# Trial Incentives in Sequential Litigation

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**Abstract**

We analyze when and why trials can emerge in equilibrium when a defendant may sequentially face multiple plaintiffs. Subsequent potential plaintiffs learn about their chances of winning from the initial trial outcome. An initial trial serves as an experiment that the defendant can run to induce plaintiffs' learning. The initial case may go to trial when a favorable trial outcome for the defense can deter potential future plaintiffs from filing lawsuits. Possible *future* meritless lawsuits further raise the attraction of an initial trial. We show how outcomes are affected if the initial plaintiff's attorney may represent future clients, and hence also values learning, and derive the impact of the plaintiff's bargaining power.

Keywords: Trial, Settlement, Learning, Sequential Litigation.

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# 1 Introduction

When and why do litigating parties go to trial? Given the high costs associated with trials, it would seem to be in the mutual interest of a plaintiff and defendant to reach a settlement that obviates the need for a trial that seems to destroy so much surplus. Researchers have offered many explanations for why the litigating parties fail to settle and go to trial despite the large potential cost savings, including prediction mistakes, asymmetric information and multiple-litigant externalities.[1] In this paper, we consider a setting where none of the forces identified in the literature are present, in order to highlight how sequential litigation incentives can cause litigating parties to go to trial due to learning induced by the trial and the possibility of avoiding future pre-trial costs.

Our contribution is to characterize when and why trials emerge in equilibrium in settings where a defendant may sequentially face multiple plaintiffs. Sequential litigation is a central feature of many product liability, personal injury, and environmental pollution legal cases, where multiple plaintiffs may have been injured by the same defendant, and they become aware of the damage, or become capable of filing lawsuits, at different points in time. A RAND corporation analysis of product liability cases, Dungworth (2007), finds that asbestos litigation went from just over 1% of the total federal caseload in 1976 to 44% of all federal product liability cases in 1986. "The growth coincided with the increasing numbers of punitive damage awards made in ... courts, and it seems likely that the filing level was stimulated by [learning about] these earlier plaintiff successes." The study also finds that most product liability cases are concentrated on a few defendants in those industries prone to product liability cases (e.g., pharmaceutical or motor vehicle industries).[2]

Sequential litigation has several distinctive features that are important to integrate and understand. First, there is a positive correlation between the trial outcomes of the initial lawsuit and subsequent ones the lawsuits go to trial. This positive correlation emerges naturally—courts may follow precedents established in the initial trial, the culpability or vulnerability of the same defendant or the legal strategies that work against the same defendant. Second, plaintiffs learn due to the correlation: the plaintiffs will use the trial outcome—whether the defendant wins or loses, or how much the initial plaintiff receives—to update about the likely outcomes if their cases go to trial.

A defendant understands how plaintiff's learning from the initial case affects the future costs and settlement amounts in subsequent possible lawsuits. When deciding whether to settle or go to trial, a defendant internalizes the effects of a trial on (a) future decisions by possible plaintiffs to file lawsuits, (b) future settlement outcomes, and (c) future trial outcomes. Going to trial represents a gamble not

[1] We will review the literature in detail later in the introduction.

[2] See Rosenberg (2002) or Che and Yi (1993) for more examples of sequential lawsuits.

only over current payouts, but also over the future numbers of plaintiffs, levels of future settlements and future legal costs. The defendant understands that a successful trial outcome may deter subsequent entry. The question becomes: when does a defendant have an incentive to take this complex trial gamble rather than to settle?

We show that to understand when sequential litigation can lead to trials, it becomes vital to distinguish between pre-trial costs and trial costs. Trial costs can be avoided by settling a case, but pre-trial costs must be incurred even prior to any settlement. In practice, most litigation expenses involve discovery and experts, and are incurred prior to a trial.[3] For example, an expert devotes most of his or her time to a review of case materials, report preparation and pre-trial deposition. These discovery and expert costs far outweigh the trial costs that can be avoided by a settlement. If there is only a single plaintiff—in a "one-off" case that has no bearing on other cases—pre-trial costs, although large, are effectively sunk costs that have no impact on decisions of whether to settle or go to trial, and hence can be ignored by a researcher since only potential trial costs enter settlements. This ceases to be true in sequential litigation. As a result, the (large) *potential* pre-trial costs of *future* litigation enter a defendant's decision of whether to settle the first case or take it to trial.

Plaintiff learning screens out those plaintiffs who will not gain from future litigation after a defendant-win, but who would enter if the initial case is settled without information about their prospects being revealed. The presence of such plaintiffs absent the learning induced by a trial *reduces* the amount a defendant must pay to settle future cases. This force favors settling the initial lawsuit, making it all the more interesting to explore and understand when a defendant wants to take the initial lawsuit to trial in equilibrium.[4]

In sequential litigation, one should also account for the prospective impact of meritless cases, i.e., of cases that have a surface appearance of those with merit, but whose lack of merit would be revealed at trial. Initial trial outcomes serve to spread beliefs about the prospects of future serious cases, and this feeds back to affect the number of meritless cases a defendant may have to confront.

We build a simple two-period model of sequential litigation to get at these issues. The first period corresponds to the first date at which a plaintiff realizes that he has a case against the defendant that has sufficient merit to make filing a lawsuit worthwhile (i.e., the expected payment to the plaintiff covers any pre-trial and trial costs that might be incurred). There is *no* asymmetric information between the defendant and the plaintiff: they share the same prior belief about their prospects. The second period telescopes into a single period all future cases whose trial outcomes may be correlated with that of the

[3] Final Colorado Civil Access Pilot Project Overview 8-31-11, Website of the Colorado Supreme Court.

[4] This extra incentive to settle due to the sequential litigation is also present in Wickelgren (2013).

initial case. To make the analysis transparent, we assume that the payment the defendant must make to a plaintiff who wins at trial is known: the sole source of uncertainty concerns *whether* a plaintiff would win a trial. To highlight how learning by potential future plaintiffs can lead to trials, we first assume away both meritless lawsuits and any stake the initial plaintiff's attorney may have in future cases.

We identify conditions under which plaintiffs' learning leads to trials in the initial lawsuit. We prove that for the initial lawsuit to go to trial despite the symmetric information that litigants hold, (a) an initial win by the defense must cause future potential plaintiffs to update sufficiently negatively about their prospects that they do not file lawsuits, (b) an initial settlement, which does not alter beliefs of future plaintiffs, must not deter future potential plaintiffs, and (c) the savings from deterring future lawsuits for the defendant must exceed the combined initial trial costs of the plaintiff and defendant. This logic is encapsulated in an assessment by a Janney Capital Market Analyst following a victory in court by Intuitive Surgical, a defendant in a negligence case: "The victory [could] deter additional suits...[and] turn some cases into quick settlements." (Joseph Walker, Dow Jones Business News, May 23, 2013).

These conditions highlight how the central features of sequential litigation can lead to trials:[5] condition (a) is easier to satisfy when future outcomes are more closely tied to the outcome of the initial trial—with a stronger desire of courts to follow precedent or greater similarities among plaintiffs, there is a greater reduction in the winning probability a plaintiff expects in a future trial following an initial win by the defense; and condition (c) becomes easy to satisfy when there are many possible future cases, so that the defendant's savings from deterring future lawsuits are larger.

We then observe that while the conditions under which a trial occurs are quite plausible, they are also demanding. In particular, the payment to a winning plaintiff cannot be so high that a plaintiff-loss in the initial trial fails to deter subsequent plaintiffs from filing lawsuits; but the payment to a winning plaintiff also cannot be so low that an initial settlement would deter subsequent plaintiffs from filing. Of course, the fact that it was worthwhile for the initial plaintiff to file suggests that the expected payment is high enough, as subsequent plaintiffs likely face lower costs. Finally, even if these two conditions are satisfied, it still might not be in the interest of a defendant to take the first case to trial—the gains from possibly deterring future lawsuits must exceed the initial trial costs. In particular, there *must* be substantial savings in pre-trial costs associated with future litigation for the initial trial even to be able to reduce the expected payout in future litigation.[6]

We next introduce the possibility of meritless lawsuits—cases that have no chance of winning in

[5] Our benchmark of no sequential litigation is one where all cases settle in the initial lawsuit: under symmetric information the parties settle to save the trial costs.

