of these two events is $1 - q_2 + q_2H(\bar{\delta}_j)$. Note that if victim i waits in period 2, he expects that nothing will change in any subsequent period, so his decision is really between filing in period 2 or never filing. If victim i files suit in period 2, then he expects victim j to follow him in period 3 with probability $q_2\{[H(\bar{\delta}_j) - H(\underline{\delta})]/[1 - q_2 + q_2H(\bar{\delta}_j)]\}$; on the other hand, if victim j does not exist or has $\delta_j < \underline{\delta}$, then she will not follow victim i in period 3 even if he files in period 2; this event has probability $\{[1 - q_2 + q_2H(\underline{\delta})]/[1 - q_2 + q_2H(\bar{\delta}_j)]\}$. If he is not joined in period 3 by victim j, then P_i must re-assess his position and decide whether to drop or proceed with his suit. Thus, victim i expects the following payoff, denoted $z^N(\delta_i, \bar{\delta}_j)$, if he files in period 2 (following a history in which neither victim filed in period 1):

$$z^N(\delta_i, \bar{\delta}_j) \equiv q_2\{[H(\bar{\delta}_j) - H(\underline{\delta})]/[1 - q_2 + q_2H(\bar{\delta}_j)]\}[L_2\delta_i - c_2 - f]$$

$$+ \{[1 - q_2 + q_2H(\underline{\delta})]/[1 - q_2 + q_2H(\bar{\delta}_j)]\}[\max\{L_1\delta_i - c_1, 0\} - f].$$

We now characterize a threshold value of δ_i, denoted $\psi(\bar{\delta}_j)$, with the property that it is optimal for victim i to file suit in period 2 (following a history in which neither victim filed in period 1) only if $\delta_i \geq \psi(\bar{\delta}_j)$. First, consider the case of $\bar{\delta}_j = \underline{\delta}$; then $z^N(\delta_i, \underline{\delta})$ (>, =, <) 0 as δ_i (>, =, <) δ_1 and thus $\psi(\bar{\delta}_j) = \delta_1$. Next, consider $\bar{\delta}_j > \underline{\delta}$: the facts that: (a) $z^N(\underline{\delta}; \bar{\delta}_j) = -f\{[1 - q_2 + q_2H(\underline{\delta})]/[1 - q_2 + q_2H(\bar{\delta}_j)]\} < 0$; (b) $z^N(\delta_1; \bar{\delta}_j) > 0$; and (c) $z^N(\delta_i, \bar{\delta}_j)$ is strictly increasing in its first argument, jointly imply that there exists a unique value of $\delta_i \in [\underline{\delta}, \delta_1)$, denoted $\psi(\bar{\delta}_j)$, at which $z^N(\psi(\bar{\delta}_j); \bar{\delta}_j) = 0$. Moreover, it is optimal for victim i to file suit in period 2 (follow a history in which neither victim filed in period 1) only if $\delta_i \geq \psi(\bar{\delta}_j)$.

We can now write victim i's expected payoff from waiting in period 1, denoted $\mathcal{W}^N(\delta_i, \bar{\delta}_j)$ to indicate the many-period case, as follows (again, we need only consider values of $\delta_i \geq \underline{\delta}$):

$$\mathcal{W}^N(\delta_i, \bar{\delta}_j) \equiv q_2[1 - H(\bar{\delta}_j)][L_2\delta_i - c_2 - f] + [1 - q_2 + q_2H(\bar{\delta}_j)][\max\{0, z^N(\delta_i, \bar{\delta}_j)\}]$$

$$= q_2[1 - H(\bar{\delta}_j)][L_2\delta_i - c_2 - f] + \max\Big\{0, q_2[H(\bar{\delta}_j) - H(\underline{\delta})][L_2\delta_i - c_2 - f] + [1 - q_2 + q_2H(\underline{\delta})][\max\{L_1\delta_i - c_1, 0\} - f]\Big\},$$

where the expression $\max\{0, q_2[H(\bar{\delta}_j) - H(\underline{\delta})][L_2\delta_i - c_2 - f] + [1 - q_2 + q_2H(\underline{\delta})][\max\{L_1\delta_i - c_1, 0\} - f]\}$ (>, =) 0 as δ_i (>, ≤) $\psi(\bar{\delta}_j)$. Victim i's expected payoff from filing suit in period 1 is unchanged from the two-period case, since filing in period 1 provokes any possible follow-on suits in period 2:

$$F^N(\delta_i, \bar{\delta}_j) \equiv q_2[1 - H(\underline{\delta})][L_2\delta_i - c_2 - f] + [1 - q_2 + q_2H(\underline{\delta})][\max\{L_1\delta_i - c_1, 0\} - f].$$

Let $\mathcal{Z}^N(\delta_i, \bar{\delta}_j) \equiv F^N(\delta_i, \bar{\delta}_j) - \mathcal{W}^N(\delta_i, \bar{\delta}_j)$ denote the net value of filing in period 1 (net of the value of waiting and then behaving optimally in all future periods). Then

$$\mathcal{Z}^N(\delta_i, \bar{\delta}_j) = q_2[H(\bar{\delta}_j) - H(\underline{\delta})][L_2\delta_i - c_2 - f] + [1 - q_2 + q_2H(\underline{\delta})][\max\{L_1\delta_i - c_1, 0\} - f] - \max\Big\{0, q_2[H(\bar{\delta}_j) - H(\underline{\delta})][L_2\delta_i - c_2 - f] + [1 - q_2 + q_2H(\underline{\delta})][\max\{L_1\delta_i - c_1, 0\} - f]\Big\}. \quad \text{(A2)}$$

