Threats to sue and cost divisibility under asymmetric information

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Abstract

The early literature on litigation and settlement assumed that a plaintiff’s threat to litigate is credible only when her litigation value—the difference between the expected judgment and her litigation costs—is positive. More recently, however, Bebchuk (1996) has suggested that even if the plaintiff’s litigation value is negative, divisibility of her litigation costs may render credibility to her threat to sue. We show that Bebchuk’s result is limited to environments where there is relatively little asymmetric information. When a defendant holds private information concerning his liability he can deter small value suits by engaging in a stonewalling strategy, consistently refusing to settle, even if the plaintiff’s costs are very finely divided.

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1. Introduction

Threats to sue rarely materialize, as most claimants choose not to pursue their grievance in court, fearing the prospect of high litigation costs.1 The early literature on litigation and settlement assumed that a plaintiff’s threat to litigate is credible only when her litigation value—the difference between the expected judgment and her litigation costs—is positive.2 More recently, however, Bebchuk (1996) has suggested that even if the plaintiff’s litigation value is negative, divisibility of her litigation costs may render credibility to her threat to

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1 See for example Miller and Sarat (1981) and Trubeck et al. (1983), finding that less than 10% of all grievances with a minimum value of $1000 were filed in court.
When litigation is divided into several stages, and the plaintiff’s litigation costs in the last stage are lower than the expected judgment, her threat to proceed to judgment, contingent on reaching this stage, is credible. The defendant is therefore willing to settle the suit before the last stage. But then, if the expected settlement is higher than the plaintiff’s costs in the previous stage, her threat to proceed in that stage is also credible, and again, the defendant is better off settling before. Proceeding by backward induction, the defendant is expected to settle the lawsuit immediately after it is filed, even if the plaintiff’s total litigation costs are higher than the expected judgment.

This paper shows that when the defendant privately knows whether he is liable or not, the plaintiff’s threat to sue may lose its credibility even under very fine cost divisibility. Under Bebchuk’s assumption that the plaintiff and the defendant are symmetrically informed the plaintiff’s expectations regarding the defendant’s future behavior are not affected by the defendant’s responses to previous settlement offers. Even if the defendant has consistently declined all her settlement demands, the plaintiff would still expect her next settlement offer to be accepted. If, however, the defendant holds private information about his expected liability then by refusing the plaintiff’s settlement offers he can signal that his liability is low. The plaintiff should then update her beliefs and become less confident that the defendant would settle the case, thus increasing the risk of having to pursue the case to trial and end with a net loss. Clearly, this reasoning only reinforces the defendant’s inclination to refuse the plaintiff’s offers, which again, undermines the plaintiff’s certainty that the case would settle.4

Defendants’ private information is important in exactly those cases where divisibility of litigation costs would seem plausible: complex cases, where discovery and pretrial stages may be long, numerous, and expensive. A prominent example is that of class actions. On the one hand, class actions fit well within the divisibility argument, as they are procedurally divided to many stages, including class certification, pretrial, and often, bifurcated trial stages.5 On the other hand, class action defendants often hold private information concerning their liability, whereas no such information is available to the dispersed, low interested plaintiff class. As this paper demonstrates, under such information asymmetry defendants can credibly maintain stonewalling strategies and deter all lawsuits, meritorious or not, notwithstanding cost divisibility. It therefore undermines class action defendants’ contention that they are blackmailed by plaintiff lawyers who threaten them with long and costly litigation.6
Our model builds on Spier (1992) and Nalebuff (1987). Spier (1992) explored the dynamics of pretrial negotiations in a multiple period setting, assuming the plaintiff’s litigation value is positive. Nalebuff (1987) discussed the effects of the credibility problem on bargaining in a one period litigation model. Combining the two models we show the sensitivity of the divisibility argument to problems of information asymmetry.

