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Abstract: Why do some legal disputes fail to settle? From a bird's eye view, the literature offers two categories of reasons. One consists of arguments based on informational disparities. The other consists of psychological arguments. This paper explores the psychological theory. It presents a model of litigation driven by risk preferences and examines the model's implications for trials and settlements. The model suggests a foundation in Prospect Theory for the Mutual Optimism model of litigation. The model's implications for plaintiff win rates, settlement patterns, and informational asymmetry with respect to the degree of risk aversion are examined.

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1. Introduction

Why do some legal disputes fail to settle? From a bird's eye view, the literature offers two categories of reasons. One consists of arguments based on informational disparities: either two-sided asymmetry, which manifests in seemingly random errors driving disputants into court rather than settlement (Priest and Klein, 1984), or one-sided informational advantages that distort the settlement process by inducing litigants to signal their private information (Reinganum and Wilde, 1987; Png, 1987) or screen in reaction to hidden information on the other side (Bebchuk, 1984; Png, 1983). The other category consists of psychological arguments: each side may privately exaggerate their own likelihood of winning, or enmity toward the other party may drive them to discount the validity of the other's position and invest their beliefs entirely in their own cause (e.g., Posner, 2004, at 250; Farnsworth, 1999). Under the psychological approach, mutual optimism (Shavell, 1982) is the central force behind litigation.

This paper explores the psychological theory. One could argue, to be sure, that psychological and informational theories of litigation are inseparable, because psychological or emotional causes of disputes can always be characterized as grounded in differences in information. However, the two theories are separable. A psychological theory of litigation assumes, in contradistinction to an information-based theory, that the parties have incentives to litigate even when they share the same information sets. This paper assumes that opposing litigants have the same information sets.

Disputants having the same information sets, the remaining factors that could lead to litigation can be corralled under the category of preferences. Psychological attitudes toward risk would appear to be a major source of variation in preferences. A litigant who is risk averse is more likely to prefer a settlement, a sure payoff, to the risk of litigation. In addition, the emotional factors that impel a party toward or away from litigation can also be characterized as influencing that party's attitude toward risk. A feeling of enmity toward the other disputant, for example, could lead a plaintiff to perceive the marginal utility from a damages award to be increasing in the size of the award rather than decreasing, as in the standard case of risk aversion. As a general matter, many plausible psychological theories are characterizable, in economic terms, as biasing attitudes toward risk. This paper offers an economic model of litigation based on risk preferences.

Although it is not difficult to model risk preferences in economics, and such modeling has been a mainstay for years, economic theory by itself does not provide a basis for predicting preferences toward risk. A utility function that builds in the assumption of risk aversion can be used to predict how a risk-averse agent will behave, but this approach to prediction begins with the assumption of risk aversion. Why such an assumption would be empirically acceptable in the first place cannot be answered by the standard comparative statics, and is a matter of psychology.

The most successful psychological theory of risk preferences is Prospect Theory (Kahneman and Tversky, 1979). According to one of the predictions of the theory, agents behave as if they are risk averse when evaluating gambles that promise significant gains, and risk seeking with gambles that promise significant losses. In the litigation context, this prediction suggests that defendants would tend to have (or to behave as if they have) risk-seeking preferences while plaintiffs would tend to have risk-averse or risk-neutral preferences (Rachlinksi, 1996). Prospect theory provides an empirical grounding for a theory of litigation based solely on risk preferences.

This paper presents a model of litigation driven by risk preferences and examines its implications for trials and settlements. The model provides a foundation for the Mutual Optimism model of litigation (Shavell, 1982). Specifically, the Mutual Optimism model is shown to be consistent with implications of Prospect Theory, in that divergently optimistic trial-outcome predictions are most likely to be observed when the defendant behaves as if he is risk seeking. More specifically, mutual optimism will be observed when the defendant is risk seeking, and (a) the plaintiff is also risk seeking or (b) the intensity of the defendant's risk preference exceeds that of the plaintiff. Since risk preferences, not different information sets, drive litigation in this model, all disputes settle unless at least one party is risk seeking.

I examine the model's implications for trial-outcome statistics. In the basic version of the Mutual Optimism/Prospect Theory model, win rates vary directly with the objective probability of plaintiff victory, ruling out Priest-Klein dynamics. In an extension of the Mutual Optimism model that incorporates risk preferences and reference points, the Priest-Klein Theorem emerges in the case where plaintiff and defendant have exponential utility functions. In general, litigation is driven by a "variance effect" and a "stakes effect,' and Priest-Klein dynamics are observed only if the variance effects dominates, which occurs unambiguously under exponential utility.

Since all disputes settle when both parties are risk averse, I complicate the model later by introducing informational asymmetry in the form of imperfect information about the degree of risk aversion of the other party. Now settlements will not consistently occur even when both sides are risk averse. This is a simple model of screening, but arguably more plausible than standard models because of the difficulty of any party credibly signaling his preference toward risk.

Part 2 presents a brief discussion of the mutual optimism theory and questions about its foundations. Part 3 introduces a quadratic utility function to capture the risk preferences of the litigating parties. In addition, it introduces risk-neutralized probability measures to incorporate risk premia directly into the notional subjective probabilities used by the parties to determine the settlement range. This extends the familiar Landes-Posner-Gould analysis to incorporate risk preferences. In the risk-neutralized LPG condition, the joint incentive to settle depends on the parties' risk preferences, the variance of the litigation payoff, and the difference in the litigation stakes. The variance and stakes effects are mediated through the parties' risk-preference parameters. Prospect Theory offers an empirically validated basis for assigning risk preferences to the parties. However, the theory also emphasizes the importance of the litigant's frame of reference – including whether the litigant looks at the litigation gamble as alternative to a sure loss or to a gain. The model explains some anomalous features of settlement negotiations, such as the risk aversion of plaintiffs who have received settlement offers, and the prevalence of zero offers. Part 4 introduces imperfect information on risk preferences, and Part 5 concludes.

2. Mutual Optimism and Litigation

Let P_p be the plaintiff's prediction of his likelihood of winning the trial, P_d be the defendant's prediction of the plaintiff's likelihood of winning, D represent the damages award, C_p the plaintiff's cost of litigation, and C_d the defendant's cost of litigation. Finally, let P be the objective probability of plaintiff victory.

