Judgment-Contingent Commitments: Signaling in Negative Expected-Value Suits

Shay Lavie Avraham Tabbach*

November 10, 2020

Abstract

This paper explores judment-contingent commitments as a signaling device in negative expected-value (NEV) cases. We find that, in contrast to the positive expected-value (PEV) setting, informed defendants in NEV cases can reduce trials by using judgment-contingent commitments without demanding a side-payment from the counter party. Moreover, the informed party would like to commit to a judgment-contingent payment precisely to the extent this commitment transforms the plaintiff's case into a zero expected-value one, what we refer to as a ZEV case. We predict, then, that signaling attempts should be more common in NEV settings than in PEV settings.

Keywords: Negative Expected-Value Suits, Signaling, Settlements, Pretrial Bargaining, Asymmetric Information, One-Way Fee-Shifting, Arbitration Clauses

JEL Code: K41. D82.

1 Introduction

Policymakers and academics have long studied the reasons for which parties to a legal dispute fail to settle. A major reason for settlement failures is asymmetric information (Bebchuk, 1984; Reinganum & Wilde, 1986). The uninformed party cannot distinguish between different types of the informed party, and thus she is bound to take some cases to trial. As litigation is costly, we should expect informed parties to strive to indicate their type in order to avoid trials. Although in some cases parties can credibly and easily convey their type, voluntary disclosure is not always feasible (Shavell 1989; Hay

*Tel Aviv University, Faculty of Law. We thank participants at the European Law & Economics Association annual meeting and the Hebew University Law & Economics Workshop for helpful discussions and comments. This research project was supported by the Israeli Science Foundation (grant No. 1708/16).

1994), and mandatory discovery is costly (*Bell Atl. Corp. v. Twombly*, 550 U.S. 544, 559 (2007)). One should therefore think of alternative avenues to convey information in pre-trial bargaining. Along these lines, in previous work (Lavie & Tabbach, 2018, 2020) we explored the role of judgment-contingent commitments as a signaling device. To illustrate, consider the following hypothetical message from an informed defendant to an uninformed plaintiff:

> I advise you to accept my low settlement offer. To help convince you, I am willing to double your award at trial in the event that you reject my offer, take me to trial, and win.

Presumably, such commitments can signal the strength of the committing party and allow the uninformed to accept more settlement offers. Thus, these commitments can reduce the incidence of costly trials (or, costly pre-trial discovery, to the extent parties settle after discovery). However, in previous work we showed that, by and large, these commitments are not feasible unless they are coupled with a side-payment from the uninformed party. We surmised that the side-payment, which mandates a bilateral transaction, hinders the realization of judgment-contingent settlements, and can thus explain, at least partially, the absence of such strategies in the real-world.

In this paper we explore negative expected-value (NEV) settings. We show that, unlike the positive expected-value (PEV) setting, in the NEV setting no side-payment is required to facilitate judgment-contingent commitments by informed defendants. As judgment-contingent signaling can be effectuated unilaterally, we expect such signaling to be more prevalent in NEV settings. Moreover, in NEV cases we can easily identify the optimal judgment-contingent commitment by the informed party. We show that in NEV cases the judgment-contingent commitment should precisely transform the uninformed's case into a zero expected-value one – what we refer to as a ZEV case.

More specifically, we use a private information model, in which informed defendants, of a continuum of types, make a single take-it-or-leave-it offer, possibly coupled with a judgement-contingent clause. We assume that a lawsuit against some, strong defendants has a negative expected value, that is, the costs of litigation for the plaintiff are higher than the expected judgement; whereas a lawsuit against other, weak defendants has positive value. This description can fit, for example, situations in which the private information relates to the defendant's liability, that is, where some defendants are negligent and others are not. In the basic equilibrium we find that NEV defendant types offer to settle for zero, whereas some PEV defendants mimic (and offer zero) and other PEV defendants reveal (and offer a positive settlement offer). The plaintiff takes zero offers to trial at a constant rate; positive offers are taken to trial at a rate which decreases with the size of the settlement offer.

We then turn to analyze the option to commit to a judgment-contingent payment, which takes the form of a multiplier K on the award at trial (should the plaintiff reject the offer and win at trial). We find that the equilibrium under the commitment option is a fully-revealing equilibrium. More specifically, our analysis leads to the following results.

First, NEV defendants offer a zero settlement and simultaneously commit to augment the judgment at trial by a multiplier that transforms the NEV suit into precisely a ZEV (zero expected value) suit. Mathematically, this multiplier equals the ratio of the plaintiff's litigation costs to the expected judgement of the committing, NEV defendant (which is greater than 1, due to the NEV nature of a suit against these defendants). This threshold can thus be denoted $K_{ZEV} = \frac{C_P}{J_i}$, and it depends on each type's expected liability at trial – the strongest types, with the smaller expected liability, commit to a larger K. Second, the rate at which the plaintiff takes in equilibrium zero offers to trial depends on the magnitude of the multiplier K_{ZEV} – offers that are coupled with larger commitments (which come from the strongest defendants) are taken to trial less often. Third, the ability of defendants to commit to multiply the award by K leads to a fully-revealing equilibrium – that is, there is no mimicking by PEV defendants. All PEV defendants reveal, without committing to a multiplier, and they are taken to trial at a differential rate which decreases, as before, with the size of the (true) offer. Intuitively, under the commitment equilibrium mimicking to a zero offer (coupled with a commitment to augment the judgment at trial) becomes more costly. Overall, the equilibrium under the judgment-contingent commitment appears better, from a societal standpoint. It is a fully-revealing equilibrium, creating a better separation of the defendant types; and, as there is no mimicking the plaintiff can extract gains from all PEV defendants and is better off. These benefits notwithstanding, the commitment equilibrium impairs the defendants' position. For instance, some defendants would have preferred to mimic, but the commitment equilibrium makes this commitment counter-productive; likewise, other defendants would have preferred to offer the same settlement, but without adding the commitment to augment the judgment at trial. Finally, the overall rate of settlements depends on the distribution of the defendant types, and it may or may not increase under the commitment option (in our numerical examples the commitment equilibrium does generate more settlements).

In our previous work, under an assumption of PEV, we showed that judgment-contingent commitments are ineffective and will not be effectuated by the informed party without a side-payment from the uninformed (Lavie & Tabbach, 2018, 2020). In this paper we find that, given the option to commit, NEV defendants are expected to offer a multiplier $K_{ZEV} = \frac{C_P}{J_i}$. What is the source of the discrepancy between the PEV and the NEV settings? The gist lies in the ability of NEV defendants to commit to augment the judgment without increasing their settlement offer. To illustrate, take a defendant who is likely to pay at trial 20, and suppose that the litigation costs of the plaintiffs are 40. As the expected value of a lawsuit against that defendant is negative, -20, the defendant can offer to settle for zero. Under the commitment equilibrium, this NEV defendant now commits to $K_{ZEV} = \frac{C_P}{J_i} = 2$. However, the settlement offer from that defendant remains 0, as this offer reflects the zero value for the plaintiff of a lawsuit under the multiplier $K = 2$ (expected liability times the multiplier minus the plaintiff's litigation expenses precisely equals zero). By contrast, in the PEV setting there is no such slack between the expected value at trial and the settlement offer, hence any judgment-contingent commitment increases the settlement offer and harms the committing defendant.

This relates to a further point. Unlike PEV settings, the analysis in our paper cannot be generalizable to NEV setups in which plaintiffs have private information. Intuitively, where plaintiffs have private information, and some plaintiffs are NEV and some are PEV types, it is the strong, PEV plaintiffs who would like to signal their strength by committing to a judgment-contingent multiplier. However, such a commitment by PEV plaintiffs necessarily reduces their settlement offer. Therefore, the logic that we present in this paper will not work in NEV settings in which the plaintiff has private information (for the same reasons that jugement-contingent commitments are ineffective in PEV settings).

We conclude, then, that NEV settings where defendants have private information present a more amenable environment for the use of judgment-contingent commitments. Our point can be illustrated through arbitration clauses in standard-form contracts. In the last decades companies have started to insert to their contracts provisions that require, in the event of a dispute, individual arbitration. The immediate gain from such clauses is eliminating the threat of class actions by those who are subject to the contract, most notably, consumers and employees (e.g., *AT&T Mobility LLC v. Concepcion*, 563 U.S. 333 (2011)). However, there are important differences within individual arbitration provisions as a few imporant firms, e.g., AT&T and Verizon, drafted their arbitration clause in a relatively pro-plaintiff manner (Consumer Financial Protection Bureau, 2015, § 2.5.10). A notable example is commitment by the defendant to a prospective one-way fee-shifting, that is, to pay the customer's fees (or even double that amount) should they lose, but not the other way around (Chandrasekher & Horton, 2019, p. 16). These practices can be interpreted from a signaling perspective. Pro-plaintiff one-way fee-shifting is mathematically identical to a commitment to augment by K (the share of attorneys' fees is represented by $K-1$). The fact that only a (non-trivial) minority of firms choose to insert plaintiff-friendly commitments is in line with our model – we predict that only strong, NEV defendants would like to signal by committing to augment the judgment. In the context of arbitration clauses, one can think of a range of "types" of firms, with different expected liabilities at trial, where the customer cannot distinguish between these types (e.g., some firms may generally be better at complying with regulatory requirements). Given the small individual amounts of consumer claims it is not implausible to think that, at least in some matters, a legal action against the signaling firms carries a negative expected value whereas an action agasint other firms bears a positive expected value.

