Tailored Suits: Contracting on Litigation[*]

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Abstract

A plaintiff and defendant are negotiating in the shadow of pending litigation. When the divergence between their subjective beliefs is sufficiently large, and they are not too risk averse, the litigants will forego settlement in favor of a contract that tailors the damage payments to suit their beliefs and preferences. With CARA expected utility, the optimal contract is increasing in the likelihood ratio of their subjective beliefs. When the litigants' beliefs are normally distributed with divergent means, the optimal contract is linear in the court's award and is flatter when the parties are more risk averse, when beliefs are more aligned, when the trial outcome variance is larger, and when litigation costs are endogenous. Implications for real world litigation practice include the use of high-low settlement agreements and partial settlement in multi-issue litigation. Finally, the role of third parties, including litigation funders and insurance companies, is analyzed and discussed.

KEYWORDS: Settlement; Pretrial Bargaining; Trial; Litigation; High-Low Agreements; Partial Settlement; Contingent Fees, Litigation Finance; Litigation Funding; Insurance;

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1 Introduction

In the autumn of 2002, two young women became lost in New Jersey while driving to a dance club. Lisa Duran was the driver of the car and her friend Claudia Clemente, a 20-year-old student, was the passenger. Tensions rose, insults were exchanged, and the fight escalated. Clemente – who ended up partially outside the vehicle – was dragged down the street as Duran drove away.[1] Prior to the trial, the two parties entered into a partial settlement agreement that featured a payment schedule based on the jury's finding of liability. "Under the terms of the agreement, if the defendant were found by the jury to be not at fault, or less than 50% at fault, the plaintiff would recover $6,000; if the defendant were found to be 50% at fault, the plaintiff would recover $11,250; and if the defendant were found to be over 51% at fault, [the plaintiff] would recover $22,500." The jury subsequently found the defendant to be 70% negligent and the plaintiff 30% comparatively negligent, and so Claudia Clemente recovered $22,500.[2]

The academic literature on pretrial bargaining has traditionally viewed settlement as a simple transfer payment from the defendant to the plaintiff in exchange for the plaintiff declining to pursue the claim.[3] However, examples such as the one described above illustrate that the standard account of settlement is too simple. In practice, litigants are not constrained to choose between out-of-court settlement and trial. Instead, litigants are free to write contracts that tailor the outcome at trial to

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[1]Claudia Clemente v. Lisa Duran, 2006 WL 4643243 (N.J.Super.L.)(Verdict and Settlement Summary). Clemente's injuries included a broken nose, lacerations, and a herniated disc at L5-S1. Clemente later sought recovery for pain and suffering. Duran denied liability saying that she had acted in self-defense.

[2]Under New Jersey's comparative negligence law, in the absence of a partial settlement, Clemente would have received 70% of the court-determined damages. If Duran had been found less than 50% at fault, Clemente would have recovered nothing.

[3]Of the many civil cases that are filed in state and federal courts each year, the vast majority settle out of court. See Ostrom et al. 2001, 29; Judicial Business of the United States Courts 2001, 154 table C-4. The academic literature on litigation and settlement has been a very active one. Landes (1971), Posner (1973), and Gould (1973) suggested that settlement may fail when litigants are mutually optimistic about what will happen at trial. More recent scholarship has viewed the failure to settle as arising due to information asymmetries between the litigants (P'ng 1983; Bebchuk 1984; Reinganum and Wilde 1986; Nalebuff 1987; Spier 1992). Surveys of this literature include Spier (2007), Daughety (2000), Cooter and Rubinfeld (1989), and Hay and Spier 1998. See Farmer and Pecorino (1994) and Heyes et al. (2004) for settlement models with risk averse parties.

better suit their needs and preferences (Prescott et al., 2014). This paper allows the litigants to negotiate contracts that condition transfer payments on the outcome at trial itself, and shows that tailored suits can increase value for both litigants.

The paper considers a model with two risk-averse litigants, a plaintiff and a defendant, with CARA expected utility functions. At trial, the factfinder (who may be a judge, a jury, or an arbitrator) will award damages that are drawn from a continuous support.[4] The litigants have potentially different subjective beliefs about the probability distribution over the possible damage awards, and these beliefs are assumed to be common knowledge. Thus, negotiations take place under complete information.[5] The parties may decide to either settle out of court or go to trial. If they go to trial, it is shown that the optimal contract specifies a lump-sum transfer and a contingent payment that is monotonic in the ratio of the plaintiff's and defendant's subjective beliefs. When the litigants are mutually optimistic, in the sense that this likelihood ratio is increasing in the court's award, then contractual payment is an increasing function of the court's award.[6] When the litigants are mutually pessimistic, the contractual payment is a decreasing function of the court's award.[7] The lump-sum payment will tend to be larger, and the contingent payment smaller, when the litigants are more risk averse.