[6] If a plaintiff has enough bargaining power, trials can emerge even when his pre-trial costs are zero.

a trial, but, due to their similar appearances to legitimate cases, may be settled by a defendant. We identify two ways in which the possibility of future meritless cases increases the circumstances under which a defendant takes the initial case to trial. First, a trial that deters future plaintiffs with serious cases also deters plaintiffs with meritless cases. Second, even when a trial does not deter future serious cases from being filed, it can still reduce the expected payout in future meritless cases: information revealed by the initial trial helps the defendant because her expected payout to meritless cases is a concave function of the probability that a future plaintiff with a serious case will win. Most clearly, with a large pool of possible future meritless cases, to deter meritless lawsuits, a defendant adopts a mixed strategy of sometimes going to trial in the future, and, to preserve the defendant's indifference, fewer meritless cases must be filed when legitimate cases are stronger.

**The Literature.** Researchers have identified other reasons for why litigating parties can fail to settle.[7] For example, trials can result when the litigating parties have different priors, or have a desire for vindication, or are overly-optimistic (Gross and Syverud 1991, 1996, Hay and Spier 1998, Daughety 2000, or Daughety and Reinganum 2005). This source of trials is absent in our model because the litigating parties share a common prior about the likelihood of a defendant-win. Trials can also emerge if one litigating party has private information (Reinganum and Wilde 1986 build a signaling model where the informed party makes a settlement offer; Bebchuk 1986 and Spier 1992 build screening models where the informed party receives a settlement offer).

Several papers explore trial/settlement incentives in lawsuits where parties are asymmetrically informed and there can be subsequent lawsuits. Briggs et al. (1996) consider a privately-informed defendant, showing that the existence of future cases raises a guilty defendant's incentive to pool with non-guilty types. This causes an initial plaintiff to reject more settlement offers, so more cases go to trial. Yang (1996) considers privately-informed plaintiffs, where, with correlation in plaintiff types, an uninformed defendant may want to learn about future plaintiffs via an initial trial. In Che and Yi (1993), cases are connected by a court's practice of following precedent. In their model, a defendant makes screening offers to a sequence of *exogenously*-arriving, privately-informed plaintiffs and a defendant has an incentive to set a precedent via trial. Learning takes a different form: the privately-informed plaintiffs learn nothing, but the defendant learns about damage awards to future successful plaintiffs via the correlation in damages. In our setting, the endogeneity of plaintiff entry is central—plaintiffs learn about the probability of winning and use that information to decide whether to file a case—and this drives trials in our base framework. In contrast, in Che and Yi (1993), entry is exogenous, and trials help a defendant to learn or to turn a weak plaintiff (a nuisance case) into a favorable precedent. We also consider meritless cases. However, they matter for very different reasons: they

[7] See Hay and Spier (1998), Daughety (2000), or Daughety and Reinganum (2005) for reviews.

cannot serve as precedent for serious cases, but since a defendant cannot distinguish a meritless case from a serious one without incurring trial costs, to the extent that a meritless plaintiff's willingness to file depends on the expected settlement and the probability of going to trial, the defendant internalizes them when deciding whether to take the initial case to trial.

In contrast to this literature, in our analysis, the *initial* plaintiff and defendant share the same information—our focus is on identifying the conditions under which a defendant wants to experiment by going to trial in order to induce common learning by future plaintiffs. Even when we introduce meritless cases, so that future plaintiffs have private information about whether their cases have merit, we maintain the assumption that the litigating parties in the initial lawsuit are symmetrically informed. We then show that this possibility of *future* meritless cases further enhances a defendant's incentives to induce common learning by taking the *initial* case to trial.

Hua and Spier (2005) also study learning in sequential litigation. They show that the existence of potential future defendants who may harm the same plaintiff can lead to more trials because the plaintiff may want to generate information that induces future potential defendants to exercise caution. The paper closest to ours is Wickelgren (2013). He also studies settlement/trial decisions when one defendant may face future plaintiffs who can learn from the initial lawsuit. There are two key differences between his paper and ours: (a) Wickelgren introduces asymmetric information in the initial lawsuit, so that in the benchmark of no sequential litigation, the case sometimes goes to trial; and (b) Wickelgren does not allow for pre-trial litigation costs. Because of this, sequential litigation does not provide incentives to go to trial. In fact, absent pre-trial litigation costs, Wickelgren (2013) shows that sequential litigation can turn trials into settlements; while we show that large pre-trial litigation costs can turn settlements into trials.

Other externalities between litigating parties can also lead to trials. Kornhauser and Revesz (1994a, b) consider two defendants facing one plaintiff when defendants share liability due to joint and several liability. One defendant's settlement raises the remaining defendant's expected liability, which allows the plaintiff to raise its settlement demand, leading to trials. Spier (2002) considers two plaintiffs facing one defendant, where a defendant-loss may result in bankruptcy. With high correlation between cases, if one plaintiff settles, the other expects to get more, making it expensive to settle, leading to trials. Meurer (1992) and Sykes (1994) show that liability insurance can lead to trials because it delegates decisions to insurance companies, which rationally refuse to pay as much as a defendant would pay absent the insurance. Spier and Sykes (1998) show how a corporate defendant's debt can lead to trials because shareholders become tougher bargainers when a judgement is partially borne by debtholders in bankruptcy. Our model builds in none of these sources of trials.

Cases may also be connected in ways other than a positive correlation in trial outcomes, for example, by confidential agreement (Daughety and Reinganum 1999, 2002), economy of scale (Daughety and Reinganum 2011, Che and Spier 2007), a "Most-Favored-Nation" clause (Spier 2003a, 2003b, and Daughety and Reinganum 2004).

Our paper is also related to the literature on negative expected value (NEV) suits (see Schwartz and Wickelgren (2009) for a review). Meritless cases are an extreme form of NEV suits: they have no chance of winning, so litigating them has a strictly negative expected value due to the positive litigation costs. As Bebchuk (1998) and Katz (1990) argue, when NEV suits cannot be distinguished from positive expected value (PEV) suits, a defendant may settle NEV suits.

Our paper is organized as follows. Section 2 develops our base model, exploring when a defendant can gain from trial due to the learning by subsequent potential plaintiffs about the likelihood of success. Section 3 introduces meritless cases. Section 4 discusses the robustness of our findings. Section 5 concludes. All proofs are in an appendix.

# 2 Base Model

Our two-date model features a single defendant $D$ who faces a sequence of potential plaintiffs who may have been damaged by $D$. All parties—defendant, plaintiffs and lawyers—are risk neutral, and there is no discounting. Date 1 corresponds to the moment at which the first plaintiff, $P_1$, realizes that he has been injured, and that the expected award from a lawsuit may be sufficient to compensate for the costs of pursuing the lawsuit. We collapse the arrival of all subsequent potential plaintiffs, whose trial outcomes are correlated with the outcome of the initial case, into date 2. Specifically, at date 2, independently of date-1 litigation outcomes, $N_2$ potential plaintiffs realize that they also have been injured.[8] Our primary focus is on a defendant's interaction with the very first plaintiff, and our qualitative findings do not change if date-2 litigants arrive sequentially, although the analysis becomes tedious. We describe future plaintiffs as "potential" because an injured party will choose not to bring a lawsuit against $D$ if the expected costs outweigh the expected benefits. We refer to the defendant as "she" and each plaintiff as "he", and use $P_2$ to describe a representative date-2 plaintiff.

As in Spier (2002), we build all relevant uncertainty into the probability that a plaintiff wins. Thus, trial outcomes are binary, either a plaintiff-win or a defendant-win. A date-$t$ plaintiff who wins at trial receives $m_t > 0$, where we allow the possibility that $m_1 \neq m_2$. The probability that any given plain-

[8]In contrast, Daughety and Reinganum (2002) investigate the role of a trial to create awareness, where an injured party's probability of realizing that he is injured depends on the previous litigation outcomes.

tiff wins at trial is $\pi \in [0, 1]$. Trial outcomes are positively correlated, with correlation coefficient $\rho \in (0, 1)$. Consequently, if the initial case goes to trial, the verdict provides subsequent plaintiffs information about their chances. Following a date-1 plaintiff-win, a date-2 plaintiff updates to believe that he will win with probability $\overline{\pi} = \pi + \rho(1 - \pi)$; and following a date-1 plaintiff-loss, a date-2 plaintiff updates negatively to believe that he will win with only probability $\underline{\pi} = (1 - \rho)\pi$. When trial outcomes are perfectly correlated, $\overline{\pi} = 1$ and $\underline{\pi} = 0$; and when trial outcomes are independent, $\overline{\pi} = \underline{\pi} = \pi$. The positive correlation in trial outcomes emerges naturally in sequential litigation for many reasons—courts may follow precedents established in the initial trial, and the culpability or vulnerability of the defendant are similar across cases, or the characteristic of the plaintiffs are similar as well. As a result, this positive correlation is often high.