We now characterize victim i's filing decision in period 1, given victim j's bandwagon strategy $\bar{\delta}_j$. As in the 2-period case, we will refer to the resulting threshold as $\varphi(\bar{\delta}_j)$; we will use the same notation because, as we will see, the same equation determines $\varphi(\bar{\delta}_j)$. First, consider $\bar{\delta}_j = \underline{\delta}$; then $\mathcal{Z}^N(\delta_i, \underline{\delta}) = [1 - q_2 + q_2H(\underline{\delta})]\big[\max\{L_1\delta_i - c_1, 0\} - f - \max\{0, \max\{L_1\delta_i - c_1, 0\} - f\}\big]$. Since $\mathcal{Z}^N(\delta_i, \underline{\delta}) = 0$ for $\delta_i \geq \delta_1$ and $\mathcal{Z}^N(\delta_i, \underline{\delta}) < 0$ for $\delta_i < \delta_1$, it follows that $\varphi(\underline{\delta}) = \delta_1$. Next, consider $\bar{\delta}_j > \underline{\delta}$; then $\mathcal{Z}^N(\underline{\delta}, \bar{\delta}_j) = [1 - q_2 + q_2H(\underline{\delta})]\big[\max\{L_1\underline{\delta} - c_1, 0\} - f - \max\{0, \max\{L_1\underline{\delta} - c_1, 0\} - f\}\big] < 0$. Moreover, by the definition of $\psi(\bar{\delta}_j)$, it follows that $\mathcal{Z}^N(\delta_i, \bar{\delta}_j) = 0$ for all $\delta_i \geq \psi(\bar{\delta}_j)$. Finally, for $\delta_i \in (\underline{\delta}, \psi(\bar{\delta}_j))$, the function $\mathcal{Z}^N(\delta_i, \bar{\delta}_j) = q_2[H(\bar{\delta}_j) - H(\underline{\delta})][L_2\delta_i - c_2 - f] + [1 - q_2 + q_2H(\underline{\delta})][\max\{L_1\delta_i - c_1, 0\} - f]$ is strictly increasing in δ_i. These facts jointly imply that a victim with $\delta_i \geq \psi(\bar{\delta}_j)$ is indifferent about filing in period 1 or waiting and, by our assumption that victims file when indifferent, these victims file in period 1. Thus, the first-period filing threshold $\varphi(\bar{\delta}_j)$ is equal to $\psi(\bar{\delta}_j)$. A victim with $\delta_i \in [\underline{\delta}, \varphi(\bar{\delta}_j))$ will wait in period 1 and file in period 2 only if another victim j is available to be joined. No filings will occur (along the equilibrium path) in period 2 following a history of no filings in period 1 because any type that would be willing to do so will have already filed in period 1. Finally, we simply note that the equation defining $\varphi(\bar{\delta}_j)$ is the same in the two-period case (wherein the expression in equation (A1) is set equal to zero to obtain $\varphi(\bar{\delta}_j)$) and in the multi-period case (wherein the expression in equation (A2) is set equal to zero to obtain $\psi(\bar{\delta}_j)$, which is equal to $\varphi(\bar{\delta}_j)$). Since we know that the same equation defines $\varphi(\bar{\delta}_j)$, the remainder of the argument from the two-period case establishes the existence of a unique symmetric bandwagon equilibrium for the multi-period case, and it is the same bandwagon equilibrium as in the two-period case: $\{\underline{\delta}, \bar{\delta}^N\}$.

Derivation of the SBE with Preemptive Settlement and Data Suppression

We start by determining victim i's best response to victim j's bandwagon strategy $\bar{\delta}_j$. First, consider $\delta_i \geq \delta_1$; then $Z^S(\delta_i, \bar{\delta}_j) = q_2[1 - H(\underline{\delta})][L_2\delta_i - c_2 - L_1\delta_i + c_1] > 0$. That is, any victim i with damages $\delta_i \geq \delta_1$ would strictly prefer to file suit in period 1. If $\delta_i \in [\underline{\delta}, \delta_1)$ then the value of waiting in period 1 is zero, since $W^S(\delta_i, \bar{\delta}_j) = \max\{L_1\delta_i - c_1 - f, 0\} = 0$. Thus, for $\delta_i \in [\underline{\delta}, \delta_1)$, the net gain to filing in period 1 is:

$$Z^S(\delta_i, \bar{\delta}_j) = q_2[1 - H(\underline{\delta})][L_2\delta_i - c_2 - f] + [1 - q_2 + q_2H(\underline{\delta})][\max\{L_1\delta_i - c_1, 0\} - f]. \quad \text{(A3)}$$

Furthermore, it is clear that $Z^S(\underline{\delta}, \bar{\delta}_j) = -f\,[1 - q_2 + q_2H(\underline{\delta})] < 0$, and that $Z^S(\delta_i, \bar{\delta}_j)$ is strictly increasing in δ_i (and is independent of $\bar{\delta}_j$). Thus, there is a unique value $\bar{\delta}^S \in (\underline{\delta}, \delta_1)$ such that $Z^S(\bar{\delta}^S, \bar{\delta}^S) = 0$. Victim i's best response is to file in period 1 if $\delta_i \geq \bar{\delta}^S$ and, if $\delta_i \in [\underline{\delta}, \bar{\delta}^S)$, to wait in period 1 and file in period 2 only if victim j has already filed suit (and is available to be joined). Thus, for any bandwagon strategy being played by victim j, victim i's best response is to play a bandwagon strategy. This equilibrium is actually in dominant strategies, and is given by $\{\underline{\delta}, \bar{\delta}^S\}$.

Since equations (A1) and (A3) imply that $Z^S(\delta, \delta) = Z^N(\delta, \delta) + q_2[1 - H(\delta)][L_2\delta - c_2 - f]$ for $\delta \in [\underline{\delta}, \delta_1)$, it follows that $Z^S(\bar{\delta}^N, \bar{\delta}^N) = q_2[1 - H(\bar{\delta}^N)][L_2\, \bar{\delta}^N - c_2 - f] > 0$. Since $Z^S(\delta, \delta)$ is strictly increasing in δ and $Z^S(\bar{\delta}^S, \bar{\delta}^S) = 0$, it follows that $\bar{\delta}^S < \bar{\delta}^N$; that is, more victim types will file in period 1 in the preemptive settlement regime than when no (or only deferred) settlements are possible. On the other hand, there will be no follow-on suits (in equilibrium) in the settlement regime because there will be no non-settled suit to join, while victims with $\delta \in [\underline{\delta}, \bar{\delta}^N)$ will file follow-on suits when no settlement is possible. Thus, in equilibrium, types in $[0, \bar{\delta}^S)$ will not file while types in $[\bar{\delta}^S, \infty)$ will file in period 1 and will settle with D for $s_1^1(\delta_i, \bar{\delta}^S)$ if no other victim filed, or for $L_2\delta_i - c_2$ should two victims have filed.

Derivation of the SBE with Preemptive Settlement and Data Availability

We start by determining victim i's best response to victim j's bandwagon strategy $\bar{\delta}_j$. First, consider $\delta_i \geq \delta_1$; then, similar to the earlier analyses, $Z^A(\delta_i, \bar{\delta}_j) > 0$. That is, any victim i with damages $\delta_i \geq \delta_1$ would strictly prefer to file suit in period 1. Next, consider $\delta_i \in [\underline{\delta}, \delta_1)$. Then the value of waiting in period 1 is non-negative, since the first term on the right-hand-side of $W^A(\delta_i, \bar{\delta}_j)$ is non-negative for these δ-values while the second term is zero. Thus, for $\delta_i \in [\underline{\delta}, \delta_1)$, the net gain to filing in period 1 can be written as:

$$Z^A(\delta_i, \bar{\delta}_j) = Z^S(\delta_i, \bar{\delta}_j) - q_2[1 - H(\bar{\delta}_j)][\max\{L\delta_i - c_1 - f, 0\}]. \quad \text{(A4)}$$