Mutual Optimism posits $P_p > P_d$. Under the strongest form of the assumption, both parties are optimistic relative to an objective observer, $P_p > P > P_d$. However, mutual optimism does not require such a strong assumption. It is sufficient that the plaintiff view his chances as better than does the defendant, and this could be true even when both parties are optimistic (or pessimistic) relative to an objective observer. The central assumption of the mutual optimism model holds when there is "relative optimism" among the parties.

The mutual optimism model typically treats the parties as risk neutral, but with different subjective probability estimates. The plaintiff brings suit if the risk neutral expected payoff from litigation is positive, $P_pD - C_p > 0$. The plaintiff accepts a settlement payment for an amount that is no less than the expected payoff. The defendant, on the other hand, will settle for an amount less than his expected payout, P_dD+C_d. The parties are unable to settle when the minimum demand of the plaintiff exceeds the maximum offer of the defendant, or equivalently when $(P_p - P_d)D > C_p+C_d$.

Because of its simplicity and power, this is an attractive approach to modeling litigation incentives, introduced in Landes (1971), Posner (1973), extended in Gould (1973), and developed in full in Shavell (1982). Mutual optimism emerges under this model as a necessary condition for litigation.

Despite its attractiveness, the mutual optimism model raises several questions. What explains mutual optimism? One explanation is access to different types of evidence, that is, different information sets. But if the parties are drawing their trial outcome predictions from different information sets, then there is no reason to describe the subjective probability differential as due to optimism, because each party's prediction would then be based rationally on the information available only to him. It would be misleading to refer to the cause of litigation as mutual optimism, especially insofar as the term has mostly a psychological connotation, when the fundamental source is differences in information. In addition, if information differences constitute the source of mutual optimism, then those differences will sometimes produce mutual pessimism, $P_p < P_d$. Mutual optimism, then, would be just one manifestation of the truism that the parties may have unequal access to information. Under this view, the term "mutual optimism" should be discarded and replaced by the label "differential information."

If mutual optimism means something distinct from differential access to information, then it must be grounded in psychological differences between litigants that have nothing to do with access to information. Mutual optimism must reflect a set of psychological dispositions that impel the parties toward litigation even when they have access to the same information.

One obvious psychological feature that could explain mutual optimism unrelated to informational differences is attitude toward risk. As is well known, a risk averse litigant will tend to prefer the sure payout from settlement to the gamble of litigation. As Shavell (1982) notes, a risk averse plaintiff will demand a smaller settlement amount than would a similarly situated risk neutral plaintiff. If a risk averse plaintiff has a dispute with a risk neutral defendant, settlement is more likely to occur than in the case where the parties are similarly situated and risk neutral. Since risk aversion suggests mutual pessimism, cases of mutual optimism are likely to be associated with risk-preferring preferences.

If there are no informational differences and the parties are risk neutral, their predictions of the likelihood of a plaintiff victory will be the same, and hence the expected judgment differential will be zero, which is obviously less than the sum of the litigation costs. Litigation will never be observed.

In the case where solely psychological differences impel the parties to litigation, the subjective probability estimates differ not because of differential information but because of the effect of psychological attitudes on the assessment of risk. In the next part, I discuss a model of psychological risk assessment in litigation that provides a foundation for the mutual optimism theory.

3. Model

The probability of plaintiff victory is P. The utility of the plaintiff is U_p and that of the defendant U_d. I assume utility is quadratic, but in a later part I will generalize the argument to any utility function. If π_{p_i} represents the plaintiff's payoff in state i,

$$U_p(\pi_{p_i}) = \pi_{p_i} – b\pi_{p_i}^2$$

If the plaintiff is risk averse, $b > 0$; if risk-neutral, $b = 0$, and if risk-preferring $b < 0$. A well-known property of the quadratic utility function is that expected utility can be expressed in terms of mean and variance:

$$E[U_p(\pi_p)] = \overline{\pi_p} - b[\sigma^2 + \overline{\pi_p}^2], \tag{1}$$

where $\sigma^2 = P(1-P)D^2$ is the variance of π_p and $\overline{\pi_p} = E(\pi_p)$.

3.1. Risk-Neutralizing Probability Measure

If the plaintiff litigates, he enters a gamble where in state one (win), $\pi_{p_1} = D - C_p > 0$, and in state 2 (lose), $\pi_{p_2} = -C_p < 0$. Thus, the expected payoff from litigation is $\overline{\pi_p} = P(D - C_p) + (1 - P)(-C_p) = PD - C_p$. The variance of the litigation gamble is $\sigma^2 = E(\pi_p^2) - \overline{\pi_p}^2 = P(1-P)D^2$. The expected utility of litigation is

$$E[U_p(\pi_p)] = PD - C_p - b[\sigma^2 + \overline{\pi_p}^2]$$

The plaintiff can choose to settle the lawsuit. In the assumed timing of events in this model, the plaintiff has an initial choice whether to file suit or not to sue, and second whether to settle after he concludes that filing suit is desirable. The cost of filing (not litigating, just filing) is assumed to be zero. The plaintiff will find suit desirable, and therefore file or have a credible threat to file suit, only if the expected utility of suit is greater than the expected utility of remaining at the status quo, with a payoff of zero. Thus, the decision to file or to threaten suit implies

$$E[U_p(\pi_p)] > U_p(0) = 0$$

Put another way, the implicit reference point for regarding preferences toward litigation is the zero payoff received by the plaintiff if he does nothing.[1] If the reference point changes from the zero payoff point, the risk preferences of the agent may change too – a point I will return to later.

[1] The credibility condition implies that a risk-neutral or risk-averse plaintiff will not threaten to sue or sue unless $\overline{\pi_p} = PD - C_p > 0$. A risk-seeking plaintiff may bring a negative expected value lawsuit, where $\overline{\pi_p} < 0$, while still satisfying the expected utility condition.

I define P_p as the measure that *risk-neutralizes* the agent's preferences.[2] Thus, discounting the damages award by P_p equates the risk-neutral expected utility from litigation with the corresponding expected utility $E[U_p(\pi_p)]$.