Asymmetric information in which the plaintiff is the informed party was used by Bebchuk (1988) and Katz (1990) to explain the plaintiff’s ability to extract a positive settlement in suits whose litigation value may be negative. Our paper shows that the opposite may be true when the defendant is the privately informed party. Finally, there exists an extensive literature on litigation and settlement under incomplete information (see e.g. Bebchuk, 1984; Reinganum and Wilde, 1986; Schweizer, 1989), but this literature assumes that the plaintiff’s litigation value is positive, and her threat to litigate is therefore credible.\(^7\)

The paper proceeds as follows: Section 2 presents the model. Section 3 analyzes the simple case where litigation is divided into only two periods, demonstrating the main result of the paper. Section 4 discusses the multiperiod case. Section 5 concludes. Proofs are relegated to the appendix.

2. The model

A risk neutral plaintiff decides whether to file a lawsuit against a risk neutral defendant, where filing fee is positive but arbitrarily close to 0.\(^8\) If the lawsuit is filed then there are \(n\) litigation periods, indexed by \(t = 1, 2, \ldots, n\). In each period the plaintiff makes a take-it-or-leave-it offer, the defendant either accepts or rejects the offer, and if he rejects it the plaintiff decides whether to proceed to the next period or drop the suit. If the defendant rejects the plaintiff’s offer and the plaintiff proceeds then the plaintiff incurs litigation costs denoted \(c_t > 0\), and the sum of these litigation costs over all periods 1 to \(n\) is denoted \(C\).

For the sake of exposition clarity we assume that the defendant bears no litigation costs.\(^9\)\(^10\).

Each litigant incurs his litigation costs irrespective of the court’s judgment, according to the American rule.\(^11\)

The litigants’ strategies at each period \(t\) are a function of the history of the game in past periods. Since the game ends whenever a settlement offer is accepted or the case is dropped, a history of the game at the beginning of period \(t\) can be described by a vector of settlement offers that were made in previous periods, \(S_{t-1}\). We denote the plaintiff’s settlement offer in period \(t\) by \(S_t(S_{t-1})\), and the probability that the plaintiff proceeds in period \(t\) after her

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\(^7\) For a comprehensive review of the literature on litigation and settlement under incomplete information, see Farmer and Pecorino (1996).

\(^8\) We assume a strictly positive filing fee only to avoid cases where the plaintiff files the suit and immediately drops it. None of our results would materially change if we drop this assumption.

\(^9\) See Klement (1999) for a detailed analysis when this assumption is relaxed.

\(^10\) For simplicity we also assume no discounting.

\(^11\) The analysis can be adjusted for alternative rules of fee allocation. See Bebchuk (1984), explaining the way to make such adjustments.
offer $S_t$ was rejected by $p_t(S_{t-1}, S_t(S_{t-1}))$. For notational clarity we denote the settlement offers and the probability of proceeding simply by $S_t$ and $p_t$ whenever possible. If the suit is not dropped then the plaintiff incurs her litigation costs in that period and the game moves to the next period. If the plaintiff decides to proceed in the last period then the court delivers its judgment, $J$. The defendant knows whether he is liable, in which case $J = W > 0$, or not liable, where $J = 0$. The defendant’s strategy specifies at time $t$ the probability he accepts a plaintiff’s offer $S_t$ after history $S_{t-1}$, and it is denoted $a_L^t(S_{t-1}, S_t)$ for a liable defendant, and $a_N^t(S_{t-1}, S_t)$ for a defendant who is not liable.

The plaintiff does not know whether the defendant is liable or not but before filing the suit she believes that the probability he is liable is $\alpha > 0$. This belief is updated in each period $t$ if the defendant rejects the plaintiff’s offer, and is denoted $\mu_t(S_{t-1}, S_t)$. The parameters $W$, $\alpha$, $c_t$, and $n$ are all common knowledge.

The equilibrium concept we use is that of a sequential equilibrium. A combination of strategies is a sequential equilibrium if the strategies are sequentially rational and beliefs are updated according to Bayes’ rule, given the equilibrium strategies and the plaintiff’s prior belief.