If a plaintiff files a case, then it either (a) is settled out of court with the plaintiff accepting the defendant's take-it-or-leave-it settlement offer,[9] (b) is withdrawn by the plaintiff, or (c) goes to trial.[10]

We denote date-$t$ pre-trial costs by $k_{pt} \geq 0$ and $k_{dt} \geq 0$ for the plaintiff and defendant respectively. These are costs that have to incurred if an plaintiff files a lawsuit. If a lawsuit goes to trial, the date-$t$ parties incur additional trial costs of $c_{pt} \geq 0$ and $c_{dt} \geq 0$ respectively. A plaintiff's net payoff is zero if he does not file, and it is any payment from the defendant less his litigation costs if he files. The defendant's payoff is her initial wealth $W$ less any payments made to plaintiffs and litigation costs incurred. We assume that the defendant is wealthy enough that there are no bankruptcy concerns.[11] It eases presentation to describe the defendant's payoffs as net of her initial wealth. Recalling the definition of date 1 as the first moment at which a serious plaintiff found it worthwhile to file a lawsuit, there is an implicit premise that the potential gains to the plaintiff from filing exceed the costs, i.e., $\pi m_1 \geq c_{p1} + k_{p1}$. This admits the possibility that the first case is in some way "unusual".

The timing is as follows: (1) Date 1: $P_1$ files a lawsuit. (2) $D$ makes a take-it-or-leave-it settlement offer $s_1 \in [0, \infty)$ to $P_1$. (3) $P_1$ chooses whether to withdraw the case, accept the offer, or reject the offer. If $P_1$ accepts the offer, he is paid $s_1$. If $P_1$ rejects the offer, the case goes to trial. (4) The date-1 trial outcome is realized and payment is made. (5) Date 2: All date-2 plaintiffs observe date-1 outcomes and decide whether to enter. (6) $D$ makes take-it-or-leave-it settlement offers $s_2 \in [0, \infty)$ to date-2 plaintiffs who file. (7) Each date-2 plaintiff chooses whether to withdraw his case, accept

[9] One can show that our qualitative findings are unchanged if plaintiffs have more bargaining power.

[10] We allow the plaintiff to withdraw a negative expected value lawsuit to ensure that a plaintiff who has a meritless case cannot simply enter with a commitment to go to trial if there is no settlement and thereby extort money from a defendant. See Rosenberg and Shavell (1985) and Bebchuk (1988).

[11] Bankruptcy concerns (e.g., with asbestos litigation) create incentives for a defendant to go to trial in the first litigation because the limited liability bounds her downside risk. We ignore this occasionally important, but well-studied (Spier 2002), incentive to go to trial, in order to focus on other strategic incentives to go to trial in sequential litigation.

the offer, or reject the offer. A plaintiff who accepts the offer is paid $s_2$. Date-2 cases that are not settled or withdrawn go to trial. (8) Date-2 trial outcomes are realized and payments are made. Figure 1 shows the timing.

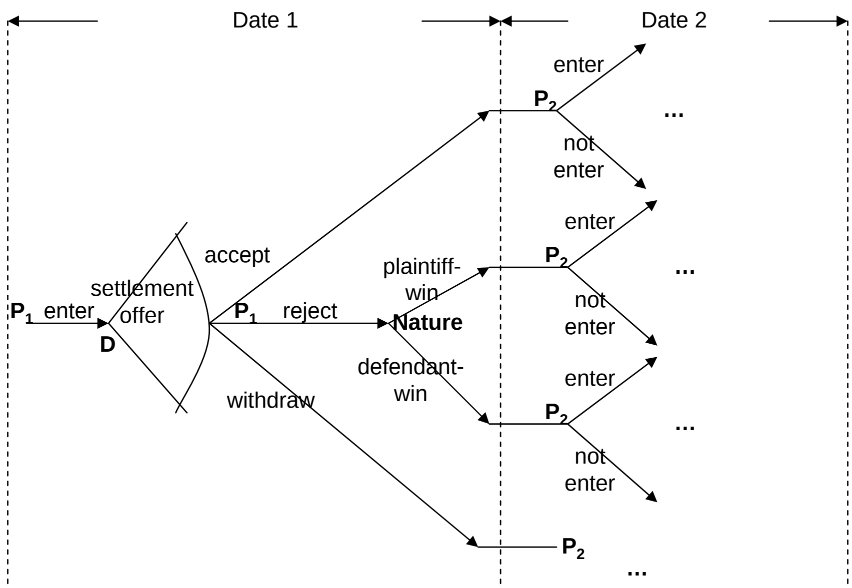


Figure 1: Timing of the game

We analyze the Perfect Bayesian Equilibrium of this game. Since the defendant makes take-it-or-leave-it offers, in equilibrium a plaintiff must always accept an offer when indifferent between accepting or not, since an infinitesimally higher settlement offer would break the indifference. To ease exposition, we assume that when indifferent between entering and not, a plaintiff chooses not to enter. This allows us to make "if and only if" statements.

As a benchmark, suppose that date-1 and date-2 litigations are not correlated: any trial results in a plaintiff-win with independent probability $\pi$. With nothing to link lawsuits, the symmetric information between the two litigating parties in a case then directly results in all cases being settled.

Now suppose that trial outcomes are positively correlated. To solve for equilibrium outcomes, we use backward induction. The probability that a date-2 plaintiff wins can depend on the outcome of date-1 litigation. Denote the posterior probability that a date-2 plaintiff wins by $q$. Since both $D$ and $P_1$ have no private information, neither a date-1 settlement nor a withdrawal of a suit by $P_1$ conveys information to potential date-2 plaintiffs about their probabilities of winning in trial, so following either of these outcomes, their posteriors remain $q = \pi$. In contrast, a date-1 trial serves as a test or signal that conveys information to potential date-2 plaintiffs: following a plaintiff-win, their posteriors optimistically rise to $\overline{\pi}$; but following a defendant-win, their posteriors pessimistically fall to $\underline{\pi}$.

By the Law of Iterated Expectations, $\pi\overline{\pi} + (1-\pi)\underline{\pi} = \pi$. Thus, at date 2, $q \in \{\overline{\pi}, \pi, \underline{\pi}\}$. We begin with a preliminary result establishing that once learning about trial outcomes has occurred, all cases will be settled.

**Lemma 1.** *Date-2 plaintiffs enter if and only if $qm_2 > k_{p2} + c_{p2}$. Along the equilibrium path, after entry, $D$ settles every date-2 case by offering each date-2 plaintiff $qm_2 - c_{p2}$.*

This lemma conveys how and when the outcome of the initial litigation affects decisions by future potential date-2 plaintiffs on whether or not to file lawsuits.

**Proposition 1.** *An initial trial reduces the expected settlement payment to future plaintiffs (relative to the payment following an initial settlement) only if $k_{p2} > 0$.*

The intuition is that in the absence of learning, the plaintiff's settlement will weight the plaintiff's reservation value both when it is positive and when it is negative, but with learning the negative part is replaced with zero, which raises the total expected settlement. Hence, when $k_{p2} = 0$, allowing the plaintiff to learn and self select to enter hurts the defendant.

Next consider $k_{p2} > 0$. Now a defendant-win can deter date-2 plaintiffs who would extract positive settlements from the defendant were they to enter, but these future settlements would not be large enough to cover their pre-trial costs of $k_{p2}$. When this happens, expected future settlement payments are reduced by spreading beliefs via a date-1 trial.

The precise necessary and sufficient conditions for an initial trial to reduce expected payments to future plaintiffs are the following:

1. Future lawsuits can be deterred, but only if the defendant wins the initial trial: $\underline{\pi} m_2 \le k_{p2} + c_{p2} < \pi m_2$.
2. The deterred future plaintiffs would have been able to extract a positive settlement by entry: $\underline{\pi} m_2 - c_{p2} > 0$.[12]

Clearly, if $k_{p2} = 0$ then Conditions 1 and 2 cannot both hold.