As before, we can use the monotonicity properties of $Z^A(\delta_i, \bar{\delta}_j)$ to find the symmetric crossing point, but inspection allows us to find the result more easily. Recall that $Z^S(\delta_i, \bar{\delta}_j)$ is independent of $\bar{\delta}_j$. Notice what is happening in the second term on the right-hand-side of equation (A6). When $L = L_1$, then $Z^A(\delta_i, \bar{\delta}_j) = Z^S(\delta_i, \bar{\delta}_j)$, so that the equilibrium symmetric crossing point using equation (A4), $\bar{\delta}^A$, is simply $\bar{\delta}^S$; that is, the waiting set is the same as in the data suppression case, as it must be if $L = L_1$. Now consider a value of L slightly larger than L_1. Let $\delta_M(L)$ be the marginal type that will pursue a stand-alone case in the second period if L is the likelihood of winning; that is, $\delta_M(L) \equiv (c_1 + f)/L$. Clearly, $\delta_M(L_1) = \delta_1$, and $\delta_M(L)$ is declining in L but, by continuity, for L only slightly larger than L_1: 1) $\delta_M(L) > \bar{\delta}^S$; and 2) $L\delta_M(L) - c_1 - f = 0$. Thus, as L becomes larger, so that it causes $\delta_M(L)$ to decline toward $\bar{\delta}^S$ from above, the equilibrium value for the upper bandwagon value found by using equation (A4), $\bar{\delta}^A$, will continue to be $\bar{\delta}^S$. Importantly, there is no guarantee that there exists a value of $L \leq L_2$ such that $\delta_M(L) = \bar{\delta}^S$; if no such value of L exists, then the equilibrium for the data availability case will always look exactly the same as in the case of data suppression.

If, however, $L = L_2$ and $\delta_M(L_2) < \bar{\delta}^S$, then $Z^A(\bar{\delta}^S, \bar{\delta}^S) = Z^S(\bar{\delta}^S, \bar{\delta}^S) - q_2[1 - H(\bar{\delta}^S)][\max\{L_2\bar{\delta}^S - c_1 - f, 0\}] < 0$, meaning that $\bar{\delta}^A$ does not equal $\bar{\delta}^S$; in fact, monotonicity of Z^A means that $\bar{\delta}^A > \bar{\delta}^S$ in this case. Furthermore, when $L = L_2$ and $\delta_M(L_2) < \bar{\delta}^S$, it is straightforward to show that $Z^A(\bar{\delta}^N, \bar{\delta}^N) = q_2[1 - H(\bar{\delta}^N)][c_1 - c_2] > 0$. Therefore, again based on the monotonicity of Z^A, it follows that $\bar{\delta}^S < \bar{\delta}^A < \bar{\delta}^N$. We formalize the results for the case wherein data from a first-period suit which has settled is available to enhance the win probability of a second-period lone filer in the following proposition.

<u>Proposition A1</u>. $\{\underline{\delta}, \bar{\delta}^A\}$ is the unique SBE with preemptive settlement when data is available.

a) If $\bar{\delta}^S \leq (c_1 + f)/L_2$, then the SBE is exactly the same as described in Proposition 4. In particular, $\bar{\delta}^A = \bar{\delta}^S$.

b) If $\bar{\delta}^S > (c_1 + f)/L_2$, then $\bar{\delta}^A$ uniquely satisfies $Z^A(\bar{\delta}^A, \bar{\delta}^A) = 0$; moreover, $\bar{\delta}^A \in (\bar{\delta}^S, \bar{\delta}^N)$. In equilibrium, victim i takes the following actions, depending on the level of harm:
   i) $\delta_i \in [0, \underline{\delta}) \Rightarrow$ never file;
   ii) $\delta_i \in [\underline{\delta}, (c_1 + f)/L_2) \Rightarrow$ wait in period 1; file in period 2 only if another victim has filed in period 1 and not settled (in which case, accept any settlement offer of at least $L_2\delta_i - c_2$).
   iii) $\delta_i \in [(c_1 + f)/L_2, \bar{\delta}^A) \Rightarrow$ wait in period 1; file in period 2 only if another victim has filed in period 1. If the other victim has not settled (resp. settled), accept any settlement offer of at least $L_2\delta_i - c_2$ (resp. $L_2\delta_i - c_1$).
   iv) $\delta_i \in [\bar{\delta}^A, \infty) \Rightarrow$ file in period 1; if no other victim has filed, accept any settlement offer of at least $s_1^1(\delta_i, \bar{\delta}^A)$;
   v) $\delta_i \in [\bar{\delta}^A, \infty) \Rightarrow$ file in period 1; if another victim has also filed, accept any settlement offer of at least $L_2\delta_i - c_2$.

c) In equilibrium, D makes the following offers if at least one victim has filed in period 1:
   i) if only one victim has filed in period 1, offer $s_1^1(\delta_i, \bar{\delta}^A)$; if a victim subsequently files in period 2, offer that victim $L_2\delta_i - c_1$;
   ii) if two victims have filed and joined their suits, offer victim k: $L_2\delta_k - c_2$.

Derivation of the SBE (with and without Preemptive Settlement) when Some Victims are Unaware of the Source of Harm

First suppose that no settlement is possible. Given a bandwagon strategy for victim j, by waiting in period 1, an aware victim i expects to receive a payoff of:

$$W_\rho^N(\delta_i, \bar{\delta}_j) \equiv \rho q_2[1 - H(\bar{\delta}_j)][L_2\delta_i - c_2 - f] + [1 - q_2 + (1 - \rho)q_2 + \rho q_2 H(\bar{\delta}_j)][\max\{L_1\delta_i - c_1 - f, 0\}].$$

The reasoning is as follows. If victim i waits in period 1, then with probability $\rho q_2[1 - H(\bar{\delta}_j)]$ victim j exists, is aware, and has damages sufficient to induce her to file suit in period 1 (and hence will be available for victim i to join in period 2). On the other hand, with probability $[1 - q_2 + (1 -$

$\rho)q_2 + \rho q_2 H(\bar{\delta}_j)]$ victim j does not exist, or exists but is unaware, or exists and is aware but does not have damages sufficient to induce her to file suit in period 1; in all of these cases, victim i will be left to file alone in period 2.

On the other hand, by filing suit in period 1, victim i expects to receive a payoff of:

$$F^N_\rho(\delta_i, \bar{\delta}_j) \equiv \rho q_2[1 - H(\bar{\delta}_j)][L_2\delta_i - c_2 - f] + \{(1 - \rho)q_2[1 - H(\bar{\delta}_j)] + q_2[H(\bar{\delta}_j) - H(\underline{\delta})]\}[L_2\delta_i - c_2 - f]$$

$$+ [1 - q_2 + q_2H(\underline{\delta})][\max\{L_1\delta_i - c_1, 0\} - f].$$

To see why, notice that if victim i files in period 1, then regardless of what else happens he will pay the fee f. If victim j exists and is aware (this occurs with probability ρq_2), then she will also file in period 1 if $\delta_j \geq \bar{\delta}_j$. If victim j exists, is unaware, and has $\delta_j \geq \bar{\delta}_j$, or if she exists and has $\underline{\delta} \leq \delta_j < \bar{\delta}_j$, then she will wait in period 1, but she will become aware (as a consequence of P_i's filing suit) and thus she will file subsequently in period 2 (and join P_i). Finally, if victim j does not exist, or she does exist but has damages less than $\underline{\delta}$, then victim j will never file. In this case, victim i will decide between dropping his case and receiving 0 or continuing and receiving $L_1\delta_i - c_1$. Upon collecting terms, we note that $F^N_\rho(\delta_i, \bar{\delta}_j)$ is the same as $F^N(\delta_i, \bar{\delta}_j)$ for all ρ; the value of filing suit (for an aware victim) is independent of the likelihood that the other victim is aware.