### 3. Two period litigation

We initially analyze the simple case where litigation is divided into two periods, $n = 2$. As a benchmark we first describe the subgame perfect equilibrium when both parties hold the same information. Specifically, we assume that the defendant does not know $J$ but only $\alpha$. We then analyze the case of interest where the defendant is privately informed about his liability.

#### 3.1. Symmetric information

Begin by analyzing the litigants’ strategies in the second period. At that point the plaintiff has already sunk her first period costs, $c_1$, and she only considers her remaining costs, $c_2$, when deciding whether to drop the suit or proceed to judgment. If her remaining costs are lower than the expected judgment, $c_2 \leq \alpha W$, then her threat to proceed with litigation is credible, and therefore the defendant is willing to pay her as much as the expected judgment.

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12 The assumption that a defendant who is not liable expects a zero loss in trial implies that the court never finds such a defendant liable. Together with the assumption that the defendant’s litigation costs are 0 this assumption ensures that the plaintiff does not file the suit for its nuisance value, namely, the sum of the defendant’s litigation costs and his expected loss due to erroneous finding of liability. Although nuisance value is one reason why suits with negative expected value would be filed and settled (see Rosenberg & Shavell, 1985), this is not the case of interest, neither in this paper nor in Bebchuk (1996).

Another implication of that assumption is that even under a very fine divisibility the plaintiff’s per-period litigation costs are always higher than the lowest judgment possible. We discuss this implication in Section 4.

13 See Kreps and Wilson (1982). In this game the sequential equilibrium solution is equivalent to a perfect Bayesian equilibrium.

14 A player’s strategy is sequentially rational if given her information this strategy is the best response to the other player’s strategy.
αW.\textsuperscript{15} To maximize her payoff the plaintiff offers the defendant exactly that amount. If the plaintiff’s remaining costs are higher than the expected judgment, $c_2 > \alpha W$, then she drops the suit if her settlement offer is declined. Expecting that, the defendant refuses any positive settlement offer. Whether the parties settle for zero, or do not settle and the plaintiff drops the suit is of no significance for our analysis.

In the first period the plaintiff has to spend $c_1$ to proceed to the second period. When $c_2 \leq \alpha W$ the plaintiff expects to gain $\alpha W$ if she proceeds to the second period. Her threat to proceed in the first period is therefore credible if and only if $c_1 \leq \alpha W$. The defendant is then better off settling in the first period for as much as $\alpha W$. Hence, the suit is settled for that amount immediately after it is filed. Following the same reasoning as in the second period, if $c_1 > \alpha W$ then the plaintiff drops the suit in the first period if her settlement offer is rejected, the defendant therefore refuses any positive settlement offer, and since filing costs are positive the suit is not filed. When $c_2 > \alpha W$ the plaintiff drops the suit in the first period if her offer is declined, knowing she would have to spend $c_1$ only to gain zero if she proceeds to the next period. Here too, the suit is not filed.

It follows that when the plaintiff’s total litigation costs are higher than the expected judgment, $C > \alpha W$, but her per-period costs are lower than the expected judgment, $c_2 \leq \alpha W$ and $c_1 \leq \alpha W$, divisibility alone renders the plaintiff’s threat to sue credible. Notice that in this case there is a Nash equilibrium in which the defendant never settles and the plaintiff does not file the suit. The defendant’s problem is that in the absence of any commitment mechanism his threat to reject the plaintiff’s offer in the second period is not credible, and therefore such equilibrium is not subgame perfect.