To illustrate the impact of *future* plaintiffs' pre-trial costs, consider the following numerical example: (a) the probability of winning for the initial case is 0.5 and the correlation with subsequent cases is 0.4. This means that following a defendant-win, a future plaintiff wins with probability 0.3, and following a plaintiff-win, the future plaintiff wins with probability 0.7; and (b) a date-2 plaintiff has a

[12] This condition comes from $\pi(\overline{\pi} m_2 - k_{p2}) < \pi m_2 - k_{p2}$.

pre-trial cost of \$2,200 and trial cost of \$2,000, while the defendant has no cost. If the initial lawsuit settles, the expected settlement offer to a future plaintiff is \$5,000 - \$2,000 = \$3,000. Since this exceeds the pre-trial cost of \$2,200, a future plaintiff will enter after an initial settlement and receive this offer. If, instead, the initial lawsuit goes to trial, then future outcomes hinge on the verdict. After a plaintiff-win and entry, the expected future settlement offer is 0.7 × \$10,000 - \$2,000 = \$5,000. After a defendant-win and plaintiff entry, the expected settlement offer is 0.3 × \$10,000 - \$2,000 = \$1,000. But, this is less than a plaintiff's pre-trial costs, so the plaintiff will not enter after a defendant-win in equilibrium. Integrating over possible initial trial outcomes, the expected payment to a future plaintiff is 0.5 × \$5,000 + 0.5 × \$0 = \$2,500, which is less than \$3,000, the expected payment after an initial settlement. This example illustrates how, with positive pre-trial costs for future plaintiffs, an initial trial can reduce the future payments a defendant expects to make to plaintiffs.

If one goes a step further to consider a defendant's preference over an initial trial vs. settlement, it is easy to see that positive future pre-trial costs of the *defendant* further favor an initial trial because deterring future plaintiffs allows the defendant to save on pre-trial costs. Proposition 2 gives the full necessary and sufficient conditions for the initial lawsuit to go to trial:

**Proposition 2.** *In equilibrium, the initial case goes to trial if and only if the following conditions on the date-2 litigation both hold:*

1. *Future lawsuits can be deterred, but only if the defendant wins the initial trial:* $\underline{\pi} m_2 \leq k_{p2} + c_{p2} < \pi m_2$*,*
2. *The benefits to the defendant from possibly deterring date-2 lawsuits outweigh the extra date-1 trial costs:* $(1 - \pi)(\underline{\pi} m_2 - c_{p2} + k_{d2})N_2 > c_{p1} + c_{d1}$.

Condition 1 says that for subsequent trials to be deterred, a defense victory must cause subsequent plaintiffs to revise beliefs downward by enough that they switch from wanting to file suits to refraining. Condition 2 reflects that the benefit of deterring entry is derived from those plaintiffs whose beliefs are revised downward to $\underline{\pi}$ following a defendant-win.

Proposition 2 shows that a defendant's incentive to take the initial case to trial does not rise monotonically with the future litigation stakes, $m_2$. The future stakes must be high enough to make it worthwhile for $D$ to deter future plaintiffs from filing (Condition 2), and they must be high enough that a settlement does not deter date-2 plaintiffs from entering. However, the stakes cannot be so high that future plaintiffs still want to go to trial even if the defendant wins the initial trial.

Relatedly, a defendant's incentive to take the initial case to trial is not monotone in the prior, $\pi$. From Condition 1, if the prior that a plaintiff will win is too high, the defendant cannot deter future plaintiffs; and conversely, if $\pi$ is too low, then a defendant need not go to trial to deter future plaintiffs. There is also an important subtlety in how the prior enters Condition 2: A higher $\pi$ implies that deterring entry is more difficult as $\underline{\pi}$ is higher; but conditional on deterring entry, a higher $\pi$ means that the defendant saves more from deterring entry (as the settlement payment upon entry would have been higher).

As the following corollary summarizes, a defendant can gain from deterring date-2 plaintiffs for two reasons: (1) $D$ saves by not incurring pre-trial cost $k_{d2}$, and (2) it may reduce the expected settlement payment to date-2 plaintiffs who face positive pre-trial costs $k_{p2}$.

**Corollary 1.** *The initial lawsuit goes to trial only if $k_{p2} > 0$ or $k_{d2} > 0$.*

Importantly, the circumstances under which the initial case goes to trial grow with the two central features of sequential litigation: (1) the number $N_2$ of subsequent cases whose trial outcomes would be affected by the initial trial outcome, and (2) the extent to which trial outcomes are correlated. That is, the larger is $N_2$, the greater is a defendant's gain from deterring future lawsuits; and the greater is the correlation in trial outcomes, the more negatively plaintiffs update following a defendant-win, spreading the difference in beliefs $\pi - \underline{\pi}$ about future trial outcomes following a settlement versus a defendant-win, making it "easier" for a defendant-win to deter entry. A caveat to this observation is that increased correlation in trial outcomes also reduces the benefit that the defendant derives from actually deterring entry (i.e., Condition 2 is harder to satisfy). However, when $N_2$ is large enough, the savings from deterring entry exceed the costs of a single trial, so the crucial condition becomes the ability of the defendant to deter future plaintiffs with a defendant-win.

The conditions under which substantial learning in sequential litigation causes the initial case to go to trial are quite plausible. In particular, with many future potential plaintiffs, the savings on future pre-trial costs can easily be more than enough to cover the costs of a single trial. Nonetheless, there is a limited extent to which learning on its own can lead to trials. First, only a limited set of combinations of the prior $\pi$, the correlation coefficient and trial stakes $m_2$ causes future potential plaintiffs to be deterred by a defendant-win, but *not* by a settlement. Second, when the correlation is high, after a defendant-win, it is unlikely that the deterred plaintiffs would have been able to extract a positive settlement payment by entry ($\underline{\pi}$ is low so $\underline{\pi} m_2 - c_{p2}$ is low) and when the correlation is high, the defendant's pre-trial costs are likely to be low as most discovery was already done in the first litigation ($k_{d2}$ is low). This makes Condition 2 in Proposition 2 harder to satisfy. We next consider how potential meritless cases at date-2 affect the settlement versus trial decision at date-1.

# 3 Meritless Cases

In this section, we allow some future plaintiffs to have meritless cases. That is, they know that they have no chance of winning if they enter, but their cases cannot be distinguished from a serious case (those with positive chances of winning) unless they go to trial. This introduces asymmetric information between the defendant and plaintiffs at date-2. Reflecting the standard intuition that it is sometimes in the interest of a defendant to go to trial to screen out privately-informed plaintiffs with low chances of winning, date-2 trials can emerge in equilibrium. Our primary objective, however, is to understand how this information asymmetry at *date-2* affects trial versus settlement decisions at *date-1* where the defendant and the initial plaintiff share the same information.

We first show how meritless cases at date 2 can give rise to trials at *date 2* (Lemma 2 below). We then show how such date-2 meritless cases increase the circumstances under which the initial date-1 case, which is *known* to have merits, goes to trial. In part, this reflects that a date-1 win by a defendant that deters future plaintiff cases with merits, also deters future meritless cases. More subtly, expected payouts to future plaintiffs can be a concave function of date-2 beliefs about the probability of a plaintiff-win by a serious case due to the endogenous decisions to file meritless lawsuits. This creates an added incentive for a defendant to spread beliefs by going to trial at date 1.

We modify our base-case model so that there is now a potential supply $FN_2$ of meritless cases at date 2. These are cases that have a surface similarity with serious cases, but their lack of merit would be revealed in a trial. Our base-case scenario corresponds to $F = 0$. Meritless cases incur the same litigation costs as serious ones. The sole difference is that meritless cases never win in court.[13] A plaintiff knows whether his case has merits, but the defendant does not. To ease analysis, we assume that the defendant's strategy at date 2 is a mapping from the posterior to a settlement offer—the defendant does not condition date-2 decisions on the number of cases filed.[14] Our analysis ignores the three hairline parameter cases, $\pi m_2 = c_{p2} + k_{p2}$, $\underline{\pi} m_2 = c_{p2} + k_{p2}$ and $\overline{\pi} m_2 = c_{p2} + k_{p2}$, to avoid having to analyze uninteresting subgame equilibria that only exist in these hairline cases. Our maintained

[13]We focus on cases that have no chance of winning instead of just ones that have a negative expected value (NEV) because we want to highlight the impacts of the mixed entry strategy of future plaintiffs on the initial case. In the Extension, we discuss that if some future plaintiffs may be encouraged by a plaintiff-win (which by definition means that they are NEV plaintiffs absent the trial information, but are not meritless cases), there is a disincentive for the initial case to go to trial. This effect is orthogonal to the one we identify here.