$$F^N_\rho(\delta_i, \bar{\delta}_j) \equiv q_2[1 - H(\underline{\delta})][L_2\delta_i - c_2 - f] + [1 - q_2 + q_2H(\underline{\delta})][\max\{L_1\delta_i - c_1, 0\} - f].$$

Let $Z^N_\rho(\delta_i, \bar{\delta}_j) \equiv F^N_\rho(\delta_i, \bar{\delta}_j) - W^N_\rho(\delta_i, \bar{\delta}_j)$ denote the <u>net</u> value of filing in period 1 (net of the value of waiting and then behaving optimally in period 2), for $\rho \in (0, 1)$. Then (by arguments analogous to the case of $\rho = 1$), the symmetric bandwagon equilibrium period 1 filing threshold is given by $\bar{\delta}^N_\rho \in (\underline{\delta}, \delta_1)$ such that $Z^N_\rho(\bar{\delta}^N_\rho, \bar{\delta}^N_\rho) = 0$. Since $F^N_\rho(\delta, \delta)$ is independent of ρ and $W^N_\rho(\delta, \delta)$ is increasing in ρ, it follows that $\bar{\delta}^N_\rho$ is an increasing function of ρ which converges to $\bar{\delta}^N$ as $\rho \to 1$. Moreover, since $F^N_\rho(\delta_i, \bar{\delta}_j) = F^N(\delta_i, \bar{\delta}_j) = F^S(\delta_i, \bar{\delta}_j)$ (that is, when $\rho = 1$ the value of filing in period 1 is the same when early settlements are allowed as when they are not allowed, see equations (2) and (7) in the main text), it follows that $\bar{\delta}^N_\rho$ converges to $\bar{\delta}^S$ as $\rho \to 0$.

Now suppose that, at every stage, D can offer a settlement to any plaintiff who has filed suit; we assume that settlement negotiation occurs at the "end" of each period. Suppose P_i learns that he filed alone in period 1; he uses this observation to update his beliefs about P_j, as does D. This event occurs if either (1) there is no victim j; or (2) there is a victim j but she is unaware; or (3) there is a victim j and she is aware, but she has damages $\delta_j < \bar{\delta}_j$. These events have combined probability $[1 - q_2 + q_2(1 - \rho) + \rho q_2H(\bar{\delta}_j)]$. Thus, upon learning that he filed alone in period 1, P_i and D anticipate that P_i will be joined by P_j in period 2 with probability $\left[q_2(1 - \rho)[1 - H(\bar{\delta}_j)] + q_2[H(\bar{\delta}_j) - H(\underline{\delta})]\right]/[1 - q_2 + q_2(1 - \rho) + \rho q_2H(\bar{\delta}_j)]$ and will ultimately receive a settlement of $S^2_2(\delta_i) \equiv L_2\delta_i - c_2$. On the other hand, P_i and D anticipate that P_i will not be joined by a P_j in period 2 with probability $[1 - q_2 + q_2H(\underline{\delta})]/ [1 - q_2 + q_2(1 - \rho) + \rho q_2H(\bar{\delta}_j)]$, and thus P_i will ultimately receive a settlement of $s^2_1(\delta_i) \equiv \max\{L_1\delta_i - c_1, 0\}$. Combining these gives P_i's expected continuation value if he filed alone in period 1; by assumption, this is what D must offer to induce P_i to settle. Since this will depend on the bandwagon strategy being played by P_j (which is taken as given by both P_i and D), we denote this amount by $S^1_{1\rho}(\delta_i, \bar{\delta}_j)$.

$$s^1_{1\rho}(\delta_i, \bar{\delta}_j) \equiv \Big\{\big[q_2(1 - \rho)[1 - H(\bar{\delta}_j)] + q_2[H(\bar{\delta}_j) - H(\underline{\delta})]\big]/[1 - q_2 + q_2(1 - \rho) + \rho q_2 H(\bar{\delta}_j)]\Big\}[L_2\delta_i - c_2]$$

$$+ \Big\{[1 - q_2 + q_2 H(\underline{\delta})]/[1 - q_2 + q_2(1 - \rho) + \rho q_2 H(\bar{\delta}_j)]\Big\}[\max\{L_1\delta_i - c_1, 0\}].$$

Now consider P_i's optimal decision in period 1. As before, if P_i waits in period 1, he does not expect to be able to join another plaintiff in period 2; either P_j does not exist, or she exists, but did not file suit (either because she is unaware or she was waiting to follow P_i and will not file in period 2 since P_i did not file in period 1), or she exists and she did file suit in period 1, but settled her suit. Thus, if P_i waits in period 1, then he will file suit in period 2 only if $\delta_i \geq \delta_1$. That is, P_i's expected payoff from waiting in period 1 is:

$$W^S_\rho(\delta_i, \bar{\delta}_j) = \max\{L_1\delta_i - c_1 - f, 0\}.$$

On the other hand, P_i's expected payoff if he files in period 1 is:

$$F^S_\rho(\delta_i, \bar{\delta}_j) = \rho q_2[1 - H(\bar{\delta}_j)][L_2\delta_i - c_2 - f] + [1 - q_2 + q_2(1 - \rho) + \rho q_2 H(\bar{\delta}_j)][s^1_{1\rho}(\delta_i, \bar{\delta}_j) - f]$$

$$= q_2[1 - H(\underline{\delta})][L_2\delta_i - c_2 - f] + [1 - q_2 + q_2 H(\underline{\delta})][\max\{L_1\delta_i - c_1, 0\} - f].$$

Note that $F^S_\rho(\delta_i, \bar{\delta}_j)$ is exactly the same as $F^S(\delta_i, \bar{\delta}_j)$ (and $F^N_\rho(\delta_i, \bar{\delta}_j)$ and $F^N(\delta_i, \bar{\delta}_j)$). The value of filing in period 1 is independent of ρ and is the same whether or not settlement is deferred. All of these expressions are equal because of the assumption that D needs only to offer P_i's continuation value in settlement. Since $F^S_\rho(\delta_i, \bar{\delta}_j)$ and $W^S_\rho(\delta_i, \bar{\delta}_j)$ are independent of ρ, their difference $Z^S_\rho(\delta_i, \bar{\delta}_j) \equiv F^S_\rho(\delta_i, \bar{\delta}_j) - W^S_\rho(\delta_i, \bar{\delta}_j)$ is also independent of ρ, as is the solution $\bar{\delta}^S_\rho$ to the equation $Z^S_\rho(\delta, \delta) = 0$. That is, when settlement is possible at every stage, the period 1filing threshold is $\bar{\delta}^S_\rho = \bar{\delta}^S$ for all ρ.