When the litigants' beliefs are normally distributed with divergent means but a common variance, it is shown that the Pareto optimal contract is a linear function. The defendant pays pays the plaintiff a guaranteed lump sum and a fixed proportion

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[4]Prescott et al. (2014) present the first theoretical and empirical analysis of high-low contracts. The theoretical framework is a binary distribution (such as win or lose). Here, the environment and the contracts are generalized.

[5]Thus, the litigants have non common priors. Anecdotal and experimental evidence suggest the existence of self-serving biases where plaintiffs overestimate and defendants underestimate judgments at trial (Loewenstein et al., 1993; Bar-Gill, 2006). See Yildiz (2003, 2004) on bargaining without common priors. Models without common priors have been used to explore fee-shifting (Shavell 1982), the selection of cases for trial (Priest and Klein 1984), and bifurcation of trials (Landes 1993), among others. It has also been used in empirical work on settlement (Waldfogel, 1998; Watanabe, 2005).

[6]When the ratio is increasing, the plaintiff places greater relative likelihood on higher trial outcomes than the defendant does.

[7]While this is a curious theoretical prediction of the model, contracts with negative slopes are unlikely to be used in practice, since they could naturally lead litigants to sabotage their own cases. The model does not include such opportunities for the litigants.

of the court-determined damages.[8] The slope of the optimal contract is flatter when the litigants' beliefs are more closely aligned and when the variance of the probability density function is larger. When the litigants are sufficiently risk averse, the slope of the contract is smaller than one, so the optimal contract imposes less risk on the parties than a naked trial.[9] When the litigants are not too risk averse and/or are sufficiently optimistic about their own cases, the optimal contract may have a slope that is greater than one.[10] Rather than seeking to mitigate the risk at trial, the parties will find it in their mutual interest to *magnify that risk* and gamble on the court's award. When the litigation costs are endogenous and chosen after the contract is signed, the slope of the optimal contract is flatter. Intuitively, by flattening the contract the parties commit themselves to avoid inefficient rent-seeking activities and spend less money on litigation.[11]

The insights that emerge from this model are relevant for many areas of litigation practice, including the use of partial settlements. In 2007, Oracle Corporation, the California-based technology company, brought suit against SAP alleging copyright infringement for the illegal downloading of thousands of illegal copies of Oracle's applications and database software. By November of 2010, the case partially settled with SAP paying Oracle $120 million in exchange for Oracle agreeing not to seek punitive damages.[12] The case subsequently proceeded to trial where the jury decided on the level of compensatory damages alone.[13] Oracle's partial settlement arrangement resembles those described by the model. If we imagine that punitive damages are assessed as a multiple of compensatory damages, and that the litigants have divergent beliefs about the compensatory damages, then the optimal contract would include a lump sum payment and a contingent payment that is linear and increasing in the court's award.[14]

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[8]As demonstrated in an extension, when the litigants' subjective means and variances diverge the optimal contracts are quadratic.

[9]The phrase "naked trail" refers to a trial without a contract or other transfer payments. This result was also present in the binary model of Prescott et al. (2014).

[10]The corresponding lump sum transfer in this case would be negative.

[11]This idea was first mentioned in Prescott et al. (2014), but not rigorously demonstrated in a general or unified framework.

[12]Oracle, SAP Partially Settle, Proceed to Trial 28 No. 12 Westlaw Journal Computer and Internet 2 November 10 2010.

[13]The jury awarded Oracle $1.3 billion. Oracle Corporation vs. SAP AG, 49 Trials Digest 13th 10 2010 WL 5064389 (N.D.Cal.) (Verdict and Settlement Summary)

[14]The contract in Clemente v. Duran *supra* note 1 is also monotonic and increasing. The very

High-low agreements,[15] which are defined by *Black's Law Dictionary* as being contracts "in which a defendant agrees to pay the plaintiff a minimum recovery in return for the plaintiff's agreement to accept a maximum amount regardless of the outcome of trial" (Garner, 2004), provide another example. These contracts are fairly common in private insurance litigation (Prescott et al. 2014) and are featured in several state-sponsored alternative dispute programs.[16] By definition, these schedules have a slope of zero when the court award is below the floor, have a slope of one when the award is in the intermediate range, and a slope of zero when the award is above the ceiling. Although the general analysis presented here shows that high-low agreements, with fixed floors and ceilings, are not generally Pareto optimal,[17] they may create value for the parties in a similar way. By eliminating the tails of the distribution, high-low contracts can reduce the risk for both parties.[18]

The contracts described in this paper are also related to a variety of contractual arrangements between litigants and third parties. For example, it is very common for plaintiffs in personal injury and medical malpractice litigation to hire lawyers on a contingent fee basis where the lawyers bear their own costs but receive a proportional share of the award at trial.[19] Similarly, the last several years has seen growth of companies that specialize in investing in plaintiffs' suits. Specifically, litigation funders pay plaintiffs a lump sum of money in return for a stake in the outcome of trial or settlement.[20] Many defendants in civil litigation have insurance

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least the plaintiff could recover, $6,000, is analogous to the lump sum payment in the model.