1.1 Related Literature

Our paper mainly relates to the literature on negative expected-value (NEV) lawsuits, and in particular, NEV suits which stem from informational gaps. First, several papers have shown that plaintiffs who possess private information might nonetheless file a negative-value case due to the inability of the defendant to optimally "screen," that is, distinguish between PEV and NEV plaintiffs (Bebchuk 1988; Katz 1990). Other papers have shown how the regular asymmetric information models fail to describe NEV settings. Nalebuff (1987) presents an NEV version of the seminal PEV screening model (Bebchuk 1984), where uninformed plaintiffs propose a take-it-or-leave-it offer to informed defendants. In particular, the regular results are sensitive under the NEV setting to the option of plaintiffs to drop their suit before trial due to its negative value. Accordingly, Nalebuff shows that the standard comparative static results can be flipped due to the plaintiff's desire to maintain a credible threat to sue where the defendant rejects her proposal. Farmer and Pecorino (2007) extend the original pre-trial signaling model (Reinganum and Wilde 1986) to the NEV setting, where informed plaintiffs propose a take-it-or-leave-it offer. Again, the option to drop an NEV case after rejection, even by a single plaintiff with an NEV case, introduces qualitative changes to the traditional results. Hence, unlike the PEV setting, the uninformed defendant cannot maintain revelation by taking some offers to trial, and she has to reject all offers (though filing costs can restore the traditional results).

Other relevant papers are those that consider NEV settings and transmission of information given asymmetric information. Bone (1997) highlights the ability of the uninformed to search for information prior to filing. Farmer and Pecorino (2017) present a screening game in which uninformed plaintiffs make a take-it-or-leave-it offer. They show that informed defendants, who know that the plaintiff's case has a negative expected-value, have strong incentives to voluntarily disclose their information, even if such disclosure entails costs. These incentives could undermine the plaintiff's desire to maintain a credible threat to sue in these situations (compare Nalebuff 1987). Schwartz and Wickelgren (2009b) discuss a model in which uninformed defendants screen informed plaintiffs in two settlements rounds, where the defendant can trigger costly discovery between these two rounds. They show that the threat of discovery could reduce the frequency of NEV suits, although the desire of the defendant to maintain a credible threat to use discovery (compare Nalebuff 1987) limits the ability of the parties to agree on a pre-discovery settlement. Hubbard (2017) considers the general ability of informed plaintiffs to utilize costly signaling (e.g., elaborate pleading) to signal their type. In the NEV context, Hubbard finds a semi-pooling equilibrium, where NEV plaintiffs do not signal (and drop), and PEV plaintiffs reveal their type through the costly signal. Finally, our paper illustrates asymmetries in the roles of plaintiffs and defendants in NEV environments – and it thus relates to other works that show that strategies that exist in equilibrium where defendants are informed may not persist where plaintiffs are informed (and vice versa). Examples include Schwartz & Wickelgren (2009a) and Farmer & Pecorino (2017, pp. 501).

In addition to the literature on NEV settings, our paper relates more generally to literature (which typically focuses on PEV settings) on information transmission in litigation, against a background assumption of private information. Several papers in this group model formal discovery proceedings in the presence of the option to voluntarily disclose (Shavell 1989; Hay 1994; Farmer and Pecorino 2005). Other papers in this branch discuss more subtle avenues to convey, indirectly, private information. Some papers in this group examine the role played by intermediaries such as attorneys (Leshem 2009) and litigation funders (Daughety and Reinganum 2014; Avraham and Wickelgren 2014) in facilitating settlements. Other papers study litigation maneuvers that can indicate information, such as filing for costly injunctions (Jeitschko and Kim 2012) or investing in observable pretrial preparation (Choné and Linnemer 2010). Hubbard (2017) takes a more general approach and discusses costly litigation signals, such as filing fees and elaborate pleadings. In previous work we contributed to this branch by introducing judgment-contingent commitments – which are essentially a socially costless form of signaling (Lavie & Tabbach 2018, 2020). We wish to contribute to the foregoing bodies of literature by discussing the option of judgment-contingent commitments in NEV settings. More specifically, in our paper we utilize as a benchmark setup an NEV continuous-type signaling model in which defendants are privately informed – and to the best of our knowledge this setup has not been modeled in previous literature (regardless of the commitment option).

Finally, we note that our paper is also in the spirit of emerging works that discuss more sophisticated settlement settings. Examples include papers that discuss settlement environments in which parties can condition the amount at trial, with background assumptions of complete information coupled with divergent expectations and risk aversion (Prescott & Spier 2016; Spier & Prescott 2019), or under asymmetric information assumption (Lavie & Tabbach 2020). Another example in this group is settlement negotiations assuming that plaintiffs can short their opponent's stock prior to filing in order to improve bargaining leverage (Choi & Spier 2018).

Our paper proceeds as follows. In section 2 we present out benchmark setup – an NEV continuous-type signaling model in which defendants are privately informed – and solve it. In section 3 we add the option of commitment, by the defendant, to augment the award of the plaintiff conditional on the defendant's loss at trial. Section 4 offers concluding remarks.

2 Signaling by Informed Defendants – Benchmark Case

In this section we will analyze the benchmark case in which informed defendants signal their type through the settlement offer in NEV setting with continuous types. To the best of our knowledge, such a setup was not yet fully analyzed in the literature.

2.1 Setup

Consider a standard asymmetric information model where defendants have private information as to their expected liability at trial, J (for instance, damages may be common knowledge, but the defendant's liability differs with her type). We assume that the cumulative distribution of the expected judgment in the defendant population $F(J)$ is common knowledge, with density $f(J)$ on the support $[\underline{J}, \overline{J}]$. $\underline{J}$ reflects the strongest defendant (whose expected judgment is the lowest), and $\overline{J}$ the weakest defendant (whose expected judgment is the highest). We assume that if the case is adjudicated the defendant and the plaintiff will bear the litigation costs according to the American rule, denoted by

C_D and C_P respectively, independent of defendant type. We will denote the sum of legal expenses $T = C_D + C_P$. We will assume that $\underline{J} > C_P > \overline{J}$, that is, against some of the defendants (probability $F(C_P)$) the case has a negative expected value, from the plaintiff's perspective.[1] All players are assumed to be risk-neutral wealth maximizers.

Strategies and timing: We follow the standard description of pre-trial signaling models (e.g., Reinganum and Wilde 1986), albeit in a an NEV setting. In the first stage, nature assigns a type to each defendant. Then, and before trial commences and litigation costs incurred, the defendant makes a single take-it-or-leave-it settlement offer S to the plaintiff. The plaintiff responds based on her beliefs — the belief system for the plaintiff is a probability function $b(s) \longrightarrow [\underline{J}, \overline{J}]$ that assigns to every S a probability distribution on the support $[\underline{J}, \overline{J}]$. If the plaintiff accepts, the players' payoffs are made according to the settlement offer. Otherwise, the plaintiff can drop the case (with no costs or payoff to either party), or pursue a trial, in which both parties incur litigation costs and the judgment will be rendered according to the defendant's type. We will denote the probability that the plaintiff chooses to accept a settlement S by $p(s)$, and the probability with which he chooses to reject S and go to trial by $t(S)$; hence, the complementary probability, $1 - t(S) - p(S)$, reflects the odds of dropping. In other words, as Figure 1 demonstrates, the plaintiff's responding strategy is a vector function $R : (S) \longrightarrow \{t, p, 1 - p - t\}$:

[1] We will also assume that, given the distribution function $F(J)$ a lawsuit has, on average, a positive expected value for the plaintiff.

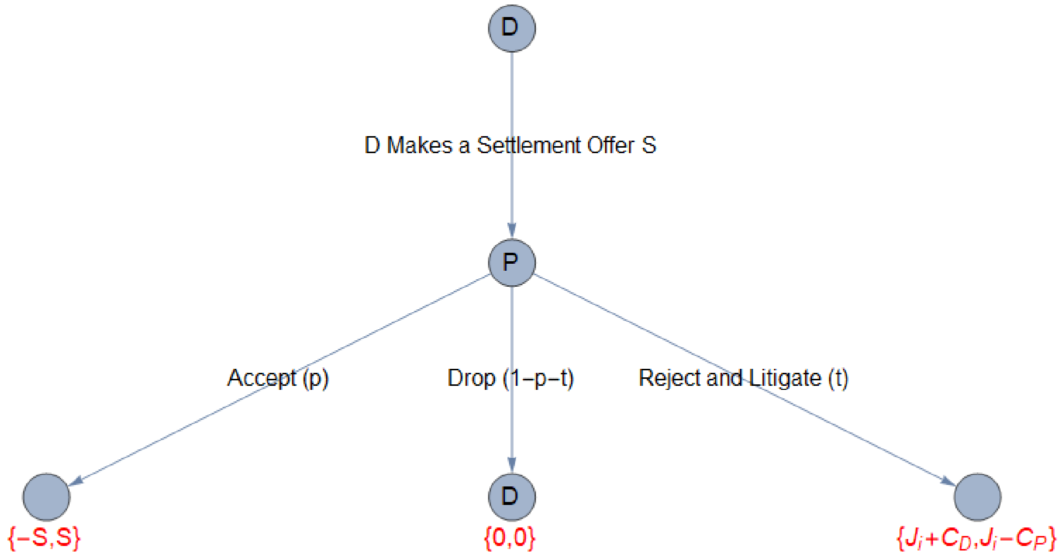

Figure 1: Strategies and Timing

This sequence implies that defendants have all bargaining power. Thus, if information were complete, a defendant of type J_i would have offered $S = \max\{J_i - C_P, 0\}$ – that is, equal to the plaintiff's profit from his best alternative opportunity (dropping if the suit is NEV, litigating otherwise).