Technical Appendix: Not For Publication - to be made available on the web

The Relationship Between Bandwagon Equilibria and Perfect Bayesian Equilibria

Claim. If there are only two periods, then any Perfect Bayesian equilibrium must be a bandwagon equilibrium.

Proof. The proof is done for the case of $q_2 = 1$ for simplicity of exposition. A strategy for victim j must specify an action for every value of δ_j and for every history of the game. First, it is a dominant strategy for a victim j with $\delta_j < \underline{\delta}$ to never file suit, regardless of the history of play. Second, sequential rationality implies that any $\delta_j \geq \underline{\delta}$ should file suit in period 2 following a first-period filing by victim i (if they haven't filed already). Third, the strategy will specify a set of types of victim j who file in period 1; let the measure of this set be denoted by μ_{j1}. Finally, the strategy will specify a set of types of victim j who do not file in period 1 but file in period 2 if victim i did not file in period 1; let the measure of this set be denoted by μ_{j2}. Then $1 - \mu_{j2} - \mu_{j1}$ is the measure of the set of types who do not file in period 1 and do not file in period 2 if victim i did not file in period 1. Let $\mu_j \equiv (\mu_{j1}\ \mu_{j2})$.

Now consider victim i's decision problem. Victim i knows that $\mu_{j1} + \mu_{j2} \leq 1 - H(\underline{\delta})$. The expectation on the left-hand-side is the probability that a randomly-drawn victim j will ever file suit (either in period 1 or in period 2) if victim i chooses not to file in period 1. The right-hand-side is the measure of victim j types that would ever possibly file suit (including those following victim i). Actually, we can say that the inequality will be strict, since $\delta_j < \underline{\delta}$ will never file suit and $\delta_j = \underline{\delta}$ is only willing to file suit if she is sure that victim i will be there as well (providing a payoff of exactly zero), but there is a probability of at least $H(\underline{\delta})$ that victim i will never file and victim j will end up alone (with a negative payoff). This argument extends to a neighborhood of δ_j values for which $\delta_j > \underline{\delta}$; victim j with $\delta_j > \underline{\delta}$ (but very close to $\underline{\delta}$) is only willing to file suit if she is almost sure that victim i will be there as well, but there is a probability of at least $H(\underline{\delta})$ that victim i will never file and victim j will end up alone (with a negative payoff). Thus, we know that in a Perfect Bayesian equilibrium, victim j will play a strategy such that $\mu_{j1} + \mu_{j2} < 1 - H(\underline{\delta})$. Re-arranging terms implies that $1 - \mu_{j1} - \mu_{j2} > H(\underline{\delta})$. The expectation on the left-hand-side is the probability that a randomly-drawn victim j never files suit if victim i chooses not to file in period 1. The right-hand-side is the measure of victim j types who will never file suit even if victim i files in period 1.

The value to victim i of filing in period 1 is (since all $\delta_j \geq \underline{\delta}$ will either file in period 1 or will follow victim i in period 2):

$$F^N(\delta_i, \mu_j) \equiv [1 - H(\underline{\delta})][L_2\delta_i - c_2 - f] + H(\underline{\delta})[\max\{L_1\delta_i - c_1, 0\} - f].$$

The value of waiting in period 1 is: $W^N(\delta_i, \mu_j) \equiv \mu_{j1}[L_2\delta_i - c_2 - f]$

$$+ (1 - \mu_{j1})\max\{0, (\mu_{j2}/(1 - \mu_{j1}))(L_2\delta_i - c_2 - f) + ((1 - \mu_{j2} - \mu_{j1})/(1 - \mu_{j1}))[\max\{L_1\delta_i - c_1, 0\} - f]\}.$$

Notice that the weights, $\mu_{j2}/(1 - \mu_{j1})$ and $(1 - \mu_{j2} - \mu_{j1})/(1 - \mu_{j1})$, sum to one and that the first of these two weight must be strictly less than one and the second weight must be strictly greater than zero (since $1 - \mu_{j1} - \mu_{j2} > H(\underline{\delta}) > 0$). Let $d_i(\mu_j)$ solve:

$$(\mu_{j2}/(1 - \mu_{j1}))(L_2\delta_i - c_2 - f) + ((1 - \mu_{j2} - \mu_{j1})/(1 - \mu_{j1}))[\max\{L_1\delta_i - c_1, 0\} - f] = 0;$$

any victim i with $\delta_i \geq d_i(\mu_j)$ would find it optimal to file suit in period 2 if neither victim filed in period 1. Note that the inequalities on the weights above imply that $d_i(\mu_j) \in (\underline{\delta}, \delta_1]$.

Finally, let $Z^N(\delta_i, \mu_j) \equiv F^N(\delta_i, \mu_j) - W^N(\delta_i, \mu_j)$ denote the <u>net</u> value of filing in period 1 (net of the value of waiting in period 1 and then behaving optimally in period 2), when victim j uses a strategy that results in μ_j. There are three relevant ranges of values for δ_i.

For $\delta_i \geq \delta_1$: $Z^N(\delta_i, \mu_j) = [1 - H(\underline{\delta}) - \mu_{j1} - \mu_{j2}][L_2\delta_i - c_2 - f] + [H(\underline{\delta}) - (1 - \mu_{j2} - \mu_{j1})][L_1\delta_i - c_1 - f]$

$$= [1 - H(\underline{\delta}) - \mu_{j1} - \mu_{j2}][L_2\delta_i - c_2 - (L_1\delta_i - c_1)].$$

Both of the expressions on the right-hand-side above are strictly positive and thus any victim i with $\delta_i \geq \delta_1$ should file suit in period 1.

For $\delta_i \in [d_i(\mu_j), \delta_1]$: $Z^N(\delta_i, \mu_j) = [1 - H(\underline{\delta}) - \mu_{j1} - \mu_{j2}][L_2\delta_i - c_2 - f]$

$$+ [H(\underline{\delta}) - (1 - \mu_{j2} - \mu_{j1})][\max\{L_1\delta_i - c_1, 0\} - f]$$

$$= [1 - H(\underline{\delta}) - \mu_{j1} - \mu_{j2}][L_2\delta_i - c_2 - \max\{L_1\delta_i - c_1, 0\}].$$

Again, both of these expressions are strictly positive and thus any victim i with $\delta_i \geq d_i(\mu_j)$ should file suit in period 1.

Finally, for $\delta_i \in [\underline{\delta}, d_i(\mu_j))$: $Z^N(\delta_i, \mu_j) = [1 - H(\underline{\delta}) - \mu_{j1}][L_2\delta_i - c_2 - f] + H(\underline{\delta})[\max\{L_1\delta_i - c_1, 0\} - f]$.