[15]See Prescott et al.(2014) for the first theoretical and empirical study of these agreements. In their model, the outcome at trial was treated as a binary random variable (e.g., win or lose). This paper extends this work by considering continuous distributions and more general contracts.

[16]High-lows are specifically included in California's expedited jury trial program,CAL. CIV. PRO. CODE 630.01(c), 630.03 (West) and in New York's summary jury trial program, NY R KINGS SJT Rules 12, 17 (West). In addition, a survey-based study from Charleston County, North Carolina found that that "virtually all parties enter into a high-low agreement when opting for a [summary jury trial]." See Paula L. Hannaford-Agor et al. (2012).

[17]A high-low contract would be Pareto optimal only if the likelihood ratio was constant below the floor and above the ceiling, and monotonically increasing with a particular functional form between the floor and the ceiling.

[18]In an article in the 1970s, a New York State judge discussed high-low agreements and their potential advantages for plaintiffs and defendants, including the mitigation of risk (Finz, 1976).

[19]See Dana and Spier (2003). Other benefits of contingent fee contracts include solving the problem of attorney moral hazard, providing liquidity constrained plaintiffs with access to justice, and mitigating asymmetric information between the lawyer and client.

[20]See Garber (2010), Molot (2010), Kirstein and Rickman (2004), Sebok (2014), Steinitz (2012),

policies with third parties that cover them against many types of losses.[21] This third party contracts – contingent fees, litigation funding, and insurance policies – all help to mitigate the risk of litigation.

This paper establishes that the litigants can themselves secure much of the risk-shifting benefits that traditionally have been provided by third parties. Recall that the Pareto optimal contract includes a lump-sum payment from the defendant to the plaintiff coupled with a contingent payment (e.g., a fraction of the court's award). Through this contract, *the defendant is effectively playing the role of a litigation funder*, paying a lump-sum purchase price to the plaintiff in exchange for a stake in the plaintiff's claim. In our earlier example, SAP effectively paid $120 million in return for the punitive damages component of Oracle's case. On the flip side, *the plaintiff is effectively playing the role of an insurance company.* The lump-sum payment made by the defendant is analogous to an insurance premium. In return for this premium, the plaintiff-insurer bears a portion of the defendant's loss. Thus, the litigants themselves are providing financial services that are usually associated with third-party investors.

The outline of the paper is as follows. The next section describes the basic model, characterizes the set of Pareto optimal contracts, and evaluates the litigants' decision to settle versus go to trial. Section 3 explores several extensions, including partial settlement with multiple issues, endogenous litigation spending, and alternative distributional assumptions. Section 4 analyzes contracting with third parties, namely litigation funders and insurance companies. Section 5 concludes.

2   The Model

Suppose that two litigants, a plaintiff (p) and a defendant (d), are negotiating with each other prior to a risky and costly civil trial. We assume that the litigants have CARA expected utility functions, so their payoffs are $u_i(z) = -\exp(-a_i z))$ where $a_i > 0$, $i = p, d$ are the coefficients of absolute risk aversion for the plaintiff and defendant, respectively.[22] If they fail to sign an out-of-court settlement or other

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Daughety and Reinganum (forthcoming).

[21]Indeed, in many (but far from all) cases, insurance companies effectively replace the defendants themselves in civil litigation.

[22]CARA expected utility functions are common in finance and macroeconomics research. Since this specification does not have income or wealth effects, they generate straightforward predictions

contractual agreement and go to trial, the court will enforce a transfer of x from the defendant to the plaintiff and the litigants will bear costs c_d and c_p. The plaintiff and defendant have potentially divergent prior beliefs about the distribution of possible damage awards. The plaintiff believes that that the award at trial is drawn from density function $f_p(x)$ while the defendant believes that it is drawn from density function $f_d(x)$. Finally, we will assume that the plaintiff has a credible threat to litigate. That is, the plaintiff receives a higher expected utility from bringing the case to trial than by dropping the case.[23] The distributions, litigation costs, and risk aversion coefficients are all assumed to be common knowledge.

Two types of contracts may be written before trial. First, the litigants may agree to an *ordinary settlement contract* where the defendant agrees to pay the plaintiff a flat amount, thereby avoiding both the risk and the direct expense of trial. Second, the parties may agree to modify the court's award through an *award-modification contract* $s(x)$.[24] Under this contract, the parties go to trial and bear the costs c_p and c_d, but the ultimate payment made by the defendant to the plaintiff need not correspond to the amount determined by the factfinder.[25] Note that since all of the parameters of the model are assumed to be common knowledge, all negotiations take place under complete information.

