A Dynamic Model of Lawsuit Joinder and Settlement

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Technical Appendix (Web)

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 $\delta_i \geq \underline{\delta}$):

$$\begin{aligned}\mathcal{W}^N(\delta_i, \bar{\delta}_j) &\equiv q_2[1 - H(\bar{\delta}_j)][L_2\delta_i - c_2 - f] + [1 - q_2 + q_2H(\bar{\delta}_j)][\max\{0, z^N(\delta_i, \bar{\delta}_j)\}] \\ &= q_2[1 - H(\bar{\delta}_j)][L_2\delta_i - c_2 - f] + \max\{0, q_2[H(\bar{\delta}_j) - H(\underline{\delta})][L_2\delta_i - c_2 - f] \\ &\quad + [1 - q_2 + q_2H(\underline{\delta})][\max\{L_1\delta_i - c_1, 0\} - f]\},\end{aligned}$$

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

$$\begin{aligned}\mathcal{Z}^N(\delta_i, \bar{\delta}_j) &= q_2[H(\bar{\delta}_j) - H(\underline{\delta})][L_2\delta_i - c_2 - f] + [1 - q_2 + q_2H(\underline{\delta})][\max\{L_1\delta_i - c_1, 0\} - f] \\ &- \max\{0, q_2[H(\bar{\delta}_j) - H(\underline{\delta})][L_2\delta_i - c_2 - f] + [1 - q_2 + q_2H(\underline{\delta})][\max\{L_1\delta_i - c_1, 0\} - f]\}. \qquad \text{(TA1)}\end{aligned}$$

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 $\mathcal{Z}^N(\delta_i, \underline{\delta}) = [1 - q_2 + q_2H(\underline{\delta})][\max\{L_1\delta_i - c_1, 0\} - f - \max\{0, \max\{L_1\delta_i - c_1, 0\} - f\}]$. 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 $\mathcal{Z}^N(\underline{\delta}, \bar{\delta}_j) = [1 - q_2 + q_2H(\underline{\delta})][\max\{L_1\underline{\delta} - c_1, 0\} - f - \max\{0, \max\{L_1\underline{\delta} - c_1, 0\} - f\}] < 0$. 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 in the Appendix) is set equal to zero to obtain $\varphi(\bar{\delta}_j)$) and in the multi-period case (wherein the expression in equation (TA1) 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: $\{\underline{\delta}, \bar{\delta}^N\}$.

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,

$$d\bar{\delta}^N/dm = - (\partial Z^N(\bar{\delta}^N, \bar{\delta}^N)/\partial m)/[Z^N_1(\bar{\delta}^N, \bar{\delta}^N) + Z^N_2(\bar{\delta}^N, \bar{\delta}^N)],$$

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.

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

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

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

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

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:

$$EFC^{S*} > EFC^* \text{ if and only if } (\Delta - \bar{\delta}^S)/\Delta > [(\Delta - \bar{\delta}^N)/\Delta\,][1 + q_2(\bar{\delta}^N - \underline{\delta})/\Delta] \tag{TA2}$$

(TA2) 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

$$q_2\bar{\delta}^N(\bar{\delta}^N - \underline{\delta}) > \Delta[\bar{\delta}^S - \underline{\delta} - (1 - q_2)(\bar{\delta}^N - \underline{\delta})]. \tag{TA3}$$

Using equations (3) and (6), 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 (TA3) implies that (TA3) 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) $\delta_i \in [0, \underline{\delta})$: $\quad 0$

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

(c) $\delta_i \in [\bar{\delta}^N_\rho, \infty)$: $\quad \rho q_2[1 - H(\underline{\delta})][L_2\delta_i - c_2] + \rho[1 - q_2 + q_2H(\underline{\delta})]\max\{L_1\delta_i - c_1, 0\}$

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

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

(e) $\delta_i \in [\bar{\delta}^S, \infty)$: $\quad \rho q_2[1 - H(\underline{\delta})][L_2\delta_i - c_2] + \rho[1 - q_2 + q_2H(\underline{\delta})]\max\{L_1\delta_i - c_1, 0\}$

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

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

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

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

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 $\bar{\delta}^N_\rho \to \bar{\delta}^S$ as $\rho \to 0$. 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 $\rho \to 0$, 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.