\textbf{Observation 1} (Following Bebchuk, 1996). \textit{Under symmetric information the plaintiff files a suit if and only if her per-period litigation costs are lower than the expected judgment.}

\subsection*{3.2. Asymmetric information}

Assume now that the defendant knows the true judgment $J$. Define the following:

\[ \mu^*_2 = \frac{c_2}{W}, \quad \mu^*_1 = \mu^*_2 \left(1 - \frac{c_1}{W}\right) + \frac{c_1}{W} \]

\textbf{Proposition 1} (Two period case). \textit{When the defendant privately knows $J$ then in the unique sequential equilibrium the suit is filed if and only if $\alpha > \mu^*_1$ and $c_2 < W$.}

The proof of this proposition is given in the appendix. Here we only describe the litigants’ strategies on the equilibrium path, and provide some intuition as to why this equilibrium is unique.

If the probability that the defendant is liable satisfies the above condition, $\alpha > \mu^*_1$, and if $c_2 < W$, then in equilibrium the plaintiff offers to settle for $W$ in both periods, the non-liable defendant rejects this offer, and the liable defendant accepts each offer with some positive probability. The probability of acceptance by the liable defendant is such that the plaintiff is indifferent in each period between proceeding to trial and dropping the suit. Nevertheless,

\textsuperscript{15} To be sure, if the defendant threatens to reject such an offer, the plaintiff can always make a lower offer arbitrarily close to $\alpha W$, which the defendant would accept.
on the equilibrium path the plaintiff proceeds with probability 1 each time her settlement offer is rejected.

Intuitively, if the liable defendant were to accept the plaintiff’s offer with probability 1 then any rejection would signal that the defendant is not liable. But then the plaintiff would drop the suit following such rejection, and expecting that, the liable defendant would be better off rejecting the settlement offer, a contradiction. Similarly, if the probability that the defendant is liable is sufficiently high and the liable defendant were to reject the plaintiff’s settlement offer with probability 1 then the plaintiff’s threat to proceed to trial would be credible. But then she could benefit by lowering her settlement offer so it would be lower than \( W \) yet very close to it, and the liable defendant would be better off accepting that offer, again a contradiction. Therefore, whenever the probability that the defendant is liable satisfies the above condition, the liable defendant accepts the offer \( S_l = W \) with some positive probability. Since the non-liable defendant rejects any positive offer, the plaintiff’s belief that the defendant is not liable increases following each such rejection. If this belief is sufficiently high the plaintiff prefers to drop the suit. But then she is better off dropping it in the previous period, and by backward induction she does not file the suit.

Rejection of the plaintiff’s offer therefore serves as a signal that the defendant is not liable. The plaintiff must be sufficiently confident that the defendant is liable before filing the suit, to be able to maintain a credible threat of proceeding to trial in the face of repeated rejections of her settlement offers.

The effect of information asymmetry on the credibility of the plaintiff’s threat to sue is best appreciated if we compare the conditions for filing the suit under the three alternative configurations—no divisibility,\(^{16}\) divisibility with symmetric information, and divisibility with defendant’s private information, for a given probability of defendant’s liability, \( \alpha \). These conditions are:

\[
\alpha \geq \frac{C}{W}, \quad \text{(No Divisibility)}
\]

\[
\alpha \geq \frac{\max(c_1, c_2)}{W}, \quad \text{(Divisibility and Symmetric Information)}
\]

\[
\alpha \geq \frac{C}{W} - \frac{c_1 c_2}{W^2} \quad \text{and} \quad \frac{c_2}{W} < 1, \quad \text{(Divisibility and Defendant’s Private Information)}
\]

Fig. 1 describes the combinations of first and second period litigation costs (divided by the judgment in case of liability, \( W \)) that allow the plaintiff a credible threat to sue, under the three alternative configurations.