2.1   Pareto Optimal Contracts

Any Pareto optimal award-modification contract $s(x)$ will maximize a weighted sum of the litigants' expected utilities:[26]

$$\beta \int u_p(s(x) - c_p) f_p(x) dx + (1 - \beta) \int u_d(-s(x) - c_d) f_d(x) dx.$$

and comparative statics. This specification was also used in Prescott et al. (2014).

[23]This assumption will be relaxed in a later section.

[24]If $s(x) = x$, the litigants are agreeing to abide by the outcome at trial without any modification. If $s(x)$ is a constant and independent of the trial outcome x, then the parties are avoiding all of the risk of a trial. Since litigation is costly, the parties would prefer to settle out of court for a fixed amount than go to trial with a contract that specifies $s(x)$ as a constant.

[25]Alternatively, the plaintiff and defendant could write a contract that specifies side payments, $t(x)$, from the plaintiff to the defendant after the payment of the damage award x. For example, $t(x) = x - s$ would require the plaintiff to return the damage award x to the defendant but keep a fixed payment s. More generally, in this alternative representation, $s(x) = x - t(x)$.

[26]Suppose that the plaintiff (for example) were choosing the contract $s(x)$ to maximize his or her own expected utility subject to the defendant's individual rationality constraint. The resulting Lagrangian would have this form.

Maximizing this expression pointwise, we find that the solution $s(x)$ implicitly solves

(1)
$$\frac{f_p(x)}{f_d(x)} \frac{u'_p(s(x) - c_p)}{u'_d(-s(x) - c_d)} = \kappa$$

where κ is a constant. With CARA expected utility, we can establish the following result:

LEMMA 1: *Any Pareto optimal award-modification contract has the following form:*

(2)
$$s(x) = k + \left(\frac{1}{a_p + a_d}\right) \ln\left(\frac{f_p(x)}{f_d(x)}\right)$$

where k is a constant.

PROOF. Since $u'_i(z) = a_i \exp(-a_i z))$, we have,

$$\frac{f_p(x)}{f_d(x)} \frac{a_p \exp[-a_p(s(x) - c_p)]}{a_d \exp[-a_d(-s(x) - c_d)]} = \kappa$$

where κ is a constant. Using the property that $\exp(m)/\exp(n) = \exp(m - n)$ this becomes

$$\frac{f_p(x)}{f_d(x)} \frac{a_p}{a_d} \exp[-(a_p + a_d)s(x) + a_p c_p - a_d c_d] = \kappa.$$

Taking the natural logarithm of both sides, and using the property that $\ln(mn) = \ln(m) + \ln(m)$, we have

$$\ln\left(\frac{f_p(x)}{f_d(x)}\right) + \ln\left(\frac{a_p}{a_d}\right) - (a_p + a_d)s(x) + a_p c_p - a_d c_d = \ln(\kappa),$$

Solving for $s(x)$ and renaming the collection of constant terms k gives the result. ∎

The expression in the lemma describes the locus of Pareto optimal contracts, contracts for which there is no alternative contract that makes both litigants better off. The contracts in this locus differ from each other only in the fixed payment from the defendant to the plaintiff, k, a value that will be determined by negotiations between the litigants.[27] The shape of the optimal award-modification contract depends on the litigants' subjective beliefs about the distribution of the court award, x, and their risk aversion coefficients.

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[27]The plaintiff will prefer a higher fixed payment, and the defendant will prefer a lower one. The constant could be negative, in which case the plaintiff pays the defendant.

Specifically, the optimal award-modification contract $s(x)$ hinges on the relative likelihood ratio, $f_p(x)/f_d(x)$ associated with the different court awards. If the plaintiff believes that the outcome x is (relatively) more likely than the defendant believes it is, so $f_p(x)/f_d(x)$ is large, then the contract stipulates that the defendant will pay the plaintiff a higher amount. Conversely, if the plaintiff believes that an outcome is less likely than the defendant, so the ratio $f_p(x)/f_d(x)$ is small, then the contract will specify a smaller amount. Note that if the distributions of the plaintiff exhibit the monotone likelihood ratio property, so higher realizations of x are more consistent with the plaintiff's subjective beliefs than the defendant's, then the contract $s(x)$ will be monotonically increasing in the court's award x.[28]

The next proposition establishes that when the beliefs of the litigants are normally distributed with a common variance but different means, then the Pareto optimal award-modification contracts are linear in the court's award, x.[29]

PROPOSITION 1: *Suppose that the plaintiff's and defendant's subjective prior beliefs $f_p(x)$ and $f_d(x)$ are normally distributed with means μ_p and μ_d, respectively, and variance σ^2. The set of Pareto optimal award-modification contracts satisfies:*

$$(3) \qquad s(x) = s_0 + \left(\frac{1}{a_p + a_d}\right)\left(\frac{\mu_p - \mu_d}{\sigma^2}\right)x,$$

where s_0 is a constant.