This concept is similar to the risk-neutralization probability measure in the finance literature.[3] P_p is not, in this approach as in the finance context, technically a probability. It is a price or bid that the plaintiff attaches to each dollar of damages. However, P_p can be analogized to a subjective probability.

Given the definition of P_p

$$P_pD - C_p = PD - C_p - b\left[\sigma^2 + \overline{\pi_p}^2\right]$$

which means that

$$P_p = P - \left(\frac{b}{D}\right)\left[\sigma^2 + \overline{\pi_p}^2\right]. \qquad (2)$$

Thus, the plaintiff's subjective probability can be characterized as the sum of the objective probability and a term capturing the influence of his risk preference – that is, the risk-neutralized probability measure incorporates a risk premium. Since $\sigma^2 + \overline{\pi_p}^2 = E(\pi_p^2)$, the bracketed term in (2) can be replaced with the expectation of the squared litigation payoff. Still, the variance-mean decomposition will be used here because it enables some useful comparisons of the effects of changes in both statistics.

There are some restrictions to impose on the parameter b given the quadratic utility function. In particular, one restriction is that marginal utility must be positive evaluated at the highest potential payoff. Treating D as the maximum payoff, then $U_p'(D) > 0$. This implies, for the risk averse case, $b < 1/(2D)$. I will examine the risk averse case here because similar restrictions can be imposed for the risk seeking case.

Using the restriction $0 < b < 1/(2D)$, it is straightforward to show that P_p has the properties of a probability measure. First, P_p is positive. From (2),

[2] For an approach to risk-neutralization and litigation, see Heaton (2018). Heaton provides a general proof that risk aversion, for the plaintiff, is equivalent to a risk-neutralized pessimistic probability of victory. This model differs by deriving the risk-neutralizing measure for quadratic and more general utility functions.

[3] See, e.g., Shreve (2012), at 19.

$$P_p = P - \left(\frac{b}{D}\right)\left[P(1-P)D^2 + (PD - C_p)^2\right]$$

which is equivalent to

$$P_p = P - b\left[P(1-P)D + \frac{(PD - C_p)^2}{D}\right].$$

Since $PD - C_p > 0$ under risk aversion,

$$P_p \geq P - b\left[P(1-P)D + \left(PD - C_p\right)\right],$$

$$P_p \geq P - \left[\left(\frac{1}{2}\right)P(1-P) + \left(\frac{1}{2}\right)\left(P - \frac{C_p}{D}\right)\right],$$

and this last expression is easily seen to be positive. P_p is less than one because the statement,

$$1 > P_p = P - b\left[P(1-P)D + \frac{(PD - C_p)^2}{D}\right]$$

is equivalent to

$$1 - P >- b\left[P(1-P)D + \frac{(PD - C_p)^2}{D}\right]$$

which holds given $b > 0$ under risk aversion. Finally, since obviously $P_p + (1 - P_p) = 1$, the risk-neutralizing probability measure can be treated as if it is a probability, even though it is simply a bid. This risk-neutralization approach can be applied to other outcomes in litigation, such as the issuance of an injunction.[4]

Now consider the defendant. While the plaintiff seeks to maximize a utility function in the payoff from litigation, the defendant seeks to minimize a disutility function in the payout from litigation. Using the same derivation as in the previous part, the corresponding risk-neutralizing probability measure for the defendant is

[4] For a model of settlement with injunctions, see Hylton and Cho (2010). This model can be extended along the lines of Hylton and Cho.

$$P_d = P + \left(\frac{\tilde{b}}{D}\right)\left[\sigma^2 + \overline{\pi_d}^2\right],$$

where $\tilde{b}$ is the quadratic utility parameter for the defendant, and $\overline{\pi_d} = PD + C_d$ is the defendant's expected payout.

3.2. Incentive to Litigate

Recall that the standard condition for litigation with risk-neutral parties requires the expected judgment differential to exceed the sum of litigation costs: $(P_p - P_d)D > C_p + C_d$. Using the risk neutralized probability measures, the expectations differential is

$$(P_p - P_d)D = -(b + \tilde{b})\left[\sigma^2 + \overline{\pi_p}^2\right] - \tilde{b}\left[\overline{\pi_d}^2 - \overline{\pi_p}^2\right], \qquad (3)$$

If this expected judgment differential is positive, mutual optimism holds. Litigation occurs, in this model, when the expected judgment differential in (3) exceeds the sum of litigation costs.

This differential shows the factors that drive litigation. The first term is the sum of the risk-preference parameters multiplied by the sum of the variance of the litigation gamble, which is the same for both plaintiff and defendant, and the square of the plaintiff's expected payoff. Obviously, the first bracketed term, containing the variance and mean squared, is positive. Thus, the sign of the first term depends on the sign of the sum of the risk-preference parameters. The second term is the product of the defendant's risk preference parameter and the difference in the squared payoff means. Since the defendant's payoff mean is greater than the plaintiff's, the second term in brackets is always positive. The sign of the second term is therefore that of the defendant's risk-preference parameter.

This model suggests that litigation is driven in large part by the variance in the litigation payoff (variance effect) and differences in the stakes (stakes effect). The ultimate effects of these components on the rate of litigation are mediated by the risk-preferences of the litigants.[5]

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[5] Perhaps a cleaner way of expressing the expected judgment differential in (3) is as follows:

$$(P_p - P_d)D = \underbrace{-(b + \tilde{b})\sigma^2}_{variance\ effect} - \underbrace{b\overline{\pi_p}^2 - \tilde{b}\overline{\pi_d}^2}_{stakes\ effect}$$

However, I find the expression in (3) more suitable for distinguishing the effects of the risk-aversion

Consider different assumptions on the risk preferences of the parties. If both parties are risk neutral, $b = \tilde{b} = 0$, the expected judgment differential is zero. Given that the parties are risk neutral and use the same objective probability, their expected awards are the same, and the parties will settle.

If both parties are risk averse, $b > 0$ and $\tilde{b} > 0$, the expected judgment differential is negative and no litigation occurs. This is intuitive, and in accord with Shavell (1982) and Viscusi (1988). If the parties are risk averse, both prefer the certainty of a settlement to the gamble of litigation. However, there is a difference between this model and the previous literature, because here risk preferences alone create differences in the risk-neutralized probabilities of the parties. The objective probability of victory is the same for both sides. Rather than reducing the scope for litigation, as in Shavell, dual risk aversion eliminates the scope for litigation.