If costs are not divisible then there is no significance to the division between first and second period costs, as only their sum matters (this is equivalent to having litigation divided to two periods without allowing any settlement negotiations in the second period). Thus, only suits whose cost combinations lie within the triangle ND are filed. If costs are divided between the two periods and information is symmetric then any suit whose costs lie in the

\(^{16}\) When costs are not divided and are higher than \( \alpha W \) the suit is not filed when information is symmetric as well as when the defendant privately knows his liability. The latter is easily verified, if we remember that the non-liable defendant never accepts any positive settlement.
square including ND, DPI and DSI is filed. If costs are divided between the two periods yet the defendant privately knows his liability the range of suits that are filed is only ND and DPI. It can be easily verified that the range of cases that are filed under divisibility with asymmetric information approaches the no divisibility case when $\alpha$ approaches 0, and that this range approaches the respective range when information is symmetric and costs are divisible as $\alpha$ approaches 1.\textsuperscript{17}

4. Multiperiod litigation

Generalizing the analysis of the two period litigation to multiperiod litigation is simple, and we therefore omit the proof of the next proposition.\textsuperscript{18} Define the following:

$$\mu^*_n = \frac{c_n}{W}, \quad \mu^*_t = \mu^*_{t+1} \left(1 - \frac{c_t}{W}\right) + \frac{c_t}{W} \text{ for } t = 1, \ldots, n-1$$

Proposition 1a (Multiperiod case). When the defendant privately knows $J$ then in the unique sequential equilibrium the suit is filed if and only if $\alpha > \mu^*_1$ and $c_t < W$ for all $t$.

The multiperiod case allows us to examine the effects of the level of divisibility on the credibility of the plaintiff’s threat to sue. Under symmetric information a suit would be filed whenever the probability that the defendant is liable is positive, $\alpha > 0$, provided that the plaintiff’s costs are sufficiently divided, so that her per-period litigation costs are lower than

\textsuperscript{17} The area under the graph implied by the condition $\alpha \geq (C/W) - (c_1c_2/W^2)$, is $(1 - \alpha)\ln(1 - \alpha) + \alpha$. Dividing by $\alpha^2$ we get the ratio between this area and the respective area when costs are not divisible. This ratio approaches 0.5 as $\alpha$ approaches 0 and it approaches 1 as $\alpha$ approaches 1.

\textsuperscript{18} For the proof see Klement (1999).
As the following proposition demonstrates, this is not true when the defendant privately knows whether he is liable. There is a threshold probability of defendant’s liability below which the plaintiff would not file the lawsuit, even if her costs were infinitely divided.

**Proposition 2.** When the defendant privately knows \( J \) then in the unique sequential equilibrium the suit is filed only if

\[
\alpha > 1 - (1 - \left[C/nW\right])^n > 1 - e^{-C/W}.
\]

Fig. 2 describes the range of suits that may be filed under each of the three configurations—no divisibility, divisibility with symmetric information, and divisibility with defendant’s private information—when costs are infinitely divided. Under no divisibility only suits in the triangle ND are filed. Under divisibility with defendant’s private information suits are filed also in DPI, and under symmetric information all suits are filed.

The assumption that the expected judgment when the defendant is not liable is 0 is not innocuous with respect to this last result. If this assumption were relaxed (so that the non-liable defendant’s expected liability in case of trial would be strictly positive, due, for example, to court error) then sufficient divisibility could lower the plaintiff’s per-period costs to the extent that they would be lower than the lowest possible expected judgment. This would render the plaintiff’s threat to sue credible. Nevertheless, it should be remembered that the level of divisibility is determined by the number of possible negotiations throughout the litigation. Since each such negotiation is costly, it seems reasonable to assume that there is a de facto lower bound on the plaintiff’s per-period costs, and whenever this lower bound is higher than the non-liable defendant’s expected judgment, the above results would still obtain.

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19 In particular, a necessary condition for filing the suit, which is also sufficient if litigation costs are equally allocated among the \( n \) periods, is \( \alpha > [C/nW] \).