Throughout the paper, we utilize a Perfect Bayesian Nash Equilibrium (PBNE) as the solution concept, which takes into account the strategies of the players and a belief system regarding their actions, such that (a) the strategies of the players are sequentially rational, that is, they minimize their costs (or maximize their gains) given the strategies of the other players and the relevant belief system; (b) the belief system is consistent given the strategy profile, that is, it is updated using Bayes' rule and thus realized in equilibrium.

2.2 Equilibrium

In a PEV setting, that is, where $C_P < \underline{J}$, the classic result in a similar setup is a fully-revealing separating equilibrium. In this equilibrium, each informed type makes a truthful settlement offer, and the uninformed accepts these offers according to a function that drives the informed party to fully reveal (Reinganum & Wilde, 1986; Spier, 2007, pp. 275-76). Where defendants are informed, truthful offers $S_i = J_i - C_P$ are accepted in equilibrium according to the function $p(s) = e^{\frac{-(\overline{S}-S)}{T}}$ (where $\overline{S}$ is the truthful offer of the weakest type) (e.g., Lavie & Tabbach 2020). Note that acceptance rate rises with the offer, and the highest offer, from the weakest type, is always accepted. This feature keeps weaker defendants from mimicking to a stronger type (and risking going to trial with a higher probability). Note also that as defendants have all bargaining power, the plaintiff is indifferent in equilibrium between accepting and rejecting the settlement offer.

In the NEV setting, however, the foregoing fully-revealing separating equilibrium cannot exist. In a fully-revealing equilibrium, NEV defendants (that is, for whom $C_P > J$) offer a zero settlement offer, and the plaintiff should strictly prefer to accept – her alternative value from trial is negative. Should the plaintiff accept zero offers with certainty, PEV defendants would always mimic to NEV ones. Hence, the plaintiff cannot always settle with zero offers, and it has to be indifferent between accepting or rejecting these offers (or dropping the case altogether). In order to maintain the plaintiff's indifference, there should be some mimicking in the model on the part of PEV defendants such that taking an offer $S = 0$ to trial has a precise zero value, from the plaintiff's perspective.

Accordingly, a possible equilibrium is one in which the following two conditions are satisfied. First, in addition to NEV defendants who truthfully offer zero, some PEV defendants (up to a cutoff defendant denoted $\widetilde{J}$) mimic and make a zero settlement offer as well. As a result, the plaintiff should be precisely indifferent between accepting zero offers, taking them to trial, or drop the case altogether. Second, the cutoff defendant $\widetilde{J}$ has to be just indifferent between mimicking and revealing (such that the weaker types, $J_i > \widetilde{J}$, find it worthwhile to reveal).

The following proposition characterizes the resulting equilibrium more formally:

Proposition 1 *The following triple $(s_i^*(J), r^*(S), b^*(S))$ is a Perfect Bayesian Nash Equilibrium.*

(i) $s^*(J) = \begin{cases} 0 & \text{for } J < \widetilde{J} \\ J - C_P & \text{for } J \geq \widetilde{J} \end{cases}.$

(ii) $r^*(S) \longrightarrow (t, p, 1-p-t) \begin{cases} 0, 1, 0 & \text{for } S > \overline{S} \\ 1-p(S), p(S), 0 & \text{for } \overline{S} \geq S > 0 \\ 1-p_0, p_0, 0 & \text{for } S = 0 \\ 1, 0, 0 & \text{for } S < 0 \end{cases}.$

(iii) $b^*(S) = \begin{cases} \overline{J} & \text{for } S \geq \overline{S} \\ J = S + C_P & \text{for } \overline{S} > S > 0 \\ \hat{J} & \text{for } S \leq 0 \end{cases}.$

Where:

$$\begin{array}{l} \widetilde{J} : \int_{\underline{J}}^{\widetilde{J}} (J - C_P) f(J) = 0 \\ p_0 = \frac{T * p(\widetilde{S})}{\widetilde{J} + C_D} \\ \overline{S} = \overline{J} - C_P \\ \widetilde{S} = \widetilde{J} - C_P \\ \hat{J}\tilde{\ } G[\underline{J}, \widetilde{J}], E(\hat{J}) = C_P \end{array}.$$

Proof. We will show that the triple $(s_i^*(J), r^*(S), b^*(S))$ is indeed an equilibrium.

*Plaintiff's Best Response***:** Given $b^*(S)$, $r^*(S)$ is a best-response.

(a). For $S \geq \overline{S}$, $b^*(S) = \overline{J}$ and the plaintiff is (at least weakly) better off accepting all offers, i.e., $p = 1, t = 0$. In that case, he gains $S \geq \overline{S}$. If he chooses to litigate $(p = 0, t = 1)$ he expects to receive an equal or lower amount, $\overline{J} - C_P$. If he drops he expects $0 < \overline{S}$. Observe that $S = \overline{S}$ offers are taken to trial according to $p(S) = e^{\frac{-(\overline{S} - S)}{T}}$ and that $p(\overline{S}) = 1$.

(b). For $0 < S < \overline{S}$, $b^*(S)$ is $S + C_P$. In that case, litigating $(t = 1)$ and settling $(p = 1)$ yield precisely S, and both are strictly preferred to dropping for 0. Hence, settling with $p(S)$ and litigating with the complementary probability is a best-response (albeit not uniquely so).

(c). For $S \leq 0$, $b^*(S) = \hat{J}$, where $\hat{J} = C_P$ in expectation. Hence for $S = 0$ the plaintiff is just indifferent between accepting, litigating, and dropping. Accepting in probability $p_0 = \frac{T * p(\widetilde{S})}{\widetilde{J} + C_D}$, rejecting in the complementary probability, and never dropping is therefore a best-response (again, not uniquely so). For similar reasons, for $S < 0$ the plaintiff is indifferent between litigating and dropping, as both yield precisely zero; and both options are strictly preferred to settling. Hence, litigating with certainty, $t = 1$, is a (not-unique) best-response for $S < 0$.

Defendant Best Response: Given $r^*(S)$, $s^*(J)$ is a best-response.

(a). Offering $S < 0$ trigers a trial with certainty, and hence expected liability of $J + C_D$. This strategy cannot be a best-response – it is dominated, for instance, by offering $S = 0$ (and going to trial only with probability $p_0 = \frac{T * p(\widetilde{S})}{\widetilde{J} + C_D} < p(\widetilde{S}) < 1$) (note that $p(\widetilde{S}) < 1$ and $\widetilde{J} > C_P$).

(b). Offering $S > \overline{S}$ yields a settlement S with certainty and cannot be a best-response either. It is dominated, for example, by offering $S = \overline{S}$ (and never going to trial, as $p(\overline{S}) = 1$).

(c). With respect to offers $S \in [0, \overline{S}]$, the following will show that offering $S = 0$ is a best-response for the subset $[\underline{J}, \widetilde{J})$; and offering $S = J - C_P$ is a best-response for the subset $[\widetilde{J}, \overline{J}]$.

(i). Let $L_{PEV}(S) = p(S)S + (1 - p(S))(J + C_D)$ (namely, the defendant's liability had its offer been accepted by $p(S)$). One can verify that, given $p(S)$, $\frac{dL_{PEV}(S)}{dS} = p(S)\frac{(S-(J-C_P))}{T}$; and therefore $S = J - C_P$ minimizes $L_{PEV}(S)$. That is, revealing is the best-response to the plaintiff's accepting with $p(s)$ (recall that the plaintiff accepts with $p(s)$ offers $0 < S \leq \overline{S}$).

(ii). Observe that $\frac{dL_{PEV}(S|_{S=J-C_P})}{dJ} = 1 - p(S) \geq 0$. That is, as the first derivative with respect to J is positive, the (revealing) defendant's liability rises with its type. Observe that $p(S)$ increases with J (for revealing defendants). Hence the second derivative of L_{PEV} with respect to J is negative. Therefore, $L_{PEV}(S|_{S=J-C_P})$ is concave in J.

(iii). Let $L_{NEV}(J) = (1-p_0)(J+C_D) = (1-\frac{T*p(\widetilde{S})}{\widetilde{J}+C_D})(J+C_D)$, that is, a defendant's liablity had it offered a zero settlement. Observe that $\frac{dL_{NEV}(J)}{dJ} = 1 - \frac{T}{\widetilde{J}+C_D}p(\widetilde{S}) > 0$, namely, L_{NEV} strictly (and linearly) rises with J.