At least one party must be risk preferring for litigation to occur. If both parties are risk preferring, $b < 0$ and $\tilde{b} < 0$, clearly the expected judgment differential is positive, and the dispute is characterized by mutual optimism. If the expected judgment differential clears the settlement hurdle – that is, if (3) is greater than the sum of litigation costs – then litigation will occur because there is no scope for a mutually agreeable settlement.

If only one party is risk preferring, then much depends on whether the risk-preference intensity of one outweighs that of the other sufficiently. If the defendant is the only risk seeking party ($\tilde{b} < 0$, $b \geq 0$), then the mutual optimism condition holds as long as the risk-preference intensity of the defendant is greater than that of the plaintiff, $|b| < |\tilde{b}|$.[6] However, even if the risk seeking defendant's risk-preference intensity is less than the plaintiff's, the expected judgment differential may be positive if the stakes differential is sufficiently large relative to the variance, which is more plausible as the defendant's litigation cost increases relative to the plaintiff's litigation cost. In short, as long as the defendant is risk seeking, a wide range of parameter configurations in this model generate behavior consistent with mutual optimism.

Conversely, if the plaintiff is the only risk seeking party ($\tilde{b} \geq 0$, $b < 0$), then the plaintiff's risk preference intensity must exceed that of the defendant for litigation to occur – that is, $|b| > |\tilde{b}|$. This is obviously satisfied when the defendant is risk neutral. Thus, one class of cases where the mutual optimism condition holds involves risk seeking plaintiffs going against risk neutral defendants. This is consistent with the *Litigious Plaintiff Model* of Eisenberg and Farber (1997).[7] If the defendant is

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parameters.

[6] The quadratic utility assumption obviously simplifies the comparison of risk preferences. For a more general approach to the intensity of risk preferences see, e.g., Li and Liu (2014).

[7] In the Eisenberg-Farber model, litigious plaintiffs have unusually low litigation costs. This easily

risk averse, then the differential in risk-preference intensities must be large enough that the variance effect dominates the stakes effect. This implies that the case of mutual optimism where the plaintiff is risk seeking and the defendant risk averse requires the strongest assumptions on the relationships among risk-preference measures, litigation variance, and litigation stakes.

3.3. Mutual Optimism and Prospect Theory

Prospect Theory is a widely accepted basis for assigning risk preferences. According to the theory, agents display risk-seeking preferences when facing significant downside gambles and risk averse preferences when facing significant upside gambles. The straightforward implication for litigation is that defendants tend to be risk preferring in behavior and plaintiffs risk averse (Rachlinski, 1996; Korobkin and Guthrie, 1994; Babcock at al. 1995). Rachlinski finds experimental and empirical evidence to support this theory. Van Koppen (1990), in an experimental study, finds strong evidence in support of the theory that defendants tend to be risk seeking, and weaker evidence of plaintiff risk aversion.

According to Prospect Theory, agents tend to be risk averse when facing a gamble involving gains, and risk seeking when facing a gamble involving losses (Van Koppen, 1990; Rachlinski, 1996). In the case of the defendant, it is clear that he faces a gamble involving losses: the defendant either loses the case, which requires him to pay the judgment in addition to his own litigation costs, or he wins the case, which requires him to pay his litigation costs only, or the defendant settles requiring him to pay a certain sum. There is no scenario (setting aside the case of fee-shifting or sanctions against frivolous litigants) in which the defendant gains from litigation.

In the case of the plaintiff, it is not true that he faces a gamble involving only gains. If the plaintiff loses, he must pay his own litigation costs, which is a loss. If the plaintiff wins, he receives his judgment less his cost of litigation, which must be positive for the plaintiff to have had an incentive to file suit. Given that the plaintiff faces a gamble involving both a gain and a loss, Prospect Theory would appear to have a less clear implication for the plaintiff's revealed risk preference. Van Koppen finds experimental evidence that plaintiffs who expect to win are (act as if they are) risk averse or risk neutral, and plaintiffs who expect to lose are risk seeking.

Kahneman (2011) explains that Prospect Theory predicts a fourfold pattern of risk attitudes, under which the agent behaves as a (1) risk averter when he has a moderate to high probability of winning, (2) a risk seeker when he has moderate to high probability of losing, (3) a risk seeker when he has a low probability of winning, and (4) a risk averter when he has a low probability of losing. Probability weights tend to be larger for low probabilities, leading to the overweighting of low risks. Under this

translates, in this model, to an unusually high taste for risk.

pattern, the defendant tends to behave as a risk seeker for moderate to high probability losses (Guthrie, 2000). The plaintiff's behavior is more complicated.

The assessment of a gamble as a potential gain or a potential loss depends on the reference point of the agent (Kahneman and Tversky, 1979, at 274; Budescu and Weiss, 1987), which is a target or aspiration level (Bedescu and Weiss, at 186).[8] From the perspective of the defendant, the potential payoffs from litigation appear to be losses, no matter what point of time before the verdict that one chooses to assess the defendant's options.[9] From the perspective of the plaintiff, the assessment of gains and losses is also dependent on the reference point. If the plaintiff already has a reliable settlement offer, any judgment (or subsequent settlement offer) less than the offer could be viewed as a loss rather than a gain. Alternatively, the same situation could be viewed as one of a low probability of winning (category 3 of the pattern).[10] This suggests that the revealed risk preferences of plaintiffs under Prospect Theory should be more variable than those of defendants.

Based on the foregoing, Prospect Theory supports the hypothesis that defendants tend to be risk seeking. Plaintiffs, under the theory, can be risk averse, risk neutral, or risk seeking, depending on the probability of winning and the reference point. With probability weighting stronger for relatively small probabilities, the intensity of risk seeking is likely to be stronger than that of risk aversion. Prospect Theory appears, therefore, to support the parameter relationships $\tilde{b} < 0$ *and* $b + \tilde{b} < 0$. If this condition holds, then the two terms in (3) are positive, and $P_p > P_d$, as mutual optimism requires.