The coefficient $[1 - H(\underline{\delta}) - \mu_{j1}]$ is positive, while $L_2\delta_i - c_2 - f$ is strictly positive (except at $\underline{\delta}$, where it is zero). The expression $\max\{L_1\delta_i - c_1, 0\} - f$ is negative for δ_i in this range. We have already established (above) that $Z^N(d_i(\mu_j), \mu_j) > 0$. Notice that $Z^N(\underline{\delta}, \mu_j) < 0$ and $Z^N(\delta_i, \mu_j)$ is strictly increasing in δ_i on this range. Therefore, there exists a unique value $\varphi(\mu_j) \in (\underline{\delta}, d_i(\mu_j))$ such that $Z^N(\varphi(\mu_j), \mu_j) = 0$. This value provides victim i's best response function and it specifies that victim i should file suit in period 1 if $\delta_i \geq \varphi(\mu_j)$ and otherwise wait. Among the types that wait in period 1: (a) victim i should never file in period 2 if $\delta_i < \underline{\delta}$; (b) victim i should file in period 2 if victim j filed in period 1 and $\delta_i \geq \underline{\delta}$; and (c) victim i should file in period 2 if victim j did not file in period 1 and $\delta_i \geq d_i(\mu_j)$ but, since $\varphi(\mu_j) < d_i(\mu_j)$, any victim i who would file in period 2 if victim j did not file in period 1 will have already filed in period 1. Thus we have shown that a best response to any sequentially-rational strategy on the part of victim j is a bandwagon strategy (which is, itself, derived to be sequentially rational with beliefs employing Bayes' rule). Thus any Perfect Bayesian equilibrium is a bandwagon equilibrium. QED

Derivation of f_{NQ}

To find an implicit condition so that $\bar{\delta}^N < \delta_Q$, first observe that if $\delta_Q \leq \underline{\delta}$, then it is immediate that $\bar{\delta}^N > \delta_Q$ since $\bar{\delta}^N > \underline{\delta}$. A sufficient condition for this to occur is if $\delta_Q = c_1/L_1 \leq (c_2 + f)/L_2 = \underline{\delta}$; that is, if $f \geq f^{max} \equiv (c_1L_2 - c_2L_1)/L_1$. In this case, while all types $\delta_i \in [\bar{\delta}^N, \delta_1)$ regret having paid the fixed cost f, none would drop, as the expected value to continuing alone is non-negative. Clearly this is a overly strong requirement on f such that no cases, once filed, are dropped. To find a necessary condition, consider $f \in (0, f^{max})$, so that $\delta_Q > \underline{\delta}$, and evaluate

$$Z^N(\delta, \delta; f) \equiv q_2[H(\delta) - H(\underline{\delta})][L_2\delta - c_2 - f] + [1 - q_2 + q_2H(\underline{\delta})][\max\{L_1\delta - c_1, 0\} - f]$$

at $\delta = \delta_Q$, where we have included the fee f as a parameter in Z^N (and recall that $\underline{\delta} = (c_2 + f)/L_2$).

Then $Z^N(\delta_Q, \delta_Q; f) = q_2[H(\delta_Q) - H(\underline{\delta})][L_2\delta_Q - c_2] - [1 - q_2 + q_2H(\underline{\delta})]f$. Since Z^N is strictly increasing in both arguments involving δ_Q, and since $Z^N(\bar{\delta}^N, \bar{\delta}^N; f) = 0$, it is clear that $\bar{\delta}^N$ (>, =, <) δ_Q as $Z^N(\delta_Q, \delta_Q; f)$ (<, =, >) 0. As $f \to 0$, $\bar{\delta}^N \to \underline{\delta} < \delta_Q$, where the inequality follows from the fact that $\delta_Q = c_1/L_1 > c_2/L_2$. Thus, for f sufficiently low, we have $Z^N(\delta_Q, \delta_Q; f) > 0$ and therefore $\bar{\delta}^N < \delta_Q$. Moreover, $\partial Z^N(\delta, \delta; f)/\partial f = - q_2h(\underline{\delta})[L_2\delta - c_2]/L_2 - [1 - q_2 + q_2H(\underline{\delta})] < 0$ for all $\delta \geq \underline{\delta}$. Therefore, there exists a unique value of $f \in (0, f^{max})$, denoted f_{NQ}, such that $\bar{\delta}^N$ (>, =, <) δ_Q as f (>, =, <) f_{NQ}.

Comparative Statics

Recall that $\underline{\delta} \equiv (c_2 + f)$ and $\bar{\delta}^N$ is defined by the following equation:

$$Z^N(\bar{\delta}^N, \bar{\delta}^N) = q_2[H(\bar{\delta}^N) - H(\underline{\delta})][L_2\bar{\delta}^N - c_2 - f] + [1 - q_2 + q_2H(\underline{\delta})][\max\{L_1\bar{\delta}^N - c_1, 0\} - f] = 0.$$

This means that $L_2\bar{\delta}^N - c_2 - f > 0$ and $\max\{L_1\bar{\delta}^N - c_1, 0\} - f < 0$. The comparative statics of $\underline{\delta}$ with respect to the parameters f, c_2, L_2, and q_2 are obvious. Recall that the function $Z^N(\bar{\delta}^N, \bar{\delta}^N)$ is strictly increasing in $\bar{\delta}^N$ and depends on the parameters f, c_2, L_2, and q_2 both directly and (possibly) indirectly through $\underline{\delta}$. Thus, for any parameter m,

$$d\bar{\delta}^N/dm = - (\partial Z^N(\bar{\delta}^N, \bar{\delta}^N)/\partial m)/[Z_1^N(\bar{\delta}^N, \bar{\delta}^N) + Z_1^N(\bar{\delta}^N, \bar{\delta}^N)],$$

so that $\bar{\delta}^N$ is an increasing function of any parameter m which decreases $Z^N(\bar{\delta}^N, \bar{\delta}^N)$, taking into account any indirect effects through $\underline{\delta}$. It is shown below that $\partial Z^N(\bar{\delta}^N, \bar{\delta}^N)/\partial f < 0$ and $\partial Z^N(\bar{\delta}^N, \bar{\delta}^N)/\partial c_2 < 0$, so the period 1 filing threshold increases (fewer cases are filed in period 1) with an increase in f or c_2. On the other hand, $\partial Z^N(\bar{\delta}^N, \bar{\delta}^N)/\partial L_2 > 0$ and $\partial Z^N(\bar{\delta}^N, \bar{\delta}^N)/\partial q_2 > 0$, so the period 1 filing threshold decreases (more cases are filed in period 1) with an increase in L_2.

$$\partial Z^N(\bar{\delta}^N, \bar{\delta}^N)/\partial f = -(q_2h(\underline{\delta})/L_2)[L_2\bar{\delta}^N - c_2 - \max\{L_1\bar{\delta}^N - c_1, 0\}] - [1 - q_2 + q_2H(\bar{\delta}^N)] < 0.$$

$$\partial Z^N(\bar{\delta}^N, \bar{\delta}^N)/\partial c_2 = -(q_2h(\underline{\delta})/L_2)[L_2\bar{\delta}^N - c_2 - \max\{L_1\bar{\delta}^N - c_1, 0\}] - q_2[H(\bar{\delta}^N) - H(\underline{\delta})] < 0.$$

$$\partial Z^N(\bar{\delta}^N, \bar{\delta}^N)/\partial L_2 = [q_2h(\underline{\delta})(c_2 + f)/(L_2)^2][L_2\bar{\delta}^N - c_2 - \max\{L_1\bar{\delta}^N - c_1, 0\}] + q_2[H(\bar{\delta}^N) - H(\underline{\delta})]\bar{\delta}^N > 0.$$

$\partial Z^N(\bar{\delta}^N, \bar{\delta}^N)/\partial q_2 = [H(\bar{\delta}^N) - H(\underline{\delta})][L_2\bar{\delta}^N - c_2 - f] - [1 - H(\underline{\delta})][\max\{L_1\bar{\delta}^N - c_1, 0\} - f] > 0,$

where the inequality follows from the facts that $L_2\bar{\delta}^N - c_2 - f > 0$ and $\max\{L_1\bar{\delta}^N - c_1, 0\} - f < 0$.