PROOF. The probability density function for litigant $i = p, d$ is

$$f_i(x) = \frac{1}{\sigma\sqrt{2\pi}}\exp\left(\frac{-(x-\mu_i)^2}{2\sigma^2}\right),$$

which implies

$$\frac{f_p(x)}{f_d(x)} = \exp\left[\frac{-(x-\mu_p)^2 + (x-\mu_d)^2}{2\sigma^2}\right].$$

Substituting this likelihood ratio into equation (2) yields

$$s(x) = k' + \left(\frac{1}{a_p + a_d}\right)\left(\frac{-(x-\mu_p)^2 + (x-\mu_d)^2}{2\sigma^2}\right).$$

Expanding the numerator and rearranging terms, this becomes:

$$s(x) = k' - \left(\frac{1}{a_p + a_d}\right)\left(\frac{\mu_p^2 - \mu_d^2}{2\sigma^2}\right) + \left(\frac{1}{a_p + a_d}\right)\left(\frac{2\mu_p x - 2\mu_d x}{2\sigma^2}\right).$$

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[28]This situation corresponds to the mutual optimism of the two litigants.

[29]We later extend this result to include divergent beliefs about the variance of the distribution, and show that the set of optimal contracts are quadratic functions.

The first two terms are constant, which we call s_0, and a slight rearranging of the last term gives the result. ∎

When $\mu_p > \mu_d$, so the plaintiff believes that the average court award will be higher than the defendant believes, then $s(x)$ is increasing in the court's award, x. That is, when the litigants are mutually optimistic, the plaintiff will receive a greater payout when the damage award is high than when it is low. When the parties beliefs are more closely aligned, so $\mu_p - \mu_d$ is smaller, then the slope will be smaller as well. In the extreme case where $\mu_p = \mu_d$, the parties beliefs are fully aligned and the optimal contract has a slope of zero. In this case, the contract specifies a flat payment from the defendant to the plaintiff.

When $\mu_p < \mu_d$, the litigants are mutually pessimistic and the Pareto optimal award-modification contract would have a negative slope. That is, the plaintiff receives less when the court's award is high than when it is low. While the possibility of a negative slope is interesting in theory, it it inadvisable in practice. In practice, a contract with a negative slope would give both litigants a strong incentive to sabotage its own case.[30] In reality, litigants can control the presentation of evidence at trial, and can thus affect the level of damages awarded by the court, factors that were not included the model. So, unless the litigants could commit themselves to putting their best cases forward, contracts along these lines are unlikely to yield the benefits identified here.[31] As has been emphasized in the literature, when litigants are mutually pessimistic it is likely that the case will settle out of court.

To illustrate the result in Proposition 1, consider the following numerical example:

Example: *Suppose $\mu_p = 200,000$, $\mu_d = 160,000$, $\sigma^2 = 400,000,000$, and $a_p + a_d = .0002$.[32] Any Pareto optimal award-modification contract has the form $s(x) = s_0 +$*

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[30]This would be analogous to an athlete betting against his or her own team and then throwing the game.

[31]The parties might be able to commit to putting their best cases forward through their contracts with attorneys. That is, the plaintiff might compensate his or her attorney with a contingent fee. This would give the attorneys to fight for their own sides. Commitment mechanisms along these lines may be practically elusive, however, since litigants themselves typically retain the rights to control their own claims.

[32]Using data from a popular game show, Metrick (1995) estimates that the coefficient of absolute risk aversion is approximately .00007; using insurance data, Cohen and Einav (2007) estimate it to be .00025.

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.5x where s_0 is a positive number.

The litigants are mutually optimistic in this example: the plaintiff's subjective assessment of the mean, μ_p, is $40,000$ higher than the defendant's subjective assessment, μ_d. To put this example in perspective, note that the standard deviation of the court's award is $20,000$. So the plaintiff's 95% confidence interval is $[160,000, 240,000]$ and the defendant's 95% confidence interval is $[120,000, 200,000]$. So although the litigants are mutually optimistic, there is also considerable overlap in their assessments. In this example, the defendant pays s_0 in exchange for a fifty percent reduction in the damage award.