For the remainder, I posit that the *Mutual Optimism/Prospect Theory model of litigation holds that* $\tilde{b} < 0$ *and* $b + \tilde{b} < 0$. This assumption is stronger than necessary for the observance of mutual optimism, because even if the sum of the risk-preference parameters is positive, the mutual optimism condition can hold when the

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[8] For evidence that reference points reflect expectations (instead of the status quo), see Ericson and Fuster (2011).

[9] However, as Rachlinski (1996, at 142 and 145) notes, the defendant's frame can lead him to view litigation or settlement as a gain rather than a loss. The gain frame presumably would emerge if the defendant had expected to pay much more and adjusted his reference point accordingly.

[10] Suppose the plaintiff initially has a .10 chance of winning $1000 with a litigation cost of $200. The expected value of his claim is -$100. For this plaintiff, the choice is between the status quo of zero and negative expected value gamble. Under the fourfold pattern, such a plaintiff would behave as a risk seeker. Now suppose later in trial the plaintiff's probability of winning increases to .4, making the expected value of his claim $200 (assuming, for simplicity, no litigation costs incurred earlier in the trial). At the same time, the plaintiff has a settlement offer of $250. This would appear to be a case of a low probability of winning relative to the reference point of $250. The decision to litigate would suggest risk seeking preferences, because the plaintiff turns down $250 for a gamble worth less than $250.

litigation stakes differential is large relative to the variance of the litigation payoff (Litigious Defendant case, Table 1). Conversely, the mutual optimism condition can hold even when the defendant is not risk seeking when the plaintiff is risk seeking (Litigious Plaintiff case). In any event, I focus on the specific model assumptions in the first cell of Table 1.

	$b+\tilde{b}<0$	$b+\tilde{b}>0$
$\tilde{b}<0$	Mutual Optimism/ Prospect Theory	Litigious Defendant $\sigma^2+\overline{\pi_p}^2<\overline{\pi_d}^2-\overline{\pi_p}^2$
$\tilde{b}\geq 0$	Litigious Plaintiff $\sigma^2+\overline{\pi_p}^2>\overline{\pi_d}^2-\overline{\pi_p}^2$	No Litigation

Table 1: Risk preferences parameters and litigation

4. Applications and Extensions

4.1. Trial Selection Dynamics

Which cases proceed to litigation, and which to settlement? Could the Priest-Klein conjecture that win rates tend toward 50 percent be consistent with this model of litigation driven by risk preferences?

Consider the types of cases that settle, and the types that are litigated. Recall, from (3), that if the parties are risk averse, the expectations differential is negative and all disputes settle. Under the Mutual Optimism/Prospect Theory parameter assumptions, by contrast, the expectations differential is positive and there is a cutoff probability $\hat{P}$, for any given *D*, below which disputes settle and above which parties litigate:

$$\hat{P}=\frac{C_p(1+bC_p)+C_d(1+\tilde{b}C_d)}{[-(b+\tilde{b})D+2(bC_p-\tilde{b}C_d)]D}\ .$$

The win rate at trial is determined by the sample of cases that clear the settlement hurdle and wind up in litigation. If, for example, cases with high values of P have the greatest expected judgment differential, then those cases will tend to go to litigation and result in win rates for plaintiffs that are correspondingly high.

The derivative of the expectations differential is

$$\frac{\partial(P_p - P_d)D}{\partial P} = \left[-(b + \tilde{b})D + 2\left(bC_p - \tilde{b}C_d\right)\right]D, \tag{4}$$

which is independent of P. The first term is positive under the Mutual Optimism/Prospect Theory model. The second term is positive if the Mutual Optimism theory's assumptions hold and the plaintiff is either risk averse or risk neutral ($b \geq 0$). If the plaintiff is risk seeking ($b < 0$), the sign of (4) is negative for low damages, and otherwise positive.[11] Thus, the propensity to litigate is increasing in P under the Mutual Optimism/Prospect Theory model – except for the rather special case of low damages coupled with risk seeking plaintiffs.

That the propensity to litigate is increasing in the objective probability of plaintiff victory under the Mutual Optimism/Prospect Theory model rules out Priest-Klein dynamics – at least in this basic version of the model. For trial selection, this model implies that one should observe plaintiff win rates that reflect the expected rate of legal noncompliance within the population. In other words, under the mutual optimism model, a high average plaintiff win rate (say 70 percent) reflects a high average rate of noncompliance with the law among defendants.

Consider the other cases in Table 1. In the Litigious Plaintiff case, the propensity to litigate is increasing in P for moderate to high damages, and otherwise decreasing.[12] In the Litigious Defendant case, the propensity to litigate is increasing in P for low damages and decreasing in P for high damages.[13]

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[11] Specifically, the sign of the expectations differential derivative with respect to P is positive if

$$D > \frac{2\left(\tilde{b}C_d - bC_p\right)}{-(b + \tilde{b})}$$

and negative if the sign is reversed. First, given that $(b + \tilde{b}) < 0$, the numerator is negative if the litigation cost amounts are roughly the same, and the inequality holds. If, to the contrary, the numerator is positive, then damages have to exceed the threshold above.

[12] The same inequality shown in footnote 11 determines whether the expectations differential derivative with respect to P is positive under the Litigious Plaintiff model – though, of course, the signs of the parameters are different from , with $(b + \tilde{b}) < 0$ and $\tilde{b} \geq 0$ in this case. Because the signs of the parameters are different, the threshold is higher in the Litigious Plaintiff case than in the Mutual Optimism case.

[13] Specifically, in the Litigious Defendant case the cutoff occurs when

Differentiating the expectations differential with respect to damages,

$$\frac{\partial(P_p - P_d)D}{\partial D} = \{ -(b + \tilde{b})(D - C_p) - \tilde{b}(C_p + C_d)\}(2P), \tag{5}$$

which is positive under the Mutual Optimism/Prospect Theory assumptions. Thus, if the Mutual Optimism conditions hold, the propensity to litigate increases in damages. For the Litigious Plaintiff case, the propensity to litigate first falls and then increases in damages; and the converse holds for the Litigious Defendant case.