[14]This is only relevant in the range characterized by a mixed strategy equilibrium, where the number of cases conveys information about the realized number of meritless cases filed. An equilibrium exists in which the number of meritless cases filed never differs by more than one. If $N_2$ is re-interpreted as an ex-ante expected number of serious date-2 cases, none of our other analysis is altered, and the total number of cases can convey arbitrarily little information about the number of meritless cases filed, and hence have arbitrarily little effect on a defendant's behavior. We ignore this for simplicity, as it does not qualitatively affect date-1 decisions to go to trial.

assumption is that the very first case has merits.

We next characterize date-2 litigation outcomes when the posterior probability that a serious case wins in court is updated to $q$ following date-1 litigation outcomes.

**Lemma 2.** *(1) If $qm_2 > c_{p2} + k_{p2}$ and $F > \frac{c_{p2}+k_{p2}}{qm_2 - c_{p2}}$, then in the date-2 subgame, the defendant's equilibrium payoffs are unique. All plaintiffs with serious cases file, and the expected number of meritless lawsuits is $\frac{c_{p2}+c_{d2}}{qm_2 - c_{p2}} N_2$. To any plaintiff that files, $D$ offers a settlement $qm_2 - c_{p2}$ with probability $\frac{k_{p2}}{qm_2 - c_{p2}}$ and goes to trial with the complementary probability.*

*(2) If $qm_2 > c_{p2} + k_{p2}$ and $F \leq \frac{c_{p2}+k_{p2}}{qm_2 - c_{p2}}$, then in the unique date-2 subgame equilibrium, all plaintiffs file lawsuits, regardless of their merits. $D$ offers $qm_2 - c_{p2}$ to settle each lawsuit.*

*(3) If $qm_2 < c_{p2} + k_{p2}$, plaintiffs do not file lawsuits at date 2.*

In part (1) of Lemma 2 where there are many potential meritless cases, the mixed strategy equilibria reflect the "matching pennies" nature of the game. If too many meritless cases enter, $D$ would want to go to trial rather than settle all cases with an offer high enough that plaintiffs with serious cases would accept. But, then meritless lawsuits would not be filed. If, instead, meritless suits are unlikely, $D$ wants to settle. But then plaintiffs want to file meritless lawsuits. As a result, in any equilibrium, $D$ adopts a mixed strategy of sometimes pursuing a trial, and sometimes settling. Only the expected number of meritless cases enter a defendant's payoffs, so in addition to the symmetric equilibrium in which all plaintiffs with meritless cases mix with a common probability, asymmetric equilibria also exist in which some plaintiffs with meritless cases always file, and some (or just one) mix between filing or not.

When a serious case is more likely to win at trial, the minimum acceptable settlement offer for a plaintiff with a serious case rises. This has two important implications. First, because the settlement offer is increased, in order to deter plaintiffs with meritless cases from filing, the defendant must be *more* likely to take a date-2 case to trial. Second, *fewer* meritless cases must be filed on average. Because the defendant must pay more to settle a serious case, it becomes more worthwhile for the defendant to weed out meritless cases. Thus, it takes fewer meritless cases to keep the defendant indifferent between paying the higher settlement offer and going to trial.

Part (2) reflects that when most cases have merit, the defendant prefers to settle all cases, paying a few unnecessary settlements, but avoiding trial costs. Plaintiffs with serious cases still enter if and only if $qm_2 > c_{p2} + k_{p2}$: the existence of meritless cases does not affect how serious cases react to date-1 litigation outcomes. Thus, Lemma 1 still characterizes their equilibrium behavior. At the same time, plaintiffs with meritless cases do not enter when those with serious cases do not enter, as part

(3) of Lemma 2 indicates. Lemma 3 describes the consequences for a defendant's expected payoffs in future litigation.

**Lemma 3.** *When a serious plaintiff expects to win a date-2 trial with probability $q$, the defendant's date-2 expected payoff is:*

$$g(q) \equiv \begin{cases} 0, & \text{if } q < \frac{c_{p2}+k_{p2}}{m_2}, \\ (-qm_2 + c_{p2} - k_{d2})N_2(1+F), & \text{if } \frac{c_{p2}+k_{p2}}{m_2} < q < \frac{1}{m_2}(\frac{c_{p2}+c_{d2}}{F} + c_{p2}), \\ (-qm_2 + c_{p2} - k_{d2})N_2(1+\frac{c_{p2}+c_{d2}}{qm_2-c_{p2}}), & \text{if } q > \max\{\frac{c_{p2}+k_{p2}}{m_2}, \frac{1}{m_2}(\frac{c_{p2}+c_{d2}}{F} + c_{p2})\} \end{cases}$$

*The function $g(q)$ is continuous and weakly convex for $q > \frac{c_{p2}+k_{p2}}{m_2}$. Moreover, when $k_{d2}(c_{p2}+c_{d2}) > 0$, it is strictly convex on the "mixed strategy range" of $q > \max\{\frac{c_{p2}+k_{p2}}{m_2}, \frac{1}{m_2}(\frac{c_{p2}+c_{d2}}{F} + c_{p2})\}$, where the defendant mixes between settling and going to trial.*

When serious cases are too unlikely to win, no cases are filed at date 2, so $D$ does not pay out anything. For an intermediate range of posterior probabilities $q$ (non-empty if and only if $F$ is small enough), all plaintiffs file, regardless of the merits of their cases, because there are not enough meritless cases to make it worthwhile for $D$ to go to trial to weed them out. When $q$ and $F$ are larger, all plaintiffs with serious cases file, but only some of those with meritless cases do, and the defendant responds by mixing between settling and going to trial.

The defendant's payout $-g(q)$ is concave over the range of $q$ with positive date-2 entry. The payout rises linearly with $q$ on the range where all meritless cases enter because the expected payout to a serious case in trial, $qm_2$, is linear in $q$ and the number of cases filed $N_2(1+F)$ does not vary with $q$. Once the probability that a plaintiff with a serious case is high enough that only some meritless cases are filed, the payout becomes strictly concave in $q$ due to the nature of the mixed strategy equilibria. When $q$ is higher (a more promising case for serious plaintiffs), to keep $D$ indifferent between settling and going to trial, fewer meritless cases are filed. Thus, when the higher $q$ raises the requisite settlement offer, the reduction in meritless cases filed partially offsets the higher payout to plaintiffs relative to a linear increase. Conversely, when $q$ is lower (a less promising case for plaintiffs), more meritless cases file, which partially offsets the decrease in payout relative to a linear decrease. Therefore, the defendant's expected payout to plaintiffs is a strictly concave function of $q$ on the mixed strategy range of $q$, i.e., when the defendant's payoff is strictly convex.

**Proposition 3.** *The circumstances under which a trial occurs rise with the proportion of potential meritless cases, $F$. In equilibrium, the initial case goes to trial if and only if one of the two following* *scenarios on date-2 litigation hold:*

*Scenario 1:* 1. $\underline{\pi} m_2 \le k_{p2} + c_{p2} < \pi m_2$, 2. $\pi g(\overline{\pi}) - g(\pi) > c_{p1} + c_{d1}$,

*Scenario 2:* 3. $k_{p2} + c_{p2} < \underline{\pi} m_2$, 4. $\pi g(\overline{\pi}) + (1-\pi) g(\underline{\pi}) - g(\pi) > c_{p1} + c_{d1}$.

It is useful to contrast this result with our base case characterization in Proposition 2. In scenario 1, Condition 1 is the standard condition that a date-1 trial deters entry following a date-1 defendant-win, but a settlement does not. As in Proposition 2, Condition 2 says that the benefit from the reduction in date-2 costs due to the possibility of deterring entry more than offsets the costs of a date-1 trial. However, this condition is now easier to satisfy because the presence of meritless cases increases the gains from deterring entry by going to trial at date 1. The LHS of Condition 2 not only includes the reduction in expected payouts to serious cases, but also the expected reduction in payouts to meritless cases. Indeed, a trial may reduce an even greater expected proportion of meritless cases than of serious ones. For example, when $\pi$ and $\overline{\pi}$ are both in the mixed strategy range, a trial reduces the probability of meritless cases from $\frac{c_{p2}+c_{d2}}{(\pi m_2 - c_{p2})F}$ to $\pi \frac{c_{p2}+c_{d2}}{(\overline{\pi} m_2 - c_{p2})F}$; the percentage reduction is greater for meritless cases since $\pi < \overline{\pi}$. So, too, when $\pi$ is not in the mixed strategy range, but $\overline{\pi}$ is, the reduction in their entry probability is from 1 to $\pi \frac{c_{p2}+c_{d2}}{(\overline{\pi} m_2 - c_{p2})F}$.