(iv). Recall that type $\widetilde{J}$ is indifferent by construction between mimicking and revealing (or: $L_{NEV}(J) = L_{PEV}(S|_{S=\widetilde{J}-C_P})$) (see Equation 2). Observe that $1-\frac{T}{\widetilde{J}+C_D}p(\widetilde{S}) = \frac{\partial L_{NEV}(J)}{\partial J}_{J=\widetilde{J}} > \frac{\partial L_{PEV}(S|_{S=\widetilde{J}-C_P})}{\partial J}_{J=\widetilde{J}} = 1 - p(\widetilde{S})$. That is, at $J = \widetilde{J}$, $L_{NEV}(J)$ rises faster than $L_{PEV}(S|_{S=J-C_P})$. Hence, the types in the subset $(\widetilde{J}, \overline{J}]$ are necessarily better off revealing and offering $S = J - C_P$.

(v). Observe that $L_{NEV}(J|_{J=C_P}) = (1 - p_0)(J + C_D) < L_{PEV}(S|_{S=0}) = (1 - p(0))(J + C_D) = J + C_D$ (as $p_0 = \frac{Tp(\widetilde{S})}{\widetilde{J}+C_D} > p(0) = e^{\frac{-\overline{S}}{T}}$).[2] Recall that L_{NEV} is linear and $L_{PEV}(S|_{S=J-C_P})$ is concave with respect to J; and that the two functions cross each other at $\widetilde{J}$ and for $J \in (\widetilde{J}, \overline{J}]$, $L_{NEV}(J) > L_{PEV}(J, S|_{S=J-C_P})$. Therefore, for the subset $[J = C_P, \widetilde{J})$, $L_{NEV}(J) < L_{PEV}(J, S|_{S=J-C_P})$, namely, defendants in this set are at least weakly better off offering $S = 0$.

[2]This can be verified by a Taylor expansion of the exponential function.

(vi). Similarly, for the defendants in the subset $[\underline{J}, J = C_P)$, it is better off to make a truthful offer $S = 0$ (rather than mimicking higher types and offering $S > 0$). To see this observe that the derivative of the defendant's liability given $S > 0$ offers and $p(s)$ is $\frac{dL_{PEV}(S)}{dS} = p(S)\frac{(S-(J-C_P))}{T}$. As S cannot be negative and this derivative is positive where $S > J - C_P$, any $S > 0$ offer by NEV defendants should be the lowest possible – however, $L_{NEV}(J < C_P) < L_{PEV}(S|_{S=0,J<C_P})$ (for reasons similar to section (c)(v) to the proof concerning the defendant's best-response above).

Finally, observe that the plaintiff's beliefs are realized in equilibrium, as the subset $[\underline{J}, J = C_P]$ makes a truthful offer of zero; defendants in the subset $(J = C_P, \widetilde{J})$ mimic and offer zero as well; and defendants in the subset $[\widetilde{J}, \overline{J}]$ reveal and offer a truthful settlement, $S = J - C_P$. ■

2.3 Discussion

As noted above, in this setup there cannot be a fully-revealing equilibrium, as in that case the plaintiff cannot be indifferent when it faces a zero offer. This characteristic invites some mimicking by PEV defendants. We can point, then, to three groups of defendants. The first is the strongest, NEV defendants, from the strongest defendant to the zero-expected-value (ZEV) one $[\underline{J}, J = C_P]$. Defendants in this group offer a truthful offer of $S = 0$, which is accepted by the plaintiff with a constant probability p_0. The second subset is mimicking PEV defendants from the ZEV defendant to a cutoff defendant $\widetilde{J}$, $(J = C_P, \widetilde{J})$. A lawsuit against defendants in this group bears a positive value – however, these defendants mimic the first group, offer $S = 0$ and are likewise taken to trial with probability p_0. The third subset are the weakest, PEV defendants $J \in [\widetilde{J}, \overline{J}]$. These defendants reveal, offer $S_i = J_i - C_P$, and their offers are accepted by $p(s) = e^{\frac{-(\overline{S}-S)}{T}}$ – this is identical to the familiar equilibrium in PEV signaling models.

Particularly, the semi-separating equilibrium requires two conditions. The first sets the marginal type $\widetilde{J}$, below which all defendant types offer zero (though some are truthful NEV defendants and some are PEV types who mimic). The marginal type $\widetilde{J}$ should be set such that for the plaintiff who faces a zero offer the expectation of trial, with expected value $J - C_P$, equals zero given that $[\underline{J}, \widetilde{J})$ mimic:

$$0 = \int_{\underline{J}}^{\widetilde{J}} (J - C_P) f(J). \tag{1}$$

The second condition requires that the cutoff defendant $\widetilde{J}$ is indifferent between mimicking and offering zero (but risking a trial with probability p_0 should the plaintiff reject); and revealing by offering $S(\widetilde{J}) = \widetilde{J} - C_P$. The following equation expresses this condition, where the left-hand (right-hand) size is the value of mimicking (revealing):

$$(1 - p_0)(\widetilde{J} + C_D) = p(s(\widetilde{J}))(\widetilde{J} - C_P) + (1 - p(s(\widetilde{J})))(\widetilde{J} + C_D). \tag{2}$$

Equation 2 yields the acceptance rate for zero offers:

$$p_0 = \frac{T * p(\widetilde{S})}{\widetilde{J} + C_D}.$$

As the proof shows, this condition implies that $J_i > \widetilde{J}$ types strictly prefer to reveal by offering $J - C_P$ (which will be accepted by the regular acceptance function, $e^{\frac{-(\overline{S}-S)}{T}}$).

We can now characterize the players payoffs. The plaintiff gains (in expectation) zero from the first two groups (that is, $[\underline{J}, \widetilde{J})$) and $J - C_P$ from the remaining one, hence its overall payoff is:

$$\pi(P) = \int_{\widetilde{J}}^{\overline{J}} (J - C_P) f(J). \tag{3}$$

The defendants in the subset $J \in [\underline{J}, \widetilde{J})$, who offer $S = 0$, pay:

$$L\left(S|_{S^*=0}\right) = (1 - p_0)(J + C_D),$$

which linearly rises in J.

The defendants in the last group $J \in [\widetilde{J}, \overline{J}]$ pay according to the familiar acceptance function, which is concave in J (see the proof of Proposition 1, section (c)(ii) concerning the defendant's best-response):

$$L(S|_{S^*=J-C_P}) = p(S)(J - C_P) + (1 - p(S))(J + C_D).$$

It can be useful to illustrate this equilibrium through the following numerical example. Let $\underline{J} = 20$, $\overline{J} = 100$, and J uniformly distributed. Suppose also that $C_P = C_D = 40$.

Under these assumptions it is easy to see that the ZEV J is $J = 40$, and likewise, given the uniform distribution, the cutoff $\widetilde{J}$ equals 60. Hence, defendants $20 - 60$ offer zero (where defendants $40 - 60$ mimic) and defendants $60 - 100$ reveal and offer $S = J - C_P$. One can verify that the acceptance rate of zero offers, p_0, is 48.5%. However, revealing offers – starting from the cutoff type who offers $\widetilde{J} - C_P = 20$, are accepted by the familiar acceptance function, from $p(S = 20) =$ ˜61% for $\widetilde{J}$ to $p(S = 60) = 100\%$ for $\overline{J}$. The following, Figure 2, depicts the unusual pattern of acceptance rate in equilibrium in this setup and numerical example, where the x-axis expresses the defendant's type and the y-axis expresses the rate of acceptance in equilibrium for each:

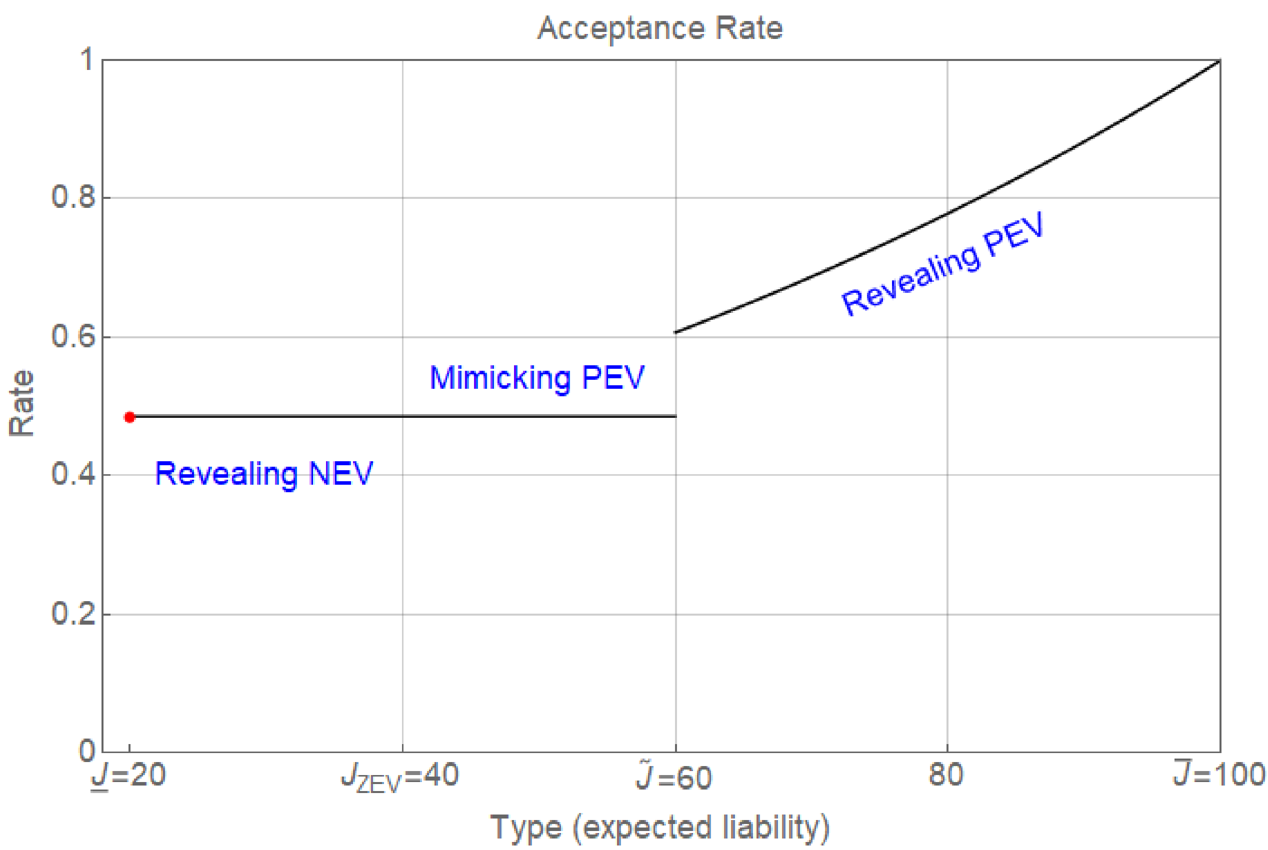

Figure 2: Acceptance Rate, Benchmark Equilibrium

3 Judgment-Contingent Commitments and ZEV Cases

3.1 Setup

In a previous paper we introduced a simple variation to pre-trial signaling models – monetary commitments by litigants, conditional on the judgment at trial. To think about contingent commitments in our setup, suppose that, in addition to proposing S, the defendant can also commit to augment the award at trial – if trial occurs and the plaintiff wins – by a factor $K \geq 1$. Practically, the commitment to augment the award at trial by $K \geq 1$ resembles a one-way fee-shifting stipulation, in which the defendant, but not the plaintiff, agrees to reimburse the plaintiff for his trial expenses should the latter win at trial.[3] We refer to such commitments as judgment-contingent commitments, and assume that they are enforceable under the law. We note that K must be greater or equal to 1, as defendants cannot commit to reduce the plaintiff's award at trial.

The introduction of the choice variable K means that, under this setup the strategy for the defendant is to propose an offer that consists of a pair of variables, S and K, or, $O : (S) \longrightarrow \{S, K\}$. Note that $K = 1$ captures the standard case, where the defendant does not commit to augment the award contingent on losing at trial. Intuitively, however, $K > 1$ commitments can be a beneficial signaling device. As they are more harmful to weaker types, whose expected liability at trial is larger, stronger types can harness judgment-contingent commitments to better indicate their type, reduce mimicking, and increase the rate of acceptance of low offers.

A particularly interesting multiplier, to which NEV defendants can commit, is $K_{ZEV} = \frac{C_P}{J_i}$. Observe that this K turns the plaintiff's case precisely into a zero-expected one. Observe also that K_{ZEV} depends on each defendant's type – such that the defendant with the strongest case, $\underline{J}$, has the highest K_{ZEV}. The marginal, ZEV defendant, that is, $J = C_P$, has a $K_{ZEV} = 1$.

Below we charaterize an equilibrium under this setup. We show that the option to commit to K drives a fully-separating equilibrium. In this equilibrium, NEV defendants

[3] Litigation expenses are commonly thought to be in the in the magnitude of one-third of the judgment. Thus, a one-way fee-shifting stiupulation against the informed defendant is akin to a commitment to augment the award at trial by $K = 1.33$.

reveal their type by offering $S=0$ and truthfully committing to each one's $K_{ZEV}=\frac{C_P}{J_i}$. Intuitively, the greater the commitment K the higher the rate of settlements – accordingly, the plaintiff accepts $S=0$ offers according to the function $p_0(K)$, which increases in K. Thus, in equilibrium stronger defendants commit to a higher K_{ZEV} and are taken to trial less frequently. The fact that the commitment to K_{ZEV} transforms the plaintiff's case into a ZEV one enables to maintain the plaintiff indifferent in equilibrium without mimicking by PEV defendants. Indeed, unlike the benchmark model, all PEV defendants reveal their type by offering $S=J_i-C_P$ (and refraining from committing, that is, they set $K=1$).

We can now fully characterize the equilibrium in which the defendant can commit to augment the award at trial by $K\geq 1$:

3.2 Equilibrium

Proposition 2 *The following triple $(o_i^*, r^*(S), b^*(S))$ is a Perfect Bayesian Nash Equilibrium.*

$$\text{(i) } o^*(S,K)=\begin{cases} 0, K_{ZEV} & \text{for } J<C_P \\ J-C_P, 1 & \text{for } J\geq C_P \end{cases}.$$

$$\text{(ii) } r^*(S,K)\longrightarrow (t,p,1-p-t)\begin{cases} 1,0,0 & \text{for } S>\overline{S},\ K>\frac{S+C_P}{\overline{J}} \\ 0,1,0 & \text{for } S>\overline{S},\ K\leq\frac{S+C_P}{\overline{J}} \\ 1-p(S),p(S),0 & \text{for } 0<S\leq\overline{S}, K=1 \\ 1,0,0 & \text{for } 0<S\leq\overline{S}, K>1 \\ 1-p_0(K),p_0(K),0 & \text{for } S=0, \frac{C_P}{\underline{J}}\geq K \\ 1,0,0 & \text{for } S<0, \frac{C_P}{\underline{J}}\geq K \\ 1,0,0 & \text{for } S\leq 0, \frac{C_P}{\underline{J}}<K \end{cases}$$

$$\text{(iii) } b^*(S)=\begin{cases} \frac{C_P}{K} & \text{for } S\leq 0, \frac{C_P}{\underline{J}}\geq K \\ \underline{J} & \text{for } S\leq 0, \frac{C_P}{\underline{J}}<K \\ J=S+C_P & \text{for } \overline{S}\geq S>0 \\ \overline{J} & \text{for } S>\overline{S} \end{cases}.$$

Where:

$$\begin{aligned} K_{ZEV} &= \frac{C_P}{J} \\ p_0(K) &= 1+(e^{\frac{-(\overline{J}-C_P)}{T}}-1)K^{\frac{-C_P}{T}} \\ p(S) &= e^{\frac{-(\overline{S}-S)}{T}} \\ \overline{S} &= \overline{J}-C_P \end{aligned}.$$

Proof. We will show that the triple $(s_i^*(J), r^*(S), b^*(S))$ is indeed an equilibrium.

Plaintiff's Best Response: Given $b^*(S)$, $r^*(S,K)$ is a best-response.

(a). For $S > \overline{S}$, $b^*(S) = \overline{J}$, and the plaintiff expects $K\overline{J} - C_P$ from trial and 0 from dropping.

(i). Accordingly, if $S \geq K\overline{J} - C_P$, or, $K \leq \frac{S+C_P}{\overline{J}}$, the plaintiff is at least weakly better off settling for S.

(ii). Likewise, if $K > \frac{S+C_P}{\overline{J}}$, the plaintiff is better off going to trial.

(b). For $\overline{S} \geq S > 0$ and $K = 1$, $b^*(S) = S + C_P$. The plaintiff, then, expects a gain of S from going to trial as well as settling, and 0 from dropping. As the plaintiff is indifferent between going to trial and settling, settling in probability $p(S)$ (and going to trial in the complementary probability) is a best-response (though not uniquely so).

(c). For $\overline{S} \geq S > 0$ and $K > 1$, $b^*(S) = S + C_P$. The plaintiff thus expects 0 from dropping, S from settling, and $K(S + C_P) - C_P = KS + (K-1)C_P$ from going to trial. One can observe that the plaintiff is strictly better off going to trial.

(d). For $S = 0$, $\frac{C_P}{\underline{J}} \geq K$, $b^*(S) = \frac{C_P}{K}$. The plaintiff expects zero from all options – settling for 0, going to trial (and gaining $\frac{C_P}{K}K - C_P$ in expectation), or dropping. As a result, settling for $p_0(K)$ (and going to trial in the complementary probability) is a best-response (though not uniquely so).

(e). For $S < 0$, $\frac{C_P}{\underline{J}} \geq K$, $b^*(S) = \frac{C_P}{K}$. The plaintiff is now indifferent between going to trial or dropping (both yield 0), and is worse off accepting a negative settlement. Hence, going to trial is a (not unique) best-response.

(f). For $S \leq 0$, $\frac{C_P}{\underline{J}} < K$, $b^*(S) = \underline{J}$. The plaintiff gains at most zero from settling and zero from dropping, whereas going to trial under the multiplier gives a positive payoff, $K\underline{J} - C_P$ (as $\frac{C_P}{\underline{J}} < K$). Hence, the plaintiff strictly prefers to litigate.

Defendants' Best Response: Given $r^*(S, K)$, $o^* = \{S, K\}$ is a best-response.