4.2. Arbitrary Reference Point, Any Utility Function

I assumed in the previous part that the reference point for the plaintiff (and for the defendant) is the zero payoff of doing nothing. However, the psychological literature has emphasized the importance of choosing a reference point for determining risk preferences. I will generalize here to allow for any reference point and for any utility function.

Consider the following Taylor expansion of U_p (for state *i*) around an arbitrary plaintiff reference point R_p:

$$U_p(\pi_{p_i}) \approx U_p(R_p) + U_p^{'}(R_p)(\pi_{p_i} - R_p) + \frac{U_p^{''}(R_p)}{2!}(\pi_{p_i} - R_p)^2$$

Given that $U_p(R_p)$ is the utility of the reference point from which the plaintiff evaluates the litigation gamble[14]

$$E[U_p(\pi_p)] - U_p(R_p) = U_p^{'}(R_p)E(\pi_p - R_p) + \frac{U_p^{''}(R_p)}{2!}E(\pi_p - R_p)^2$$

Dividing through by $U_p^{'}(R_p) > 0$,

$$D = \frac{2(bC_p - \tilde{b}C_d)}{(b + \tilde{b})}$$

For damages above this threshold, the expectations differential derivative is negative.

[14] To simplify I have replaced $\approx$ with =.

$$\frac{E[U_p(\pi_p)] - U_p(R_p)}{U_p^{'}(R_p)} = E(\pi_p - R_p) + \frac{U_p^{''}(R_p)}{2U_p^{'}(R_p)} E(\pi_p - R_p)^2$$

$$\frac{E[U_p(\pi_p)] - U_p(R_p)}{U_p^{'}(R_p)} = \overline{\pi_p} - R_p - \left(\frac{A_p(R_p)}{2}\right) E(\pi_p - R_p)^2 \ ,$$

where $A_p(R_p)$ is the plaintiff's Arrow-Pratt absolute risk aversion measure evaluated at R_p.[15] The left-hand side is the monetary utility premium from litigation.[16]

Thus, the plaintiff's bid depends on whether the expected litigation payoff beats the reference payoff, his risk preference, and variance of the differential between litigation and reference payoffs. It is natural to think of the reference payoff as something the plaintiff could get risk-free without litigation, such as a settlement. However, the literature suggests that the reference point could be a target or aspiration.

The general risk-neutralizing subjective probability for the plaintiff, incorporating the reference point, is

$$P_p = P - \left(\frac{A_p(R_p)}{2D}\right)\left[\sigma^2 + (\overline{\pi_p} - R_p)^2\right]. \tag{6}$$

The quadratic utility function considered in the previous part is a special case of this formulation where

$$A_p(R_p) = \frac{-U_p^{''}(R_p)}{U_p^{'}(R_p)} = \frac{2b}{1 - 2bR_p}$$

which, when evaluated at $R_p = 0$, yields $A_p(0) = 2b$, and generates the risk-neutralized probability in (2).

The exponential utility functions $U_p(R_p) = 1 - e^{-\lambda_p R_p}$ and $U_d(R_d) = 1 - e^{-\lambda_d R_d}$ yield constant Arrow-Pratt measures. Risk aversion, or Constant Absolute Risk Aversion (CARA) utility, is the case where $\lambda_p > 0$ and $\lambda_d > 0$. Of course, since CARA utility assumes risk aversion, there would be no litigation if both parties have CARA

[15] Viscusi (1988) presents a simple model of litigation with risk averse parties that incorporates the Arrow-Pratt measure.

[16] On the monetary utility premium, see Li and Liu (2014).

preferences. For risk seeking preferences, which enable litigation in this model, I later examine the case where $\lambda_p < 0$ and $\lambda_d < 0$.

Returning to the general model, the expected judgment differential is

$$(P_p - P_d)D = -\left(\frac{A_p(R_p) + A_d(R_d)}{2}\right)\left[\sigma^2 + (\overline{\pi_p} - R_p)^2\right]$$
$$-\left(\frac{A_d(R_p)}{2}\right)\left[(\overline{\pi_d} - R_d)^2 - (\overline{\pi_p} - R_p)^2\right]. \quad (7)$$

In the straightforward case where the reference point is a settlement offer S, then $R_p = R_d = S$, and the expected judgment differential is

$$(P_p - P_d)D = -\left(\frac{A_p(S) + A_d(S)}{2}\right)\left[\sigma^2 + (\overline{\pi_p} - S)^2\right]$$
$$-\left(\frac{A_d(S)}{2}\right)\left[(\overline{\pi_d} - S)^2 - (\overline{\pi_p} - S)^2\right]. \quad (8)$$

The first bracketed terms is positive in (8), while the sign of the second bracketed term depends on S.

Consider settlement offers within the risk-neutral contract zone $S_\alpha = \alpha\overline{\pi_p} + (1-\alpha)\overline{\pi_d}$. Substituting S_α into (8), and simplifying, the expected judgment differential can be expressed as

$$(P_p - P_d)D = -\left(\frac{A_p(S_\alpha) + A_d(S_\alpha)}{2}\right)\sigma^2$$
$$-\left((1-\alpha)^2\left(\frac{A_p(S_\alpha)}{2}\right) + \alpha^2\left(\frac{A_d(S_\alpha)}{2}\right)\right)(C_p + C_d)^2. \quad (9)$$

In the $\alpha = 1$ case where the defendant offers $S_1 = PD - C_p$, the expected judgment differential reduces to

$$(P_p - P_d)D = -\left(\frac{A_p(S_1) + A_d(S_1)}{2}\right)\sigma^2 - \left(\frac{A_d(S_1)}{2}\right)(C_p + C_d)^2 \ . \quad (10)$$

The Mutual Optimism/Prospect Theory condition, $A_d(S_1) < 0$ and $A_p(S_1) + A_d(S_1) < 0$, is a sufficient condition for litigation in this case.

In the $\alpha = 0$ case where the defendant offers (or accepts) $S_0 = PD + C_d$, the expected judgment differential reduces to

$$(P_p - P_d)D = -\left(\frac{A_p(S_0) + A_d(S_0)}{2}\right)\sigma^2 - \left(\frac{A_p(S_0)}{2}\right)(C_p + C_d)^2 \ . \qquad (11)$$

Now the Litigious Plaintiff Model condition, $A_d(S_0) \geq 0$ and $A_p(S_0) + A_d(S_0) < 0$, is a sufficient condition for litigation.