Scenario 2 says that even when a defendant-win fails to deter plaintiffs who have serious cases (Condition 3), when Condition 4 holds, the gains from deterring meritless cases still make it worthwhile to go to trial at date 1, due to the convexity of $g(q)$. Going to trial causes date-2 beliefs to diverge relative to a settlement, and because more meritless cases are now deterred when date-2 settlements are high ($q = \overline{\pi}$), than when they are low ($q = \underline{\pi}$), the associated gain (the LHS of Condition 4) may exceed the cost of a date-1 trial (the RHS of Condition 4). Indeed, in this scenario, in contrast to all previous scenarios analyzed, it can be optimal for the plaintiff to go to trial at date 1 even when there are no pre-trial cost savings, i.e., even when $k_{p2} = k_{d2} = 0$. When $k_{d2} = 0$, the payout is a piece-wise linear (concave) function of the posterior, because fewer meritless cases enter when the posterior is high enough.

When a defendant is sufficiently likely to take date-2 cases to trial, she deters all meritless cases. This might lead one to wonder whether and when a defendant would be better off if she could commit to taking *all* date-2 cases to trial. Such commitment completely deters all meritless lawsuits, but it also incurs trial costs against all serious plaintiffs. We now show that when a plaintiff with a serious case is sufficiently likely to win at date 2, a defendant would be better off committing to take all cases to trial at the beginning of date 2 than she is in an equilibrium without commitment. The intuition mirrors that in the classic predation game where a monopoly is better off committing to be aggressive to deter potential entry.

**Proposition 4.** *If and only if (a) there are enough plaintiffs who can file meritless cases, and (b) a plaintiff is likely enough to win at trial, a defendant would like to commit to going to trial at date-2:*

1. *When $q < \frac{c_{p2}+k_{p2}}{m_2}$, no plaintiffs file lawsuits, so commitment does not matter.*
2. *When $\frac{c_{p2}+k_{p2}}{m_2} < q < \frac{1}{m_2}(\frac{c_{p2}+c_{d2}}{F} + c_{p2} - k_{d2})$, a defendant is better off not committing to trials.*
3. *When $q > \max\{\frac{c_{p2}+k_{p2}}{m_2}, \frac{1}{m_2}(\frac{c_{p2}+c_{d2}}{F} + c_{p2} - k_{d2})\}$, a defendant is strictly better off committing to trials at date-2 as long as $k_{d2} > 0$.*

In situation 2, a plaintiff is sufficiently likely to win that plaintiffs file lawsuits, but a defendant is better off settling all cases, as the requisite settlement is not that high and/or there are not that many potential meritless cases. When $q$ and $F$ are large enough that $q > \max\{\frac{c_{p2}+k_{p2}}{m_2}, \frac{1}{m_2}(\frac{c_{p2}+c_{d2}}{F} + c_{p2} - k_{d2})\}$ (situation 3), a defendant would be better off committing to taking all cases to trial (provided her pre-trial costs are positive), in order to deter all meritless lawsuits.

# 4 Extensions

In this section we explore two alternative assumptions: the settlement is determined by Nash bargaining and there are heterogenous date-2 plaintiffs.

**Nash Bargaining.** We have assumed that the defendant makes take-it-or-leave-it offers. In fact, our qualitative findings are reinforced if plaintiffs have more bargaining power. We now show that the attraction to the defendant of deterring future litigation via an initial trial that results in a defense-win rises with the plaintiff's bargaining power.

Suppose now that all plaintiffs have bargaining power $\lambda \in (0, 1)$ and the defendant has bargaining power $1-\lambda$. Lemma 4 describes the decisions by potential date-2 plaintiffs of whether to file lawsuits:

**Lemma 4.** *(Bargaining) Let $\Delta_2 \equiv c_{p2} + c_{d2} > 0$. In the date-2 subgame, plaintiffs file lawsuits if and only if $qm_2 > max\{c_{p2}, c_{p2} + k_{p2} - \lambda\Delta_2\}$.*

There are essentially two necessary conditions for entry. One is that the plaintiff has a credible threat of trial, i.e., $qm_2 > c_{p2}$ (the credible-trial condition). Otherwise, the consequence of rejecting a settlement offer is not a trial, but rather a voluntary withdrawal of the lawsuit. That means in the bargaining stage the outside options of both the plaintiff and the defendant are $0$, so the settlement amount will be $0$ as well, which is not enough to attract entry. The other condition is that the settlement amount can cover the plaintiff's pre-trial cost. $\Delta_2$ here is the total trial costs that can be saved by a settlement, which is the joint surplus of Nash bargaining that is shared between the two parties. Since the plaintiff's bargaining power is $\lambda$, she gets $\lambda\Delta_2$ in the bargaining. Therefore, we have the two terms on the RHS of the entry condition in Lemma 4. In contrast, with t-i-o-l-i offers, the second condition implies the first, so only one condition describes the entry decision in Lemma 1. However, when the plaintiff has enough bargaining power, the credible-trial condition becomes the binding condition for entry. The following proposition is derived in the same fashion as Proposition 2, so we omit its proof.

**Proposition 5.** *(Bargaining) Let $\Delta_2 \equiv c_{p2} + c_{d2} > 0$. Then, in equilibrium there is a trial at date 1 if and only if the following conditions on the date-2 litigation hold:*

1. $\underline{\pi} m_2 \leq max\{c_{p2}, c_{p2} + k_{p2} - \lambda\Delta_2\} < \pi m_2$
2. $(1-\pi)(\underline{\pi} m_2 + c_{d2} + k_{d2} - (1-\lambda)\Delta_2)N_2 > c_{p1} + c_{d1}$.

Condition 1 again says that a defendant-win at a date-1 trial is necessary to deter entry. Condition 2 is still the trade-off between settling and going to a trial at date 1. The RHS of Condition 1 is the cost of going to trial for $D$ and $P_1$ from their joint perspectives. The LHS of Condition 2 is the defendant's date-2 gain from deterring date-2 lawsuits; $P_1$ does not care about what happens in the future. In Condition 2, if $\lambda = 0$, we are back to t-i-o-l-i offers. A defendant gains more from deterring date-2 lawsuits when plaintiffs have more bargaining power because she must pay more to settle if they enter. This makes Condition 2 easier to satisfy, i.e., greater plaintiff bargaining power increases the circumstances under which a defendant takes the initial case to trial (when Condition 1 is satisfied).

Note that even when $k_{p2} = k_{d2} = 0$, both conditions in Proposition 5 may hold. That is, when the plaintiff has positive bargaining power, the initial litigation may go to trial in equilibrium even in the absence of pre-trial costs. This is because there is a discontinuity in the settlement amount at $V = 0$: The settlement is 0 if $V = 0$, but jumps to $V + \lambda\Delta_2$ for $V > 0$. Proposition 1 does not apply. This is because it can happen that the plaintiffs will not enter after a defendant-win ($\underline{\pi} m_2 - c_{p2} < 0$), but can extract positive settlements after an initial settlement due to their positive bargaining power ($\underline{\pi} m_2 - c_{p2} + \lambda(c_{d2} + c_{p2}) > 0$).

**Heterogeneous date-2 plaintiffs.** In our core analysis, without meritless cases, we show that there is a force for trial in the initial lawsuit only if future plaintiffs can be potentially deterred by a defendant-win in the initial lawsuit. We have assumed that future plaintiffs are homogeneous in the sense that if any plaintiff can be deterred by a defendant-win, then all of them can be deterred. The basic intuition for the incentive for trial extends to settings where future plaintiffs are heterogeneous. In this case, there is a force for trial in the initial lawsuit if *enough* future plaintiffs can be deterred by a defendant-win relative to those who are attracted by a plaintiff-win, and if this benefit outweighs the other costs of going to a trial compared to a settlement.

Learning is a double-edged sword: While learning may deter some plaintiffs with certain characteristics (e.g., with moderate litigation costs, so they file unless they receive bad news) from entering following a defendant-win, it may also encourage plaintiffs with other characteristics (e.g., higher litigation costs, so they only file if they receive good news) to enter following a plaintiff-win. While the deterrence effect favors a trial, the encouragement effect favors a settlement. If the encouragement effect is strong enough, there will be no trial, and the outcome are the same as in the benchmark with no sequential linkage between litigations.