(a). Offering $S > \overline{S}$ cannot be a best-response.

(i). An offer of $S > \overline{S}$ and $K > \frac{S+C_P}{\overline{J}}$ will be taken to trial with certainty, resulting in expenses of $KJ + C_D > J + C_D$. Any defendant can do better, for instance, by offering $S = 0, K = 1$. This results in expected liablity of $(1 - e^{\frac{-(\overline{J}-C_P)}{T}})(J + C_D) < J + C_D$.

(ii). An offer of $S > \overline{S}$ and $K \leq \frac{S+C_P}{\overline{J}}$ will be settled with certainty. A defendant can do better, for instance, by offering $\overline{S}$, which will always be accepted (observe that $p(\overline{S}) = e^{\frac{-(\overline{S}-S)}{T}} = 1$).

(b). Offering $0 < S \leq \underline{S}, K > 1$ cannot be a best-response. In that case, the defendant will always be taken to trial. Alternatively, the defendant can, for instance, offer $S = 0, K = 1$ (and be taken to trial with some probability).

(c). Offering $S < 0, \frac{C_P}{\underline{J}} \geq K$ or $S \leq 0, \frac{C_P}{\underline{J}} < K$ cannot be a best-response, as in these cases the defendant will again be taken to trial always (whereas the defendant can alternatively offer $S = 0$ and $K = 1$ and be taken to trial with only some probability).

(d). With respect to offers $S \in (0, \overline{S}]$, the following will show that offering $\{S = J - C_P, 1\}$ is a best-response for the subset $[J = C_P, \overline{J}]$; and offering $\{S = 0, K_{ZEV}\}$ is a best-response for the subset $[\underline{J}, J = C_P)$.

(i). Let $L_{PEV}(S) = p(S)S + (1 - p(S))(J + C_D)$ (namely, the defendant's liability had its offer been accepted by $p(S)$). Similarly to the proof of Proposition 1, one can verify that, given $p(S)$, $\frac{dL_{PEV}(S)}{dS} = p(S)\frac{(S-(J-C_P))}{T}$; and therefore $S = J - C_P$ minimizes $L_{PEV}(S)$. That is, revealing is the best-response to the plaintiff's accepting with $p(s)$ (recall that the plaintiff accepts with $p(s)$ where $o(S, K) = \{0 < S \leq \overline{S}, K = 1\}$).

(ii). Let $L_{NEV}(0, K) = (1 - p_0(K))(J + C_D) = (1 - e^{\frac{-(\overline{J}-C_P)}{T}})K^{\frac{-C_P}{T}}(KJ + C_D)$, that is, a defendant's liablity had it offered a zero settlement and a multiplier K. One can verify that $K = \frac{C_P}{J_i}$, namely, K_{ZEV}, solves the first-order conditions.[4] Alternatively put, where the defendant offers zero and the plaintiff responds with $r^*(0, K) = \{1 - p_0(K), p_0(K), 0\}$, the defendant is better off setting the multiplier K to precisely K_{ZEV}.

(iii). Further observe that the ZEV defendant, $J = C_P$, is indifferent between L^*_{NEV} and L^*_{PEV}. Or, $L^*_{NEV}(S = 0, K_{ZEV} = 1) = (1 - e^{\frac{-(\overline{J}-C_P)}{T}})(J + C_D) = L^*_{PEV}(S^* = 0, K = 1)$. Therefore, offering $o^*(J - C_P, 1)$ is a (not unique) best response for that type.

(iv). PEV defendants, $J > C_P$, are better off revealing and offering $\{J - C_P, 1\}$ than mimicking and offering $\{0, K\}$.

1. To see this recall that an offer $\{0, K\}$ will be accepted according to $p_0(K)$, and thus the defendant's liablity would be $L_{NEV}(0, K)$. By deriving $\frac{dL_{NEV}(0,K)}{dK} = \frac{-(e^{\frac{-\overline{J}}{T}} - e^{\frac{-C_P}{T}})C_D e^{\frac{-\overline{J}}{T}} K^{-1-\frac{C_P}{T}}(C_P - JK)}{C_D + C_P}$ one can observe that $L_{NEV}(0, K)$ is increasing (decreasing) with K as long as K is greater (smaller) than K_{ZEV}. However, note that for PEV defendants $K_{ZEV} = \frac{C_P}{J} < 1$, meaning that any legally possible $K \geq 1$ will be smaller

---

4 $\frac{dL_{NEV}(S=0,K)}{dK} = \frac{-(e^{\frac{-\overline{J}}{T}} - e^{\frac{-C_P}{T}})C_D e^{\frac{-\overline{J}}{T}} K^{-1-\frac{C_P}{T}}(C_P - JK)}{C_D + C_P}$.

than K_{ZEV}. Hence, PEV defendants who wish to mimic and offer $S = 0$ are better off decreasing K to its lowest possible value, that is, $K = 1$.

2. Now observe that for PEV defendants $L_{NEV}(0,1) = (1 - e^{\frac{-(J-C_P)}{T}})(J + C_D) = L_{PEV}(0,1)$, but $L_{PEV}(0,1) > L^*_{PEV}(J - C_P, 1)$, as an offer $\{S^*, 1\}$ minimizes liability under $L_{PEV}(S,K)$ (see section (d)(i) to the proof above concerning the defendant's liability). Therefore, PEV defendants are better off revealing.

(v). NEV defendants $J < C_P$ are better off revealing and offering $\{0, K_{ZEV}\}$ than mimicking and offering $\{S > 0, 1\}$.

1. To see this similarly observe that $\frac{d\partial L_{PEV}(S)}{dS}$ is positive (negative) where S is greater (smaller) than $S^* = J - C_P$. NEV defendants who wish to mimic to PEV ones should offer $S > 0 > J - C_P$. This mandates that NEV defendants who mimic to PEV ones should set S at its minimal value, $S = 0$ (or $0 + \epsilon$).

2. However, for NEV defendants $L_{PEV}(0,1) = L_{NEV}(0,1)$, but $L^*_{NEV}(0, K_{ZEV}) < L_{NEV}(0,1)$, as we have already shown that K_{ZEV} minimizes liability under $L_{NEV}(0,1)$, where $S = 0$ (see section (d).(ii) to the proof above). Therefore, NEV defendants are better off revealing and offering the set $\{0, K_{ZEV}\}$.

Finally observe that the plaintiff's beliefs are realized in equilibrium as all types reveal.

■

3.3 Discussion

The contingent-commitment setup is similar in spirit to the basic one. However, its results are materially different. The option to signal through committing to the choice variable K affects the NEV defendants costs function. A revealing NEV defendant, who offers $S = 0$, can now expect to incur:

$$L(S|_{S^*=0}, K) = (1 - p_0(K))(KJ + C_D).$$

In a fully-revealing equilibrium, the plaintiff must be indifferent between accepting or going to trial. In order to achieve such an equilibrium, NEV defendants have to commit to $K_{ZEV} = \frac{C_P}{J_i}$ – such that the plaintiff gains zero from settling for 0, going to trial (and expecting $K_{ZEV}J - C_P$), or dropping. In this revealing equilibrium, PEV defendants will reveal their type (without commiting to a multiplier $K > 1$) under the familiar acceptance function $p(S) = e^{\frac{-(\overline{S}-S)}{T}}$.

We can construct this fully-revealing equilibrium by finding the acceptance function p_0 that drives each NEV defendant to commit to "her" K_{ZEV}. To do so, we can calculate the first derivative, $\frac{dL_{S=0,K}}{dK} = J(1 - p_0(K)) - p_0'(K)(KJ + C_D)$, and equate to zero at $K = \frac{C_P}{J}$. This results in the following first order differential equation:

$$p_0'(K) + \frac{C_P}{TK}p(K) = \frac{C_P}{TK},$$

whose general solution is $p_0(K) = 1 + \lambda K^{\frac{-C_P}{T}}$, where λ a positive constant. We can extract the constant λ using the boundary condition – as the ZEV type, $J = C_P$, should be taken to trial according to the familiar acceptance function $p(S) = e^{\frac{-(\overline{S}-S)}{T}}$. This yields the acceptance function for NEV defendants:

$$p_0(K) = 1 + (e^{\frac{-(\overline{J}-C_P)}{T}} - 1)K^{\frac{-C_P}{T}}.$$[5]

In the resulting equilibrium, then, all types reveal. NEV types offer $\{0, K_{ZEV}\}$ and their offers are accepted according to $p_0(K)$; PEV types offer $\{S^* = J - C_P, 1\}$ and their offers are accpeted according to $p(S)$. Note that the two acceptance functions have different patterns. The acceptance function for NEV defendants, $p_0(K)$, increases in K; as $K^* = K_{ZEV}$ decreases with the type J, $p_0^*(K)$ decreases with the type J. The PEV acceptance function $p(S) = e^{\frac{-(\overline{S}-S)}{T}}$ rises with S where S^* rises with the type J. To following Figure illustrates this interesting pattern, using our previous numerical example $(U[20, 100], C_D = C_P = 40)$, where the x-axis expresses the defendant's type and the y-axis expresses the rate of acceptance for each type in equilibrium:

One can observe that the rate of settlements in equlibrium decreases from the strongest defendant, who settles at a rate of ˜ 63%, to the ZEV defendant, who settles at the lowest rate, ˜47%. The settlement rate rises again with the type, and the weakest defendant settles with certainty.