4.2.1. Trial Selection Dynamics, Again

In the case of exponential utility, the Arrow-Pratt coefficients are constants, independent of S. Litigation occurs under the Mutual Optimism/Prospect Theory conditions or the Litigious Plaintiff conditions – otherwise, disputes settle. Assuming exponential utility, and taking the derivative of (9) with respect to the probability of plaintiff victory P

$$\frac{\partial(P_p - P_d)D}{\partial P} = -\left(\frac{\lambda_p}{2} + \frac{\lambda_d}{2}\right)\frac{\partial\sigma^2}{\partial P}, \qquad (12)$$

where

$$\frac{\partial\sigma^2}{\partial P} = (1 - 2P)D^2 \ ,$$

which is equal to zero when $P = ½$. Thus, under exponential utility, the expected judgment differential reaches its maximum when the probability of plaintiff victory is 50 percent. Put another way, the propensity for the parties to litigate reaches its maximum when P is 50 percent. This is the Priest-Klein Theorem.

4.2. Changing Reference Point

The introduction of an arbitrary reference point allows for further exploration of the Prospect Theory foundation of this model. The reference point can change over the course of litigation. As the reference point changes, so does the agent's risk-aversion measure according to Prospect Theory.

The initial development of this model assumed that the proper reference point is the zero payoff associated with the plaintiff remaining at the status quo. The plaintiff files suit, or threatens to file suit, comparing the risky payoff from suit to the status quo payoff. After the plaintiff files suit, the reference point may change (Rachlinski, 1996; Korobkin and Guthrie, 1994).[17] Once the plaintiff has a settlement offer in hand, his reference point may no longer be the zero payoff. Having a reliable settlement offer changes the plaintiff's assessment of the payoffs from litigation. Prospect Theory suggests that the mere receipt of a settlement offer could change the plaintiff's frame for the litigation gamble, and hence the plaintiff's risk preferences toward litigation.

Return to the quadratic utility case. At the moment the plaintiff files suit, or threatens to file suit, his risk-neutralized subjective probability is given by (2), which assumes a zero reference value. Any settlement such that $E[U_p(\pi_p)] \leq U_p(S)$ is immediately accepted by the plaintiff and otherwise rejected, so let us consider settlement offers that will be rejected. Once the plaintiff receives such a settlement offer S, it modifies his reference point by giving him a certain payoff without litigation. The plaintiff's risk-neutralized subjective probability changes to:

$$P_p = P - \left(\frac{b}{D(1-2bS)}\right)\left[\sigma^2 + \left(\overline{\pi_p} - S\right)^2\right]. \tag{13}$$

It follows that if the plaintiff is risk averse ($b > 0$ and $0 < 1 - 2bS < 1$), he becomes even more risk averse in his revealed preferences once he receives the settlement offer S. The plaintiff is less willing to go forward with litigation than he was before receiving the settlement offer.[18]

If the plaintiff turns toward greater apparent risk-aversion after receiving a settlement offer, then some interesting observations follow. First, the plaintiff will be more willing to settle after receiving an offer than he was when he threatened to file suit. Second, the plaintiff may be vulnerable to abuse by the defendant, assuming the defendant knows or suspects the change in the plaintiff's outlook. The defendant could reduce his offer in the expectation that the plaintiff will accept it, even though the plaintiff would have rejected the lower offer if it had been made before the initial offer. This change in incentives could help explain the phenomenon of reneging on settlement agreements (Miceli, 1995).

The preceding example draws lightly from Prospect Theory. The only feature that links to the theory is the choice of a reference point that differs from the initial

[17] More generally, according to Koszegi and Rabin (2006), reference points are determined by recent expectations about outcomes, which need not correspond to the status quo.

[18] On the phenomenon of risk aversion induced by the receipt of a settlement offer, see Gross and Syverud (1991).

status quo. However, it is obvious that reference points can change over the course of litigation, and that settlement offers can change the expected utility premium from litigation as the dispute proceeds. If the utility premium from litigation is negative given the option to settle, the plaintiff will accept the settlement offer.

The more significant innovation that Prospect Theory brings to the analysis of settlement is the notion that a reference point could depend on a target payoff that the agent adopts. In litigation, the plaintiff compares a settlement offer to his target. If the settlement is less than the target, then the plaintiff adopts the "loss frame" for viewing litigation, leading to risk seeking in litigation. If the settlement exceeds the target, then the plaintiff adopts the gain frame, inducing risk aversion. A loss frame would be applicable to the plaintiff's settlement decision if the plaintiff viewed the offer S as a loss relative to his target S^*, where $S < S^*$.

In terms of the model here, Prospect Theory implies that the Arrow-Pratt coefficients are conditional on the relationship between S and S^*. The plaintiff's Arrow-Pratt coefficient turns positive, or more so, in the gain frame ($A_p(S \mid S > S^*) > 0$), and negative, or more so, in the loss frame ($A_p(S \mid S < S^*) < 0$). Consider the settlement offer $S_1 = \overline{\pi_p} = PD - C_p$, at the bottom of the risk-neutral contract zone. A risk seeking plaintiff rejects the offer. The initial demand price of such a plaintiff is determined by

$$P - \left(\frac{A_p(0)}{2D}\right)\left(\sigma^2 + \overline{\pi_p}^2\right) \;,$$

where $A_p(0) < 0$. After the offer S_1, the new demand price is determined by

$$P - \left(\frac{A_p\left(S_1 | S_1 < S^*\right)}{2D}\right)\sigma^2.$$

where $Ap(S_1 \mid S_1 < S^*) < 0$, and since the plaintiff's demand price increases in the loss frame,

$$A_p(0)\left(\sigma^2 + \overline{\pi_p}^2\right) > A_p\left(S_1 | S_1 < S^*\right)\sigma^2.$$

In the process just detailed, the settlement offer is less than the target level. The plaintiff increases his demand price for a settlement after receiving the offer from the defendant.[19] In other words, the plaintiff is more willing to go forward with litigation

[19] This formalization suggests that in an experiment with known litigation payoffs and variance, it may be possible to recover the Arrow-Pratt coefficients.

after receiving the offer. If the defendant anticipates this change, he would not to make the settlement offer.