The Plaintiffs' Preferences over Preemptive versus Deferred Settlement

Let $V^N(\delta_i)$ be plaintiff i's payoff under the equilibrium with no settlement (equivalently, deferred settlement) when her harm is δ_i. Similarly, let $V^S(\delta_i)$ be plaintiff i's payoff under the equilibrium with preemptive data-suppressing settlement when her harm is δ_i. Then:

$$V^N(\delta_i) = \begin{cases} 0 & \delta_i \in [0, \underline{\delta}) \\ W^N(\delta_i, \bar{\delta}^N) & \delta_i \in [\underline{\delta}, \bar{\delta}^N) \\ F^N(\delta_i, \bar{\delta}^N) & \delta_i \in [\bar{\delta}^N, \infty); \end{cases}$$

and

$$V^S(\delta_i) = \begin{cases} 0 & \delta_i \in [0, \bar{\delta}^S) \\ F^S(\delta_i, \bar{\delta}^S) & \delta_i \in [\bar{\delta}^S, \infty). \end{cases}$$

In order to determine whether the plaintiff prefers deferred to preemptive settlement, we examine $V^N(\delta_i) - V^S(\delta_i)$. Since $\bar{\delta}^S < \bar{\delta}^N$ and $F^S(\delta_i, \bar{\delta}^S) = F^N(\delta_i, \bar{\delta}^N)$ – recall that F^N and the reduced form of F^S are both independent of the other potential victim's strategy – then the only places where $V^N(\delta_i)$ differs from $V^S(\delta_i)$ is on the two intervals $[\underline{\delta}, \bar{\delta}^S)$ and $[\bar{\delta}^S, \bar{\delta}^N)$, since the two payoff functions are the same on the other intervals. Furthermore, $V^N(\delta_i) - V^S(\delta_i) = W^N(\delta_i, \bar{\delta}^N) - 0 > 0$ on $[\underline{\delta}, \bar{\delta}^S)$, while $V^N(\delta_i) - V^S(\delta_i) = W^N(\delta_i, \bar{\delta}^N) - F^N(\delta_i, \bar{\delta}^N) > 0$ on $[\bar{\delta}^S, \bar{\delta}^N)$ since waiting is better than filing in the first period (as shown in Section 3) for these types.

Comparing the Aggregate Expected Filing Cost under Preemptive versus Deferred Settlement

Claim. Suppose that H is the uniform distribution on $[0, \Delta]$ and that $f < f_{NQ}$ (and thus, $\bar{\delta} < \delta_Q$). Then the expected filing cost for a single harmed plaintiff (which is proportional to the expected number of cases filed) is higher under preemptive settlement than under deferred settlement.

Proof. Let EFC* denote the expected filing cost under deferred settlement and let EFC^{S*} denote the expected filing cost under preemptive settlement. Then

$$EFC^* = f[1 - H(\bar{\delta}^N)](1 + q_2[H(\bar{\delta}^N) - H(\underline{\delta})]) \text{ and } EFC^{S*} = f[1 - H(\bar{\delta}^S)].$$

Using the uniform distribution:

$$EFC^{S*} > EFC^* \text{ if and only if } (\Delta - \bar{\delta}^S)/\Delta > [(\Delta - \bar{\delta}^N)/\Delta][1 + q_2(\bar{\delta}^N - \underline{\delta})/\Delta] \quad \text{(TA1)}$$

(TA1) holds if and only if $\Delta(\Delta - \bar{\delta}^S) > (\Delta - \bar{\delta}^N)[\Delta + \bar{\delta}^N - \underline{\delta} - (1 - q_2)(\bar{\delta}^N - \underline{\delta})]$, which holds if and only if

$$q_2\bar{\delta}^N(\bar{\delta}^N - \underline{\delta}) > \Delta[\bar{\delta}^S - \underline{\delta} - (1 - q_2)(\bar{\delta}^N - \underline{\delta})]. \qquad \text{(TA2)}$$

Using equations (5) and (8), the fact that $\bar{\delta}^N < \delta_Q$, and the uniform distribution yields the following relationship among the thresholds: $\bar{\delta}^S - \underline{\delta} = (\bar{\delta}^N - \underline{\delta})^2/(\Delta - \underline{\delta})$. Substituting this into (TA2) implies that (TA2) holds if and only if $q_2\bar{\delta}^N(\bar{\delta}^N - \underline{\delta}) > \Delta[((\bar{\delta}^N - \underline{\delta})^2/(\Delta - \underline{\delta})) - (1 - q_2)(\bar{\delta}^N - \underline{\delta})]$, which holds if and only if $q_2\bar{\delta}^N(\Delta - \underline{\delta}) > \Delta(\bar{\delta}^N - \underline{\delta}) - \Delta(1 - q_2)(\Delta - \underline{\delta})$, which holds if and only if $q_2\underline{\delta} + (1 - q_2)\Delta > 0$, which is true. QED

Preferences Over Preemptive versus Deferred Settlement in the Partially-Unaware Case

It was claimed in the text that the plaintiff still prefers deferred to preemptive settlement, while the defendant prefers to have the option to make a preemptive settlement when plaintiff awareness is sufficiently low. To demonstrate these claims, first consider the preferences of an aware harmed victim. Using notation analogous to that in the text, an aware harmed victim's expected equilibrium payoff under deferred and preemptive settlement, respectively, is given by:

$$V^N_\rho(\delta_i) = \begin{cases} 0 & \delta_i \in [0, \underline{\delta}) \\ W^N_\rho(\delta_i, \bar{\delta}^N_\rho) & \delta_i \in [\underline{\delta}, \bar{\delta}^N_\rho) \\ F^N_\rho(\delta_i, \bar{\delta}^N_\rho) & \delta_i \in [\bar{\delta}^N_\rho, \infty); \end{cases}$$

and

$$V^S_\rho(\delta_i) = \begin{cases} 0 & \delta_i \in [0, \bar{\delta}^S) \\ F^S_\rho(\delta_i, \bar{\delta}^S) & \delta_i \in [\bar{\delta}^S, \infty). \end{cases}$$