We can now check the players' payoffs. The plaintiff, by construction, expects zero from NEV defendants and $J - C_P$ from PEV ones:

$$\pi(P) = \int_{J=C_P}^{\overline{J}} (J - C_P) f(J).$$

Note that the plaintff is strictly better off compared to the previous, semi-separating equlibrium – since fewer defendants mimic as NEV ones.

Defendants' payoff depend on their subset – NEV or PEV. The expected costs of PEV defendants are identical to revealing PEV defendants in the benchmark equilibrium, as they likewise reveal and are taken to trial at $1 - p(S)$:

$$L(S|_{S^{*}=J-C_P}) = p(S)(J - C_P) + (1 - p(S))(J + C_D)$$

NEV defendants offer 0 and are taken to trial in $1 - p(K)$, hence their expected costs are:

$$L\left(S|_{S^{*}=0}\right) = (1 - p_0(K))(KJ + C_D).$$

It is interesting to compare the defendant's liability under the benchmark and the commitment equilibrium. Recall that in the benchmark equilibrium we have three different groups of defendants – the NEV, the mimicking PEV, and the revealing PEV. In the fully-separating, commitment equiliblirum, we have only two groups: NEV and PEV defendants, as the mimicking PEV defendants are now revealing their type. Consider each group's expected liability under each scenario:

- The revealing PEV defendants $[\widetilde{J}, \overline{J}]$: these are the weakest types, with the highest liability. As their liabiliity function is identical under both scenarios (in both they reveal and are taken to trial under the same acceptance function, $e^{\frac{-(\overline{S}-S)}{T}}$), they are indifferent between the two scenarios.

- The mimicking PEV defendants, $[J = C_P, \widetilde{J})$: this is the intermediate group, in terms of liability. In the first scenario, they mimic and offer zero. In the commitment equilibrium they reveal with no commitment. Recall that in the benchmark equilibrium this group preferred mimicking to revealing (under the same, $e^{\frac{-(\overline{S}-S)}{T}}$, acceptance function). Hence, these defendants are better off under the benchmark equilibrium. (Note that, by the benchmark equilibrium's construction, Equation 2, $\widetilde{J}$ is indifferent between revealing and mimicking and thus is also indifferent between the two equilibria).

- The NEV defendants, $[\underline{J}, J = C_P)$: these defendants reveal and offer zero in both scenarios. In the benchmark case, their offer is accepted with a constant probablity, $p_0 = \frac{Tp(\widetilde{S})}{\widetilde{J}+C_D}$; in the commitment equilibrium, their offer is accepted according to $p_0(K)$, which rises with K (where K decreases with the type J). Defendants in this group may or may not be better off under the commitment equilibrium. Note first that the ZEV defendant, $J = C_P$, strictly prefers the benchmark scenario to the commitment equlibrium, as $p_0 = \frac{Tp(\widetilde{S})}{\widetilde{J}+C_D} > p(S = 0) = p_0(S = 0, K = 1) = e^{\frac{-\overline{S}}{T}}$ (see the proof of Proposition 1, section (c).(v) to the defendant's best-response). Stronger NEV types commit to higher K's under the commitment option, and thus they gain a better settlement rate. By contrast, the acceptance rate for this group under the benchmark equilibrium is uniform. Stronger types, therefore, may find the commitment equilibrium more valuable.

Which equlibrium, then, is superior from a societal perspective? There are reasons to think that the new equilibrium is, by and large, socially beneficial.

First, to the extent that compensation to the victim has a social value, the commitment equilibrium is preferable as the plaintiff is strictly better off.

Second, in terms of overall settlement rate, our recurrent numerical example suggests that the commitment equilibrium could entail more settlements. To see this, Figure 3 replicates Figure 2 and superimposes the acceptance rate under the benchmark equlibrium. The solid (dashed) lines represents acceptance rate under the commitment (benchmark) equilibrium:

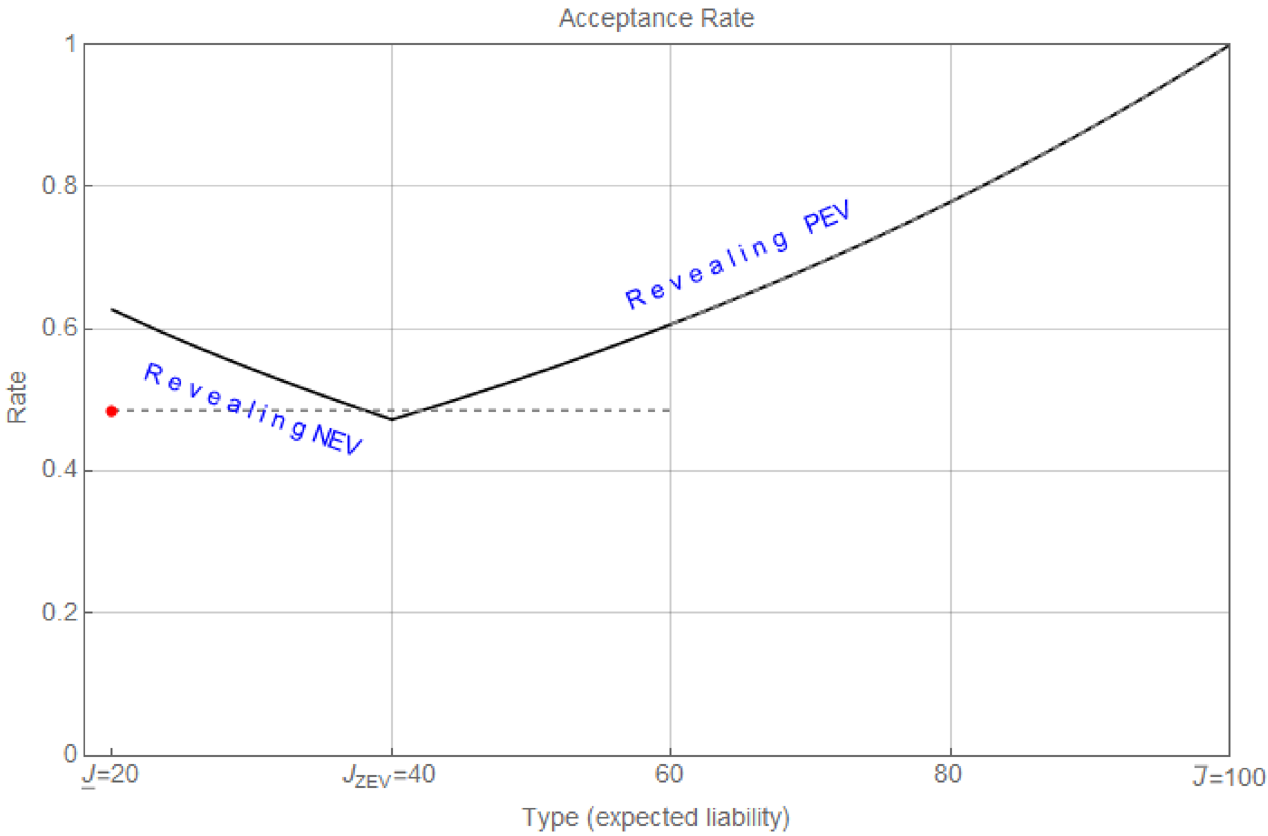

Figure 3: Acceptance Rate, Comparison

Observe first that $J = 60$ and all weaker types, that is, $J \geq \widetilde{J}$, share the same acceptance rate under both scenarios (that is, the slopes converge). Observe also that the ZEV defendant, $J = C_P = 40$, enjoys a higher acceptance rate under the benchmark case – in the benchmark case all zero offers are accepted at a constant rate of 48.5%, whereas in the commitment equilbirium she settles with a 47.2% probability.[6] As we showed above, this feature – a higher acceptance rate for the ZEV defendant under the benchmark case – is not an artifact of our numerical example. By contrast, the acceptance rate under the commitment equilibrium rises as NEV defendants become stronger – and at some point it surpasses the rate of settlements under the benchmark case. For instance, under the commitment equilibrium the strongest type, $J = 20$, commits to $K = \frac{C_P}{J} = 2$ and settles at a rate of 62.7%; but she (and other defendants who offer zero) settle at a rate of 48.5% under the benchmark case. Figure 4, then, suggests that the commitment equilibrium

[6] Accordingly, the ZEV defendant strictly prefers the benchmark case – in both cases she offers in equilibrium $S = 0$ without guaranteeing to augment the judgment.

saves litigation expenses. However, this statement depends on the distribution of cases.[7] Likewise, to the extent the cases that do reach trial are more expensive to litigate due to the multiplier K, the commitment equilibrium might entail extra litigation expenses.

Finally, the commitment equilibrium seems to promote deterrence. This relates to the fact that the strongest defendants are relatively better off under the fully-revealing, commitment equilibrium – as they can commit to a larger K and enjoy more settlements. By contrast, weaker defendants, who mimic in the benchmark case, are strictly worse off under the commitment equilibrium. This suggests, by and large, that the commitment option better separates the types, creating more incentives to take care.