20 This case is analyzed in Spier (1992), example 1.
5. Conclusion

Defendants who want to deter small value suits often engage in stonewalling strategies. This paper demonstrated that such strategies may serve to signal the defendant’s private information. As litigation proceeds and more of her settlement offers are declined the plaintiff would be forced to reason that the probability that the defendant is liable is lower than she previously thought. Although divisibility of her costs makes the plaintiff’s cost of proceeding in each litigation stage lower, it also increases the number of such stages, and with it, the number of possible rejections of her offers. If this number is too high, the plaintiff would prefer not to take the risk of running high costs for a low expected judgment, and would therefore not file her suit.

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Appendix A

Proof of Proposition 1. We first describe the sequential equilibrium of this game, and then prove its uniqueness.

In the sequential equilibrium, the plaintiff files the suit if and only if \( \alpha > \mu^*_1 \) and \( c_2 < W \).

In each period the plaintiff offers to settle for \( W \), the non-liable defendant rejects this offer, and if the offer is rejected the plaintiff never drops the suit. In the first period the liable defendant accepts the settlement offer with probability \( a^*_1(W) = (\alpha - \mu^*_1)/\alpha(1 - \mu^*_1) \), and in the second period he accepts the settlement offer with probability \( a^*_2(W, W) = (\mu^*_1 - c_2/W)/\mu^*_1(1 - c_2/W) \). Both defendant types reject any offer higher than \( W \) if it is made by the plaintiff, off the equilibrium path, and the plaintiff proceeds with probability \( 1 \) after such rejection. Any offer \( S_t \in [0, W) \) is accepted with the same probabilities above, but the plaintiff proceeds with probability \( p_t = S_t/W \).

If \( c_2 \geq W \) and the suit is filed, off the equilibrium path, then it is dropped at each period, and it is never settled for more than 0. If \( \alpha \leq \mu^*_1 \), and the suit is filed off the equilibrium path then it is either dropped or settled for 0 in the first period, and if the plaintiff proceeds to the second period off the equilibrium path, the litigants’ strategies are as specified above for the case where \( \alpha > \mu^*_1 \) if \( \alpha \geq c_2/W \), and the case is dropped or settled for 0 if \( \alpha < c_2/W \). It can be easily verified that this is indeed a sequential equilibrium.

To prove uniqueness of this equilibrium we go through the following steps (we simplify notation by letting \( \mu_2 = \mu_2(S_1, S_2), \mu_1 = \mu_1(S_1), p_2 = p_2(S_1, S_2), p_1 = p_1(S_1), a^*_1 = a^*_1(S_1), \) and \( a^*_2 = a^*_2(S_1, S_2) \).
Step 1. If the defendant is not liable then he rejects any positive offer $S_2 > 0$, and therefore, $\mu_2 \leq \mu_1$ whenever $S_2 > 0$.

Step 2. For any second period offer $S_2 \in (0, W)$, it must be that $\mu_2 \leq c_2/W$, with equality if $\mu_1 \geq c_2/W$.

If $\mu_2 > c_2/W$ then the plaintiff proceeds to judgment if the offer is rejected, so $p_2 = 1$. Expecting that, the liable defendant accepts $S_2$, so by Step 1 $\mu_2 = 0$, a contradiction. Therefore, $\mu_2 \leq c_2/W$.

If $\mu_2 < c_2/W$ then the plaintiff drops the suit if her offer is rejected, so $p_2 = 0$, and expecting that, the liable defendant rejects $S_2$. Therefore, if $\mu_2 < c_2/W$ then $\mu_1 = \mu_2$. It follows that $\mu_1 \geq c_2/W$ only if $\mu_2 \geq c_2/W$. This completes the proof of this step.

Step 3. If $\mu_1 > c_2/W$ then the liable defendant must be indifferent between accepting and rejecting any second period offer $S_2 \in (0, W)$.

By Step 2 if $\mu_1 > c_2/W$ then $\mu_2 = c_2/W$, so the liable defendant must accept $S_2$ with probability $0 < a_2^L \leq 1$. Therefore, he must be indifferent between accepting and rejecting it.