# 5 Conclusion

Sequential litigation can arise when a single defendant injures multiple potential plaintiffs, and the plaintiffs become aware of the damage, or become capable of filing lawsuits, at different points in time. We identify features of sequential litigation that can render it worthwhile for a plaintiff and defendant to choose to incur the substantial expenses of a trial, rather than negotiate a settlement.

We first observe that an initial trial outcome—whether the defendant wins or loses—conveys extensive information to future potential plaintiffs about their prospects at a trial. Trial outcomes convey more information than do settlements because plaintiffs learn whether a strategy works, whether a defendant has a particular vulnerability, and positive or negative precedents may be established. We show that, as a result, the initial lawsuit can go to trial when an initial defendant-win would cause future potential plaintiffs to update sufficiently negatively about their prospects that they are deterred from filing lawsuits, whereas a settlement would not. In our base case setting where the defendant has all bargaining power, we show that for learning incentives to induce a trial at least one of the two litigating parties must face positive pre-trial litigation costs. Then learning from the initial trial outcome that the defendant's case is stronger can deter future lawsuits, saving on those pre-trial costs. The defendant wants to take the initial case to trial in equilibrium when these savings from deterring future lawsuits exceed the combined initial trial costs of the plaintiff and defendant. Thus, sequential litigation is likely to lead to trial when *many* future cases hinge *sensitively* on the outcome of the initial trial and the pre-trial costs are substantial.

The possibility of meritless lawsuits further raises the attraction of trials. A defendant-win that deters plaintiffs with serious cases, also deters those with meritless ones. Even when a defendant-win does not deter serious plaintiffs, when there are enough possible meritless cases, defendants will sometimes take future plaintiffs to trial, to weed out meritless cases. Ironically, in this situation, more plaintiffs with meritless cases are deterred following a *defendant-loss* than following a defendant-win, precisely because the amount required to settle a serious case is higher, making a defendant more eager to go to trial to avoid paying out to meritless cases. We further show that giving plaintiffs more bargaining power, which raises the requisite settlement, also raises the attraction of an initial trial to the defendant whenever a defense-win deters future plaintiff lawsuits. Finally, we discussed the implication of heterogenous future plaintiffs and how learning can favors settlement if potential plaintiffs can be encouraged by a plaintiff-win.

We also verified the robustness of our core findings to alternative model structures (see our working paper at https://sites.google.com/site/researchoffrancesxu/). The conditions under which the initial case goes to trial, when motivated by the desire to deter future plaintiffs, are qualitatively the same regardless of whether legal decisions are made by the plaintiff, or by his attorney. We also explored how outcomes are affected if the initial plaintiff's attorney may have a stake in future trials because she may represent future plaintiffs. This increases the circumstances under which the initial case goes to trial: the plaintiff's attorney prefers a trial because it provides information that allows him to fine tune future entry decisions. Finally, we looked at how incentives to go to trial are affected by the correlation between cases when future litigation costs fall with the correlation. Such a relation arises naturally if, with more similar cases, future litigants benefit more from earlier preparation on the initial case. While higher correlation makes it easier for a defendant-win to deter entry, which favors an initial trial, it also reduces future pre-trial costs for the defendant, which makes it less desirable to incur the initial trial costs to save future litigation costs.

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# 6 Appendix

*Proof of Lemma 1.* If $qm_2 \leq c_{p2}$, then $D$'s date-2 settlement offer is $0$. This offer will be accepted because a date-2 plaintiff does not have a credible threat to go to trial. $D$ has no incentive to make an unacceptable offer because $D$ expects a negative payoff of $-qm_2 - c_{d2}$ from a date-2 trial. Thus, when a date-2 plaintiff contemplates filing a suit, regardless of whether he accepts the zero offer or withdraws, his expected payoff from filing a lawsuit is negative due to the pre-trial cost $k_{p2}$. Therefore, no date-2 plaintiff files if $qm_2 \leq c_{p2}$.

If $qm_2 > c_{p2}$, then $D$'s settlement offer at date 2 is $qm_2 - c_{p2} > 0$. This offer leaves a date-2 plaintiff indifferent between accepting and not. In equilibrium, plaintiffs accept this offer because otherwise $D$ can make the offer $\epsilon$ more attractive to break the indifference. Therefore, a date-2 plaintiff's expected payoff from filing a lawsuit is $qm_2 - c_{p2} - k_{p2}$. Since the payoff from not filing is $0$, a plaintiff files if and only if $qm_2 - c_{p2} - k_{p2} > 0$. $\square$

*Proof for Proposition 1:* Suppose $k_{p2} = 0$. Let $h(q)$ be the settlement payment to a date-2 plaintiff who would win with probability $q$. When $qm_2 - c_{p2} < 0$, date-2 plaintiffs would not enter, and the settlement payment would be $0$; and when $qm_2 - c_{p2} > 0$, the settlement payment $h(q)$ is positive and linear in $q$. Case 1. $\underline{\pi} \geq \frac{c_{p2}}{m_2}$, then $E[h(q)] = 0 = h(E[q])$. Case 2. $\overline{\pi} \leq \frac{c_{p2}}{m_2}$, then the linearity of $h(q)$ implies $E[h(q)] = h(E[q])$ again. Case 3. $\underline{\pi} < \frac{c_{p2}}{m_2}$ and $\overline{\pi} > \frac{c_{p2}}{m_2}$, then $E[h(q)] = \pi(\overline{\pi}m_2 - c_{p2}) > \pi(\overline{\pi}m_2 - c_{p2}) + (1-\pi)(\underline{\pi}m_2 - c_{p2}) = \pi m_2 - c_{p2} = h(E[q])$. That is, $E[h(q)] = h(E[q])$. $\square$

*Proof for Proposition 2:* Condition 1 follows from Lemma 1. Let $U_t^S$ denote $D$'s date-$t$ payoff from settling at date 1 with the lowest acceptable offer, and let $U_t^T$ denote $D$'s date-$t$ payoff from going to trial at date 1 (by making an unacceptable offer). Let $U^S \equiv U_1^S + U_2^S$, and $U^T \equiv U_1^T + U_2^T$.

Following a settlement, the posterior is $\pi$, so $D$'s payoff from date-2 litigation is:

$$U_2^S = (-\pi m_2 + c_{p2} - k_{d2})N_2.$$

Following a trial, there are two possibilities. If the outcome was a plaintiff-win, the posterior becomes $\overline{\pi}$ and $D$'s payoff is $(-\overline{\pi}m_2 + c_{p2} - k_{d2})N_2$ because $D$ would offer $\overline{\pi}m_2 - c_{p2}$ to each plaintiff that then enters. If the outcome was a defendant-win, the posterior is $\underline{\pi}$ and $D$'s payoff is $0$ because no plaintiff enters. Therefore, $D$'s expected payoff at date 2 following a date-1 trial is:

$$U_2^T = \pi(-\overline{\pi}m_2 + c_{p2} - k_{d2})N_2.$$

Contrasting $D$'s date-1 payoff from a trial versus a settlement, the trial brings a loss of $U_1^S - U_1^T = c_{p1} + c_{d1}$ at date 1 because $D$ incurs her trial cost and fails to make an offer which, due to the take-it-or-leave-it offer structure, could have extracted the rents from $P_1$ circumventing her trial costs. However, the possible gain at date 2, $U_2^T - U_2^S$, from a defendant-win that discourages future plaintiffs from filing may outweigh it. The difference is:

$$U^T - U^S = (U_2^T - U_2^S) - (U_1^S - U_1^T) = (1-\pi)(\underline{\pi} m_2 - c_{p2} + k_{d2})N_2 - (c_{p1} + c_{d1}).$$

Condition 2 is exactly the condition that $U^T > U^S$. $\square$

*Proof of Corollary 1.* Suppose $k_{p2} = k_{d2} = 0$. Condition 1 implies that $\underline{\pi} m_2 - c_{p2} < 0$, then the LHS of Condition 2 is strictly negative, which means that Condition 2 fails.

*Proof of Lemma 2.* If $qm_2 < c_{p2}$, then $D$ offers $s_2 = 0$ at date 2 because even a serious case is withdrawn after such an offer and there is no credible threat of a trial.