The following corollary outlines the comparative statics:

COROLLARY: *The Pareto optimal award-modification contract is flatter when the litigants' subjective beliefs are closer together ($\mu_p - \mu_d$ is smaller), when they are more risk averse ($a_p + a_d$ is larger), and when the trial is riskier (σ^2 is larger).*

When parties are more risk averse, so $a_p + a_d$ is higher, then the contract is less sensitive to the trial outcome, providing the litigants with a greater degree of mutual insurance. In our numerical example, if $a_p + a_d = .0003$ instead of $a_p + a_d = .0002$, then the optimal award modification contract would have a slope of one third instead of one half. When the variance of the underlying distribution of the court's award (σ^2) is larger, so the parties are not very confident in their own subjective assessments, then $s(x)$ would be flatter. In the numerical example, if the variance of the distribution increased from 400 million to 800 million then the slope would fall from one half to one quarter.

Interestingly, the slope of the award-modification contract can be *greater than one*. In other words, the litigants may decide to gamble or bet on the court's award. In the numerical example, if $\mu_p - \mu_d = 160,000$ instead of $40,000$, then the optimal contract would have a slope of two. That is, for every dollar awarded by the court, the contract specifies that the plaintiff will receive two dollars. So the plaintiff and the defendant are gambling on the outcome of the trial and *magnifying* the trial's risk. Note that in this this optimal contractual arrangement, the corresponding transfer s_0 negotiated by the litigants would smaller than zero.[33] Similarly, if the

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[33]So rather than the defendant making a lump sum payment to the plaintiff, the plaintiff would make a lump sum payment of $-s_0 > 0$ to the defendant for the opportunity to receive double damages. This is implied by the defendant's individual rationality constraint. If this were not

variance is sufficiently small, so the litigants have precise but potentially inconsistent prior beliefs, then the litigants will be inclined to speculate at trial and forego the benefits of mutual insurance.[34]

In practice, there are different ways that plaintiffs and defendants might exaggerate the risks at trial. For example, the litigants might write a contract to shift the litigation costs of the winner to the loser, a system known as the English Rule.[35] In this way, the stakes at trial are exaggerated: if the defendant is found liable, he will be forced to compensate the plaintiff not only for the damages but also for the litigation costs; if the plaintiff loses, he must pay the defendant's legal bills. While most jurisdictions in the United States have the American Rule, where each sides bears its own litigation costs regardless of the outcome at trial, parties remain free to contract around this rule. Indeed, it is very common for commercial contracts to specify that fees will be shifted from the winner to the loser in contract in the event of a dispute.[36]

2.2 Out-of-Court Settlement

This section explores the decision of the two litigants to settle their case out of court, both with and without award modification contracts. To do so, we will use two basic properties of model. First, when a random variable x is normally distributed with mean μ and variance σ^2 then the random variable $y = \gamma_0 + \gamma_1 x$, where γ_0 and γ_1 are constants, is normally distributed with mean $\mu_y = \gamma_0 + \gamma_1 \mu$ and variance $\sigma_y^2 = \gamma_1^2 \sigma^2$. Second, an agent with CARA expected utility will be indifferent between receiving a random payoff $y = \gamma_0 + \gamma_1 x$ and receiving its certainty equivalent

$$(4) \qquad \mu_y - a\sigma_y^2/2 = \gamma_0 + \gamma_1\mu - a_i\gamma_1^2\sigma^2/2,$$

where a_i is the agent's risk aversion coefficient.[37]

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true, the defendant would not sign the contract.

[34]The litigant's prior distributions become more aligned as the variance increases. In the limit as the variance increases to infinity, the likelihood ratio $f_p(x)/f_d(x)$ converges to one.

[35]This is required by law in England. Other types of offer-of-judgment rules define winning and losing relative to the settlement offers made by the litigants before trial. See Spier (1994).

[36]The logic of the example above suggests that, even in the absence of a pre-existing contract, litigants may find it in their interest to write a contract to shift fees. After-the-event fee-shifting is apparently rare. See Donohue (1991).

[37]See the appendix for a formal proof.

To start, let us suppose that the parties cannot write award-modification contracts. Settlement negotiations take place in the shadow of a naked trial where the plaintiff receives a random draw of damage award x and the plaintiff and defendant will pay costs c_p and c_d, respectively. The plaintiff's (subjective) certainty equivalent of a naked trial where she receives $x - c_p$ is:

$$\underline{s}^N = \mu_p - c_p - a_p \sigma^2/2.$$

That is, the certainty equivalent reflects the plaintiff's subjective assessment of the expected damage award, μ_p, less the sum of the direct cost of litigation and the risk premium, $c_p + a_p \sigma^2/2$. Note that this is the very least that the plaintiff would be willing to accept in settlement when bargaining in the shadow of a naked trial. Similarly, the defendant's (subjective) certainty equivalent of going to trial is

$$\overline{s}^N = \mu_d + c_d + a_d \sigma^2/2.$$

This is the most that the defendant would be willing to pay to settle the case out of court rather than go to a naked trial. The defendant's risk premium, $a_d \sigma^2/2$, enters this expression as a positive number – the risk averse defendant would be willing to pay extra in settlement to avoid the risk of the trial.