Step 4. If $\mu_1 > c_2/W$ then for any second period offer $S_2 \in (0, W)$, $p_2 = S_2/W$ and the plaintiff is indifferent between proceeding and dropping the lawsuit if that offer is rejected.

This follows immediately from Step 3.

Step 5. If $\mu_1 > c_2/W$ then in the second period the plaintiff offers $S_2 = W$, the non-liable defendant rejects this offer, and the liable defendant accepts it with probability $a_2^L = (\mu_1 - c_2/W)/\mu_1(1 - c_2/W)$.

By Step 4, for any second period offer $S_2 \in (0, W)$ the plaintiff is indifferent between proceeding and dropping the suit, so $\mu_2 = c_2/W$. By Bayes law $\mu_2 = (1 - a_2^L)\mu_1/(1 - a_2^L)\mu_1$. Rearranging and substituting $c_2/W$ for $\mu_2$ we get $a_2^L = \mu_1(1 - c_2/W)/(\mu_1(1 - c_2/W))$. The plaintiff’s payoff equals $a_2^L \mu_1 S_2$, which is increasing in $S_2$. Therefore, in equilibrium the plaintiff would not offer $S_2 \in (0, W)$ since she can always gain by raising her offer slightly in this range. The plaintiff would not offer $S_2 > W$ in equilibrium since such an offer would be rejected by the defendant independent of his liability, and the plaintiff’s expected payoff would then be $\mu_1 W - c_2$, which is lower than her payoff if she offers $S_2 \in (0, W)$ sufficiently close to $W$. The plaintiff would not offer $S_2 = 0$ in equilibrium since her expected payoff would be $0$, as the liable defendant would reject such an offer only if he expects the plaintiff to drop the suit afterwards. This leaves only $S_2 = W$ possible in a sequential equilibrium.

Finally, to see that the liable defendant accepts this offer with probability $a_2^L$, notice first that any higher probability of acceptance would not be sequentially rational since then $\mu_2 < c_2/W$, the plaintiff would drop the suit, and the liable defendant would have been better off rejecting the offer. A lower probability of acceptance would also violate sequential rationality, this time the plaintiff’s. Suppose that the liable defendant accepted
\( S_2 = W \) with probability \( a_2^L = \alpha - \delta \), where \( \delta > 0 \). The plaintiff’s payoff would then be \((\alpha - \delta)\mu_1 W\). For any \( \delta > 0 \) there is some \( \varepsilon > 0 \) such that the plaintiff would be better off offering \( S_2 = W - \varepsilon \), and getting \( \alpha - \delta \mu_1 (W - \varepsilon) > (\alpha - \delta)\mu_1 W \). Therefore, \( \delta = 0 \).

**Step 6.** If \( \mu_1 \leq c_2/W \) then the suit is dropped if the first period offer \( S_1 \) is rejected.

Step 1 shows that for any \( S_2 > 0, \mu_2 \leq \mu_1 \). Therefore, if \( \mu_1 < c_2/W \) the suit is dropped in the second period. Expecting that, the defendant refuses any positive settlement offer in the second period, so the plaintiff’s expected payoff if she moves to the second period is 0. If \( \mu_1 = c_2/W \) then by similar argument to the one made in Step 5 the probability of settlement in the second period is 0, so here too the plaintiff’s expected payoff if she moves to the second period is 0.

If \( S_2 = 0 \) then the plaintiff’s expected payoff would be 0, as the liable defendant would reject such an offer only if he expects the plaintiff to drop the suit afterwards. In all these cases the plaintiff is better off dropping the suit if her first period offer is rejected.

**Step 7.** If \( \alpha > \mu_1^* \) and \( c_2 < W \) then in the first period the plaintiff offers \( S_1 = W \), the non-liable defendant rejects this offer, and the liable defendant accepts it with probability \( a_1^L = (\alpha - \mu_1^*)/(\alpha(1 - \mu_1^*)) \). Otherwise, the suit is not filed.