In order to determine whether the plaintiff prefers deferred to preemptive settlement, we examine $V^N_\rho(\delta_i) - V^S_\rho(\delta_i)$. Since $\bar{\delta}^S < \bar{\delta}^N_\rho$ and $F^S_\rho(\delta_i, \bar{\delta}^S) = F^N_\rho(\delta_i, \bar{\delta}^N_\rho)$ – recall that F^N and the reduced form of F^S are both independent of the other potential victim's strategy – then the only places where $V^N_\rho(\delta_i)$ differs from $V^S_\rho(\delta_i)$ is on the two intervals $[\underline{\delta}, \bar{\delta}^S)$ and $[\bar{\delta}^S, \bar{\delta}^N_\rho)$, since the two payoff functions are the same on the other intervals. Furthermore, $V^N_\rho(\delta_i) - V^S_\rho(\delta_i) = W^N_\rho(\delta_i, \bar{\delta}^N_\rho) - 0 > 0$ on $[\underline{\delta}, \bar{\delta}^S)$, while $V^N_\rho(\delta_i) - V^S_\rho(\delta_i) = W^N_\rho(\delta_i, \bar{\delta}^N) - F^N_\rho(\delta_i, \bar{\delta}^N_\rho) > 0$ on $[\bar{\delta}^S, \bar{\delta}^N_\rho)$ since waiting is better than filing in the first period for these types. Thus, every type of aware harmed victim prefers deferred to preemptive settlement. It is clear that an unaware harmed victim prefers deferred to preemptive settlement, since deferred settlement involves a possibility that another victim may file suit and alert the unaware victim; by contrast, under preemptive settlement any (other) victim that files (early) ends up settling confidentially instead of alerting the unaware victim.

Now consider the *ex ante* preferences of the defendant. The defendant's expected payment is the *ex ante* expected number of harmed victims times the *ex ante* expected payment received by a harmed victim (this is tedious, but straightforward, to verify). We will now describe how to construct a harmed victim's expected receipts, taking into account that this victim may be aware or unaware. Under deferred settlement, a victim of type δ_i obtains the following payoffs:

(a) $\delta_i \in [0, \underline{\delta})$: 0

(b) $\delta_i \in [\underline{\delta}, \bar{\delta}^N_\rho)$: $\rho q_2[1 - H(\bar{\delta}^N_\rho)][L_2\delta_i - c_2]$

(c) $\delta_i \in [\bar{\delta}^N_\rho, \infty)$: $\rho q_2[1 - H(\underline{\delta})][L_2\delta_i - c_2] + \rho[1 - q_2 + q_2 H(\underline{\delta})]\max\{L_1\delta_i - c_1, 0\}$

$+ (1 - \rho)\rho q_2[1 - H(\bar{\delta}^N_\rho)][L_2\delta_i - c_2]$.

These payoffs are explained as follows. A victim with $\delta_i \in [0, \underline{\delta})$ will never file suit, regardless of his level of awareness. A victim with $\delta_i \in [\underline{\delta}, \bar{\delta}^N_\rho)$ will wait in the first period, regardless of his level of awareness; consequently, he will file in period 2 if there is another victim, that victim is aware, and that victim has harm in excess of $\bar{\delta}^N_\rho$; in this case, the other victim will file in period 1 and victim i will join in period 2. Finally, a victim with $\delta_i \in [\bar{\delta}^N_\rho, \infty)$ will file in period 1if he is aware (this explains the first two expressions in part (c) above); if he is unaware, he will wait in period 1 but he will file in period 2 if there is another victim, that victim is aware, and that victim has harm in excess of $\bar{\delta}^N_\rho$; this explains the third expression in part (c) above.

Under preemptive settlement, a victim of type δ_i obtains the following payoffs (after substituting for the equilibrium settlement offer):

(d) $\delta_i \in [0, \bar{\delta}^S)$: 0

(e) $\delta_i \in [\bar{\delta}^S, \infty)$: $\rho q_2[1 - H(\underline{\delta})][L_2\delta_i - c_2] + \rho[1 - q_2 + q_2 H(\underline{\delta})]\max\{L_1\delta_i - c_1, 0\}$

These payoffs are explained as follows. A victim with $\delta_i \in [0, \underline{\delta}^S)$ will not file suit in period 1, regardless of his level of awareness. Moreover, if there is another aware victim who files in period 1, this plaintiff will settle with the defendant and will thus be unavailable to be joined in period 2,and a victim with $[0, \bar{\delta}^S)$ will not proceed alone. A victim with $\delta_i \in [\bar{\delta}^S, \infty)$ will file in period 1 if he is aware; since this would permit him to alert any other victim, who would join in period 2 if her harm exceeds $\underline{\delta}$, victim i receives (via the settlement but gross of filing costs) the amount $q_2[1 - H(\underline{\delta})][L_2\delta_i - c_2] + [1 - q_2 + q_2H(\underline{\delta})]\max\{L_1\delta_i - c_1, 0\}$ with probability ρ.

A harmed victim's expected receipts under deferred and preemptive settlement, respectively, are found by integrating the payoffs described in (a)-(c) and (d)-(e), respectively, with respect to the distribution H. The defendant's *ex ante* expected payments are proportional to these expectations. The difference between the defendant's *ex ante* expected payments under deferred versus preemptive settlement are therefore proportional to $\rho\gamma(\rho)$, where

$\gamma(\rho) \equiv \int q_2[1 - H(\bar{\delta}^N_\rho)][L_2\delta_i - c_2]h(\delta_i)d\delta_i$ (where the domain of integration is $[\underline{\delta}, \bar{\delta}^S]$)

$+ \int (1 - \rho)q_2[1 - H(\bar{\delta}^N_\rho)][L_2\delta_i - c_2]h(\delta_i)d\delta_i$ (where the domain of integration is $[\bar{\delta}^N_\rho, \infty)$)

$- \int \{q_2[H(\bar{\delta}^N_\rho) - H(\underline{\delta})][L_2\delta_i - c_2] + [1 - q_2 + q_2H(\underline{\delta})]\max\{L_1\delta_i - c_1, 0\}\}h(\delta_i)d\delta_i$,

where the domain of integration for the final integral is $[\bar{\delta}^S, \bar{\delta}^N_\rho]$. Recall that $\partial\bar{\delta}^N_\rho/\partial\rho > 0$ and that $\bar{\delta}^N_\rho \rightarrow \bar{\delta}^S$ as $\rho \rightarrow 0$. Totally differentiating $\gamma(\rho)$ with respect to ρ implies that $\gamma(\rho)$ increases as ρ

decreases. Moreover, the first two integrals converge to positive numbers as $\rho \rightarrow 0$, while the third integral converges to zero. Thus, there is a value ρ_0 that is close enough to zero (but still positive) at which $\gamma(\rho_0) = 0$; for any $\rho \in (0, \rho_0)$, it follows that $\rho\gamma(\rho) > 0$. Thus, for sufficiently small levels of plaintiff awareness ρ, the defendant expects to pay more under deferred than under preemptive settlement. Thus, D prefers to have the option to make a preemptive settlement when plaintiff awareness is sufficiently low.