A mutually acceptable settlement exists when $\underline{s}^N \leq \overline{s}^N$, or when

(5) $$c_p + c_d \geq \psi^N(\mu_p, \mu_d, a_p, a_d, \sigma^2) = (\mu_p - \mu_d) - (a_p + a_d)\sigma^2/2,$$

where $\psi^N(.)$ represents the litigants' joint benefit of a naked trial. This expression is intuitive. $(\mu_p - \mu_d)$ represents the joint benefit to the two parties from mutual speculation, and $(a_p + a_d)\sigma^2/2$ is the sum of their risk premiums, or their joint cost of the risk associated with the naked trial. The litigants settle when the direct costs of litigation exceed these joint benefits.

Now suppose that the litigants can write an award-modification contract before trial. Using the formula for the certainty equivalent, and assessing risk using the plaintiff's subjective prior, the plaintiff's certainty equivalent of going to trial with a Pareto optimal contract defined in Proposition 1, $s(x) - c_p$, is

$$\underline{s}^* = s_0 + \frac{(\mu_p - \mu_d)\mu_p}{\sigma^2(a_p + a_d)} - c_p - \frac{a_p(\mu_p - \mu_d)^2}{2\sigma^2(a_p + a_d)^2}.$$

The first three terms reflect the expected value of the contract, and the last term is the plaintiff's risk premium. Similarly, the defendant's certainty equivalent of

paying $s(x) + c_d$ at trial is:

$$\overline{s}^* = s_0 + \frac{(\mu_p - \mu_d)\mu_d}{\sigma^2(a_p + a_d)} + c_d + \frac{a_d(\mu_p - \mu_d)^2}{2\sigma^2(a_p + a_d)^2}.$$

The parties will choose to settle out of court when $\underline{s}^* \leq \overline{s}^*$, or equivalently when

(6) $$c_p + c_d \geq \psi^*(\mu_p, \mu_d, a_p, a_d, \sigma^2) = \frac{(\mu_p - \mu_d)^2}{2\sigma^2(a_p + a_d)}.$$

The litigants' joint benefit of an optimally tailored trial, $\psi^*(.)$, is increasing in the divergence between their beliefs, $(\mu_p - \mu_d)^2$, and decreasing in their joint risk aversion $a_p + a_d$. This joint benefit is also decreasing in the variance, σ^2, or equivalently increasing in the precision of their subjective beliefs, $1/\sigma^2$. Cases where the litigants are more optimistic about their own cases, more confident in their subjective assessments, and less risk averse are more likely to go to trial.

We will now state an important result. The opportunity of private parties to write contracts that modify the outcome at trial will tend to reduce the level of settlement and increase the number of cases that go to trial. Through the award-modification contracts, parties can avoid the risk of trial (and the associated risk premiums) and can fine-tune the outcome at trial to meet their private risk preferences. This result is not surprising, since revealed preference suggests that going to trial will be more attractive to the litigants when award-modification contracts are feasible.

PROPOSITION 2: *When award-modification contracts are feasible, the settlement rate falls and the litigation rate rises.*

PROOF. To establish this result, we will show that the joint benefit of the Pareto optimal contract is larger than the joint benefit of a naked trial. Using the expressions defined earlier, we have

$$\psi^*(.) - \psi^N(.) = \frac{(\mu_p - \mu_d)^2}{2\sigma^2(a_p + a_d)} - (\mu_p - \mu_d) - (a_p + a_d)\sigma^2/2.$$

We rewrite this as:

$$\psi^*(.) - \psi^N(.) = \frac{(\mu_p - \mu_d)^2 - 2\sigma^2(\mu_p - \mu_d)(a_p + a_d) + (a_p + a_d)^2\sigma^4}{2\sigma^2(a_p + a_d)}.$$

Rewriting the numerator gives

$$\psi^*(.) - \psi^N(.) = \frac{[(\mu_p - \mu_d) - \sigma^2(a_p + a_d)]^2}{2\sigma^2(a_p + a_d)} \geq 0.$$

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The numerator of the expression in the proposition is equal to zero when $(\mu_p - \mu_d) = (a_p + a_d)\sigma^2$,[38] but is strictly positive otherwise. ∎

To illustrate this result, let's revisit the example where $\mu_p = 200,000$, $\mu_d = 160,000$, $\sigma^2 = 400,000,000$. For additional concreteness, suppose further that $a_p = a_d = .0001$ so the defendant and the plaintiff are both risk averse.[39] First, consider a naked trial where the parties do not write an award-modification contract. In a naked trial, the plaintiff and defendant would each bear a risk premium of $a_i \sigma^2/2 = 20,000$. The plaintiff's associated (subjective) certainty equivalent of the damage award x is $200,000 - 20,000 = 180,000$, which is exactly equal to the defendant's certainty equivalent, $160,000 + 20,000 = 180,000$. Taken together, the litigants' joint benefit of a naked trial is $\psi^N(\boldsymbol{.}) = 0$. Since litigation is expensive, the plaintiff and defendant will settle out of court for any positive litigation costs.