By Steps 5 and 6 the plaintiff’s expected payoff if she proceeds to the second period is \((\mu_1 W - c_2)/(1 - c_2/W)\) if \( \mu_1 > c_2/W \) and it is 0 otherwise. The rest of the proof follows similar arguments to the ones used in Steps 1–6.

**Proof of Proposition 2.** We first prove that for any total cost \( C \) and any number of litigation periods \( n \), \( \mu_1^* \) is minimized when litigation costs are equally divided among the \( n \) periods. We prove this by induction. Suppose first that \( n = 2 \). Then without loss of generality litigation costs in periods 1 and 2 are given by \( c_1 = (C/2) + k \) and \( c_2 = (C/2) - k \). By Proposition 1, \( \mu_1^* = (C/W) - [(C^2 - 4k^2)/4W^2] \), which is minimized by \( k = 0 \). Notice that the order of litigation costs (or, alternatively, whether \( k \) is positive or negative) does not change \( \mu_1^* \) even when costs are not equally divided. It can be similarly verified that for any number of periods \( n \), \( \mu_1^* \) would not depend on the order of the plaintiff’s litigation costs.\(^{21}\)

Now suppose that the claim is true for \( n = m \), and prove that it must also hold true for \( n = m + 1 \). By the induction assumption (given the plaintiff’s costs in the first period \( c_1 \)) \( \mu_1^* \), and therefore \( \mu_1^* \), too, are minimized among all possible distributions of the plaintiff’s litigation costs in the last \( m \) periods, \( C - c_1 \), when those costs are equally divided. Let \( \Delta^* = c_1 - (C - c_1)/m \) be the difference between the plaintiff’s costs in the first period and her per-period costs in the next \( m \) periods when these costs are equally divided. Now change the order of costs between the first and second periods. This does not affect \( \mu_1^* \). Again, \(^{21}\) Suppose \( n > 2 \). Take any two periods, \( t - 1 \) and \( t \), let \( D = c_t + c_{t-1} \), and let \( k = D/2 - c_t \). Clearly, \( \mu_{t+1}^* \) is not affected by the order of costs in periods \( t \) and \( t - 1 \). Similarly, the only effect this order may have on \( \mu_1^* \) is through its effect on \( \mu_{t+1}^* \). Using Proposition 1 a it can be verified that \( \mu_{t+1}^* \) depends only on \( k^2 \) and not on \( k \) and therefore it does not depend on the order of costs between the two periods. Finally, any ordering of the \( n \) per-period litigation costs can be obtained by a sequence of changes in two consecutive periods, without affecting \( \mu_1^* \).
equally divide the plaintiff’s costs in the last \( m \) periods, reducing \( \mu^*_1 \) and consequently \( \mu^*_2 \); and let the costs in the first period be \( c'_1 \). It can be verified that now, after redefining litigation costs in every period, the difference between the plaintiff’s costs in the first period and her per-period costs in the next \( m \) periods equals \(-(\Delta^*)/m\). Repeating these steps \( i \) times and redefining \( c'_1 \) in every such iteration we get \(|c'_1 - [(C - c'_1)/m]| = |(\Delta^*)/m^i|\) and therefore \( \lim_{i \to \infty} |c'_1 - [(C - c'_1)/m]| = 0 \). Since \( \mu^*_1 \) decreases in each such iteration, it is minimized when litigation costs are equally divided among the \( n = m + 1 \) periods.

By Proposition 1a, it can be easily verified that when costs are equally divided \( \mu^*_1 = 1 - (1 - [C/nW])^n \). This expression is decreasing in \( n \) whenever \((C/nW) < 1\). It is also easy to verify that \( \lim_{n \to \infty} \mu^*_1 = 1 - e^{-C/W} \). Therefore, the suit is filed only if \( \alpha > 1 - (1 - [C/nW])^n > 1 - e^{-C/W} \).

\[ \square \]

References