This psychological oddity might explain the puzzle noted in Gross and Syverud (1991) of disputes ending in substantial judgments where the defendants had made no offer at all to the plaintiff. The average judgment in their sample of zero offer cases was \$108,000 (\$328,000 for trials with plaintiff verdicts), which suggests that on average the zero-offer cases were positive expected value claims. Gross and Syverud suggest that the reason for offers of zero is strategic, which is quite plausible. The alternative suggested by here is that some defendant offers may have been stillborn because they would transform plaintiffs into more aggressive litigants.

This alternative explanation is supported also by the experimental results of Korobkin and Guthrie (1994), which found that offerees adjusted their reference points upward when the opening settlement offer was moderate rather than stingy ("hard"), causing settlement negotiations to fail more often. Their experiment forecloses the possibility that signaling could explain the results. Of course, whether an offer is moderate or hard depends on the apparent strength of the plaintiff's case. At a certain low level of case strength, a moderate offer may merely reset the plaintiff's expectations upward, making settlement less likely. Korobkin and Guthrie's experimental evidence suggests that moderate offers alter reference points and may induce plaintiffs to adopt a loss frame going forward, making litigation more likely, and that defendants may choose to make zero rather than moderate offers because they know that a moderate offer would make settlement less likely.

4.3. Imperfect Information on Risk Preference

Although this is a model of perfect information, it should be clear that introducing imperfect information into the model can modify its implications for litigation. One result of doing so is finding that even when all parties are risk averse, some disputes inefficiently fail to settle.

Suppose there is heterogeneity in the degree of risk aversion, and plaintiffs do not know the particular degree of risk aversion of the defendant. This scenario generates an information asymmetry model in the spirit of Bebchuk (1984). Assuming the plaintiff makes a take-it-or-leave-it settlement offer to the defendant, he chooses an offer S^* that optimizes the value of the litigation gamble, trading off the extra revenue from higher settlements against the costs of litigation.

Assume that the plaintiff is risk neutral and the defendant risk averse. The plaintiff does not know the particular risk-averseness intensity, $\tilde{b} > 0$, of the defendant.[20] However, the plaintiff does know the distribution $F(\tilde{b})$. The plaintiff's

[20] If the plaintiff did know the particular risk-intensity, he would offer a perfectly discriminating

settlement offer will be accepted if $S < P_dD + C_d$, and rejected otherwise. Equivalently, the offer is accepted if

$$\frac{S - C_d - PD}{\sigma^2 + \overline{\pi_d}^2} < \tilde{b},$$

and the probability of acceptance is

$$1 - F\left(\frac{S - C_d - PD}{\sigma^2 + \overline{\pi_d}^2}\right).$$

The plaintiff's optimal settlement offer maximizes the function

$$\left[1 - F\left(\frac{S - C_d - PD}{\sigma^2 + \overline{\pi_d}^2}\right)\right]S + F\left(\frac{S - C_d - PD}{\sigma^2 + \overline{\pi_d}^2}\right)(PD - C_p)$$

To simplify, let $\Psi(S) = \frac{S - C_d - PD}{\sigma^2 + \overline{\pi_d}^2}$. The resulting first order condition is

$$\left(\sigma^2 + \overline{\pi_d}^2\right)\left[1 - F\left(\Psi(S^*)\right)\right] = f\left(\Psi(S^*)\right)\left(S^* - (PD - C_p)\right).$$

This implies $S^* > PD - C_p$; the plaintiff earns more in expectation from settlement than from litigation. The right hand side is the cost of raising the settlement demand one extra dollar, which risks forfeiting the incremental gain from settlement relative to litigation, while the right hand side is the direct revenue benefit of increasing the settlement demand, which, because of the defendant's risk aversion, increases with the variance of the outcome and the defendant's stake in litigation. In the case where F is exponential with parameter μ, the plaintiff's optimal settlement offer is $S^* = PD - C_p + \left(\frac{1}{\mu}\right)\left(\sigma^2 + \overline{\pi_d}^2\right)$, which means that the plaintiff takes the minimal demand and adds the mean of the $\tilde{b}$ distribution multiplied by the sum of the variance and the square of the defendant's expected litigation payout.

This is a simpler screening model than Bebchuk (1984),[21] where the plaintiff has imperfect information on the defendant's degree of guilt. Simplicity here has an

settlement demand of P_dD+C_d. Every dispute would settle.

[21] Rossler and Frieh (2022), in contrast, extend the Bebchuk model by incorporating reference-dependent preferences based on Koszegi and Rabin (2006).

advantage. Where the asymmetry is over the degree of guilt, relatively innocent defendants would have every incentive to signal their innocence, and to find credible methods of doing so. This would undermine the basic assumption underlying the screening model. Where the asymmetry is over the degree of risk aversion, it is unlikely that a litigant could credibly signal his risk preference status. Hence, the screening model would seem to be entirely appropriate for this sort of information asymmetry. More generally, a screening approach to settlement is comparatively attractive when the hidden information is some unobservable personal attribute rather than an evidentiary matter such as the likelihood of guilt.

It should be clear that this model has a further extension by incorporating information asymmetry with respect to the level of guilt. The basic risk-neutralization decomposition in (2) assumes that the parties have common information on the likely trial outcome. This assumption can be relaxed to allow for a decomposition in terms of private information and private risk tolerance. The resulting decomposition would provide a tractable model for analyzing the effects of private information and risk aversion on settlement incentives.

5. Conclusion

This paper shows how risk preferences interact with the decision to sue or to settle a dispute. Updating the standard analysis of settlement to incorporate risk preferences leads to a seemingly plausible defense of the Mutual Optimism Theory of litigation. The defense draws in large part on Prospect Theory, and thus has a basis in empirical findings and psychological theory. With this foundation for the theory of mutual optimism, the model can explain patterns in plaintiff win rates and some recurrent features of observed settlement negotiations noted by Babcock, Rachlinski, Guthrie and Korobkin, and others who have applied psychological theories to the empirical and experimental evidence on litigation incentives.

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