Now suppose that $0 < qm_2 - c_{p2} < k_{p2}$. In any subgame equilibrium at date 2 with $qm_2 > c_{p2}$, $D$ makes one of two possible offers: $s_2 \in \{qm_2 - c_{p2}, 0\}$, because any other offer is dominated by one of these offers. When $0 < qm_2 - c_{p2} < k_{p2}$, even when $D$ offers $qm_2 - c_{p2}$ for sure, no plaintiffs would want to file given their pre-trial costs, so the subgame equilibrium outcome is no entry.

Now suppose that $qm_2 > c_{p2} + k_{p2}$. There are two relevant subcases.

Subcase 1. $F > \frac{c_{p2}+c_{d2}}{qm_2 - c_{p2}}$. There does not exist a subgame equilibrium in which all meritless cases enter. If so, $D$ would offer $s_2 = 0$ as the settlement offer $qm_2 - c_{p2}$ would be accepted by all meritless cases and will cost him $(qm_2 - c_{p2})N_2(1+F)$, which exceeds $(qm_2 + c_{d2})N_2$, the payout at a trial to serious cases only. Meritless cases would withdraw after such a zero-offer, so their payoff from filing would be $-k_{p2}$. Hence, they would not file, a contradiction.

There does not exist a subgame equilibrium in which no meritless cases file suits. If so, $D$ would settle with the serious cases by offering $s_2 = qm_2 - c_{p2}$. But then any meritless case would want to enter because $qm_2 - c_{p2} - k_{p2} > 0$, a contradiction.

Therefore, in a subgame equilibrium, some meritless cases enter and some do not. This implies that a plaintiff with a meritless case must be indifferent between filing and not. Let $y$ denote the probability that $D$ offers $s_2 = qm_2 - c_{p2}$; the probability of offering $s_2 = 0$ is $1 - y$. From the indifference condition for a plaintiff with a meritless case,

$$0 = y(qm_2 - c_{p2}) + (1-y)0 - k_{p2} \Rightarrow y = \frac{k_{p2}}{qm_2 - c_{p2}} < 1.$$

This implies that $D$ is indifferent between offering $s_2 = qm_2 - c_{p2}$ to settle any case that enters and offering $s_2 = 0$, which results in a serious case going to trial. Let the expected number of meritless cases be $\hat{x}N_2$. Indifference of $D$ implies that

$$(qm_2 - c_{p2})N_2(1+\hat{x}) = (qm_2 + c_{d2})N_2 \Rightarrow \hat{x} = \frac{c_{p2} + c_{d2}}{qm_2 - c_{p2}}.$$

Subcase 2. $F < \frac{c_{p2}+c_{d2}}{qm_2-c_{p2}}$. There does not exist a subgame equilibrium where meritless cases are indifferent between entering and not, because then, as in the analysis for Subcase 1, the expected number of meritless cases filed must be $\frac{c_{p2}+c_{d2}}{qm_2-c_{p2}}N_2$, which exceeds the total number of meritless cases, $FN_2$. There does not exist a subgame equilibrium in which no meritless case enters, for the same reason as in Subcase 1. Therefore, $FN_2$ meritless cases suits are filed in equilibrium. Since $F < \frac{c_{p2}+c_{d2}}{qm_2-c_{p2}}$, the best response of $D$ is to offer $qm_2 - c_{p2}$ to settle each lawsuit that is filed. □

*Proof of Lemma 3.* Note that $q = \frac{1}{m_2}(\frac{c_{p2}+c_{d2}}{F} + c_{p2})$ is equivalent to $F = \frac{c_{p2}+c_{d2}}{qm_2-c_{p2}}$, which means that $g$ is continuous for $q > \frac{c_{p2}+k_{p2}}{m_2}$. The payoff function is then directly implied by Lemma 2. Next we show strict convexity of $g$ in the mixed equilibrium range.

$$g'(q) = \frac{m_2 N_2}{(qm_2 - c - p)^2}(k_{d2}(c_{p2}+c_{d2})-(qm_2-c_{p2})^2) \Rightarrow g''(q) = \frac{2m_2^2 k_{d2} N_2(c_{p2}+c_{d2})}{(qm_2-c_{p2})^3} > 0. \qquad \square$$

*Proof of Proposition 3.* Case 1. $\overline{\pi}m_2 < c_{p2} + k_{p2}$. Here, regardless of the date-1 outcome, no date-2 plaintiffs enter. Then $D$ settles at date 1.

Case 2. $\pi m_2 < c_{p2} + k_{p2} < \overline{\pi}m_2$. These parameters imply that a plaintiff-win at date 1 attracts all serious date-2 plaintiffs and some meritless ones who would not otherwise file lawsuits. This means that there are only costs to a date-1 trial, so $D$ settles at date 1.

Case 3. $\underline{\pi}m_2 < c_{p2} + k_{p2} < \pi m_2$. In this parameter range, a defendant-win at date 1 causes all date-2 plaintiffs not to enter, while any other outcome would lead to their entry. By Lemma 3, the difference between $D$'s payoffs from a date-1 trial and a date-1 settlement is,

$$U^T - U^S = \pi g(\overline{\pi}) - g(\pi) - (c_{p1} + c_{d1}).$$

Case 4. $k_{p2} + c_{p2} < \underline{\pi}m_2$. Here, regardless of the date-1 outcome, all serious date-2 plaintiffs file suits as do some plaintiffs with meritless cases. The number of meritless cases filed depends on the date-1 outcome. The difference in payoff for $D$ between a date-1 trial and a date-1 settlement is,

$$U^T - U^S = \pi g(\overline{\pi}) + (1-\pi)g(\underline{\pi}) - g(\pi) - (c_{p1} + c_{d1}). \qquad \square$$

*Proof of Proposition 4.* If no date-2 suits are filed without commitment, commitment does not matter. When $D$ plays a mixed strategy at date 2 without commitment, her date-2 payoff is $(-qm_2 + c_{p2} - k_{d2})N_2(1 + \frac{c_{p2}+c_{d2}}{qm_2-c_{p2}})$. If she commits to a trial, no meritless cases are filed, and her date-2 payoff is $(-qm_2 - c_{d2} - k_{d2})N_2$. If $k_{d2} = 0$, the two payoffs are equal. If $k_{d2} > 0$, the payoff under no commitment is worse because $k_{d2}$ is applied to more plaintiffs (both serious and meritless ones). When $D$ plays a pure-strategy (settle) at date 2, her date-2 payoff is $(-qm_2 + c_{p2} - k_{d2})N_2(1 + F)$. If she commits to a trial, no meritless cases are filed, and her date-2 payoff is $(-qm_2 - c_{d2} - k_{d2})N_2$. The difference between these payoffs is $(c_{d2} + c_{p2})N_2 - (qm_2 - c_{p2} + k_{d2})N_2F$. Therefore, when $q < \frac{1}{m_2}(\frac{c_{p2}+c_{d2}}{F} + c_{p2} - k_{d2})$, no commitment is better. $\square$

*Proof of Lemma 4.* Let $V$ denote the outside option in date-2 bargaining for a plaintiff, and let $U$ be $D$'s outside option. Then at date 2, if a lawsuit is settled, the settlement solves:

$$\max_{s} \quad (-s - U)^{1-\lambda}(s - V)^{\lambda} \Rightarrow s^* = (1 - \lambda)V - \lambda U$$

The outside options depend on whether a plaintiff wants to withdraw a lawsuit if bargaining fails. Case 1. $qm_2 < c_{p2}$. It is optimal for the plaintiff to withdraw, so the outside options are $V = U = 0$. This implies that $s^* = 0$. That is, without a credible threat, a plaintiff cannot extract a positive settlement in bargaining. Case 2. $qm_2 > c_{p2}$. A plaintiff does not withdraw if bargaining fails and the case goes to trial. Therefore, $V \equiv qm_2 - c_{p2}$ and $U \equiv -qm_2 - c_{d2}$. If they settle, a plaintiff receives $V+\lambda(-V-U)$, and $D$ receives $U+(1-\lambda)(-V-U)$. Since $-V-U = -(qm_2-c_{p2})-(-qm_2-c_{d2}) = c_{p2} + c_{d2} = \Delta_2 > 0$, they settle. That is, there is no trial at date 2. The payoff of entry for the plaintiff is $qm_2 - c_{p2} + \lambda\Delta_2 - k_{p2}$. The plaintiff enters if and only if this payoff is positive. $\square$.