In sum, then, the mere possibility to commit to augment the award at trial triggers a materially different equilibrium. Most notably, in the commitment equilibrium we should expect the strongest, NEV types to commit to larger K's. This triggers full revelation and, depending on the distribution, fewer trials. In a previous work (Lavie & Tabbach 2020) we found that in PEV settings such a commitment is counter-productive to the defendant, and that, in order to commit to augment the judgment, defendants have to ask for a side-payment from the plaintiff – a more complicated transaction. This discrepancy merits explanation. In PEV settings, the uninformed's commitment to augment the judgment contingent on losing implicates three different considerations. First, it punishes mimicry and thus it better signals the informed party's type; this allows the uninformed to take fewer cases to trial to maintain equilibrium. Second, the commitment increases the expected liability of the committing party, should the uninformed reject her offer and take her to trial. Third, judgment-contingent commitment requires the uninformed to increase her settlement offer – as now the uninformed's gain from trial is larger. The first consideration encourages judgment-contingent commitments whereas the other two discourage them. However, the third consideration is eliminated in NEV settings. As the committing, NEV defendants offer $S = 0$, and the expected value from going to trial is negative, committing to augment the judgment up to K_{ZEV} does not affect the settlement offer. To illustrate, the strongest defendant in our example, $J = 20$, can

[7] Suppose that, rather than a uniform distribution, there is a sufficient mass of defendants symmetrically around $J = C_P$. This modification does not alter the rates of settlements that Figure 4 depicts. However, at some point it should make the overall rate of settlements lower in the benchmark case.

commit to $K \leq 2$, and, given that $C_P = 40$, her settlement offer $S = 0$ is unaffected by the commitment. This slack between the expected value of trial and the settlement offer facilitates judgment-contingent commitments in NEV settings. Indeed, in the resulting equilibrium, PEV defendants do not commit to $K > 1$; and NEV defendants find it optimal to commit precisely to K_{ZEV} (but not more than that).

4 Concluding Remarks

We analyze in this paper commitments to augment the award at trial in NEV signaling settings where defendants have private information. We find that the option to commit allows a fully-revealing equilibrium, in which NEV defendants commit to multiply the award at trial by precisely $\frac{C_P}{J_i}$ (and are taken to trial less often the higher this multiplier becomes). This multiplier transforms the plaintiff's case into a zero expected-value one, hence we denote this multiplier K_{ZEV}. As previous work has shown that judgment-contingent commitments in PEV settings are not implementable without a side-payment, we conclude that, by and large, the NEV environment is more conducive to such commitments.[8] Indeed, anecdotal evidence indicate a possible important example for the implementation of judgment-contingent multipliers in NEV settings – arbitration provisions in standard-form contracts. Nonetheless, it seems that judgment-contingent commitments are, by and large, not prevalent in practice in both the NEV and PEV settings for a variety of other reasons, e.g., lawyer-client agency problems (Lavie & Tabbach 2018, 2020).

Finally, we note that our results cannot be generalized to the reverse setting, where informed plaintiffs, some of which have an NEV suit, propose a take-it-or-leave-it offer. In this sense, our paper is in line with other papers that point to asymmetries in NEV settings between defendants and plaintiffs (e.g., Schwartz & Wickelgren (2009a)). First, observe that in the reverse case, should the defendant reject the plaintiff's offer, PEV plaintiffs proceed to trial whereas NEV plaintiffs are better off dropping. Thus, an uninformed

[8] As a side note, we see other practical advantages for judgment-contingent commitments in NEV settings. For instance, in the PEV setting plaintiff's risk-aversion lowers the side-payment that it needs to pay, rendering judgment-contingent commitments futile in some cases (Lavie & Tabbach 2020). By contrast, in the NEV environment, with no side-payment the plaintiff's attitudes to risk do not change the results (recall that the plaintiff is strictly better off under the commitment option).

defendant cannot maintain revelation by forcing some settlement offers to go to trial, and she has to reject all offers (Farmer and Pecorino 2007).[9] Furthermore, the gist of our analysis lies in the possibility of privately informed, strong, NEV defendants to commit to self-penalize conditional on losing at trial – without altering their settlement offer (they offer zero regardless of the option to commit). Where plaintiffs are privately informed we would again expect the strong types to utilize judgment-contingent commitments in order to signal their strength and reduce the rate at which they are taken to trial. However, in NEV settings in which the plaintiff is informed, strong types have a larger expected gain at trial than the weak types – and the strong plaintiff's settlement offer thus has a positive-value (the weak plaintiffs are those who have an NEV suit). Hence, any self-penalizing commitment by strong plaintiffs would have to be reflected in the settlement offer. This feature hinders the desirability of self-penalizing commitments by strong plaintiffs in NEV settings (by the same logic, self-penalizing commitments in PEV settings cannot be realized without a side-payment).

[9] We might think of a commitment on the part of strong, PEV plaintiffs to proceed to trial after rejection, which the NEV types would not mimic (compare Bone 1997, pp. 572-576). One may wonder, though, whether NEV types cannot commit to proceed to trial and renegotiate after rejection.

References

[1] Avraham, Ronen and Abraham Wickelgren. 2014. "Third-Party Litigation Funding – A Signaling Model." *DePaul Law Review* 63:233-64.

[2] Bebchuk, Lucian Arye. 1984. "Litigation and Settlement under Imperfect Information." *RAND Journal of Economics* 15:404-15.

[3] Bone, Robert G. 1997. "Modeling Frivolous Suits." *University of Pennsylvania Law Review* 145:519-605.

[4] Chandrasekher, Andrea Cann, and David Horton. 2019. "Arbitration Nation: Data from Four Providers," *California Law Review* 107:1-65.

[5] Choi, Albert H., and Kathryn E. Spier. 2020. "The Economics of Class Action Waivers." *Yale Journal on Regulation* (forthcoming).

[6] Choné, Philippe and Laurent Linnemer. 2010. "Optimal Litigation Strategies with Observable Case Preparation." *Games and Economic Behavior* 70: 271–88.

[7] Daughety, Andrew F., and Jennifer F. Reinganum. 2014. "The Effect of Third-Party Funding of Plaintiffs on Settlement." *American Economic Review* 104: 2552–66.

[8] Consumer Financial Protection Bureau. 2015. "Arbitration Study." Available at: https://files.consumerfinance.gov/f/201503_cfpb_arbitration-study-report-to-congress-2015.pdf.

[9] Farmer, Amy, and Paul Pecorino. 2007. "Negative Expected Value Suits in Signaling Model," *Southern Economic Journal* 74:434-447.

[10] Farmer, Amy, and Paul Pecorino. 2017. "Costly Voluntary Disclosure with Negative Expected Value Suits," *American Law and Economics Review* 19:486-503.

[11] Hay, Bruce. 1994. "Civil Discovery: Its Effects and Optimal Scope," *Journal of Legal Studies* 23:481-515.

[12] Hubbard, William H.J. 2016. "Sinking Costs to Force or Deter Settlement," *Journal of Law, Economics, and Organization* 32:545–85.

[13] Hubbard, William H.J. 2017. "Costly Signaling, Pleading, and Settlement." University of Chicago Coase-Sandor Institute for Law & Economics Research Paper No. 805. Available at SSRN: https://ssrn.com/abstract=2947302.

[14] Jeitschko Thomas D., Byung-Cheol Kim. 2012. "Signaling, Learning, and Screening Prior to Trial: Informational Implications of Preliminary Injunctions." *Journal of Law, Economics and Organization* 29:1085-1113.

[15] Lavie, Shay, and Avraham Tabbach. 2018. "Litigation Signals," *Santa Clara Law Review* 58:1-57.

[16] Lavie, Shay, and Avraham Tabbach. 2020. "Judgment-Contingent Settlements," *Journal of Law, Economics, and Organization* 36:170-206.

[17] Leshem, Shmuel. 2009. "Contingent Fees, Signaling and Settlement Authority." *Review of Law and Economics* 5:435-60.

[18] Nalebuff, Barry. 1987. "Credible Pretrial Negotiation," *RAND Journal of Economics* 18:198-210.

[19] Prescott, J.J. & Kathryn E. Spier. 2016. "A Comprehensive Theory of Civil Settlement." *New York University Law Review* 91:59-143.

[20] Reinganum, Jennifer F., and Louis L. Wilde. 1986. "Settlement, Litigation, and the Allocation of Litigation Costs," *RAND Journal of Economics* 17:557–66.

[21] Schwartz, Warren F. and Abraham L.Wickelgren. 2009a. "Advantage Defendant: Why Sinking Litigation Costs Makes Negative Expected Value Defenses, but not Negative Expected Value Suits, Credible," *Journal of Legal Studies* 38:235–53.

[22] Schwartz, Warren F. and Abraham L.Wickelgren. 2009b. "Credible Discovery, Settlement, and Negative Expected Value Suits," *RAND Journal of Economics* 40:636–57.

[23] Shavell, Steven. 1989."Sharing of Information Prior to Settlement or Litigation," *RAND Journal of Economics* 20:183–95.

[24] Spier, Kathryn E. 2007. "Litigation," in A.M. Polinsky and S. Shavell, eds., *Handbook of Law and Economics.* Amsterdam: Elsevier.

[25] Spier, Kathryn E. and J.J. Prescott. 2019. "Contracting on Litigation." *RAND Journal of Economics* 50:391-417.