Next, suppose that the litigants write a Pareto optimal award-modification contract with $s(x) = 90,000 + .5x$. The risk premia associated with this arrangement are $a_i \gamma_1^2 \sigma^2/2 = 5,000$, a quarter of what they were with a naked trial. Ignoring the litigation costs, the plaintiff's certainty equivalent of this arrangement is $185,000$ while the the defendant's certainty equivalent is $175,000$. Thus, both litigants strictly prefer this Pareto optimal contract to the naked trial and their joint benefit is $185,000 - 175,000 = 10,000$.[40] So, if $c_p + c_d < 10,000$, then the parties will go to trial with an award-modification contract but would settle out of court if such contracts were impossible.

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[38]In this knife-edged case, the Pareto optimal award-modification contract has a slope of one. In other words, the naked trial itself is Pareto optimal.

[39]Alternatively, it may be the case that one party is much more risk averse than the other. For example, the defendant may be represented by a diversified insurance company while the plaintiff is not insured. Since the risk of a trial is diversifiable for the insurance company but not for the plaintiff.

[40]The private value creation is even larger in example 2 where $\mu_p = 260,000$ and $\mu_d = 100,000$. The joint risk premium of a naked trial is $40,000$, as it was in example 1. The joint private value of the naked trial in this example is $\psi^N(\boldsymbol{.}) = 260,000 - 100,000 - 40,000 = 120,000$. Now consider the Pareto optimal award-modification contract $s(x) = -180,000 + 2x$. The joint risk premium is now $160,000$, or four times higher than before. The plaintiff's certainty equivalent is $-180,000 + 520,000 - 80,000 = 260,000$, while the defendant's certainty equivalent is $-180,000 + 200,000 + 80,000 = 100,000$. Therefore the joint private value of the award-modification contract is $\psi^*(\boldsymbol{.}) = 160,000$. So in this example, the increase in value is $\psi^*(\boldsymbol{.}) - \psi^N(\boldsymbol{.}) = 40,000$.

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3 Extensions

3.1 Multiple Issues and Partial Settlement

Suppose that the dispute involves two issues, x and y, both of which will influence the court's award. Specifically, suppose that the court will award damages $d(x, y)$ if the case goes to trial. In some applications, the function $d(x, y)$ could be multiplicative, $d(x, y) = xy$. For example, x could be the actual damages that the plaintiff has suffered, and y could be the degree of the defendant's liability.[41] In other applications, $d(x, y)$ could be additive, $d(x, y) = x + y$. In a personal injury case, x could reflect the victim's medical bills, and y could reflect the opportunity cost of lost work, or the pain and suffering associated with the accident. We will imagine that these these issues are observable and contractible: the litigants can write a contract $s(x, y)$.

One can readily extend our earlier techniques to this extension. Letting $g_p(x, y)$ and $g_d(x, y)$ be the subjective joint density functions for the plaintiff and defendant, respectively, we have that the Pareto optimal award-modification contract $s(x, y)$ satisfies

$$s(x, y) = \kappa + \left(\frac{1}{a_p + a_d} \right) \ln \left(\frac{g_p(x, y)}{g_d(x, y)} \right).$$

So, as before, the agreement involves a fixed payment k_0 and a variable transfer that depends on the likelihood ratio $g_p(x, y)/g_d(x, y)$. This expression simplifies if the density functions are separable in x and y, and the two parties' beliefs diverge only in regard to the variable x. That is, suppose that litigant i's subjective joint density function $g_i(x, y) = f_i(x)h(y)$ for $i = p, d$. Under these circumstances, the Pareto optimal award-modification contract simplifies to:

$$s(x, y) = \kappa + \left(\frac{1}{a_p + a_d} \right) \ln \left(\frac{f_p(x)}{f_d(x)} \right).$$

The right-hand side of this expression includes x but not y. So, in the optimal arrangement, the plaintiff and defendant tailor their suit to focus on issue x alone.

This framework sheds light on the prevalence of partial settlement when litigation involves multiple issues. Suppose for example that x are the plaintiff's damages, and that y is a binary random variable reflecting liability. If the parties have the same

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[41] Low values of y would correspond to the defendant not being liable for the plaintiff's harm, when higher values would correspond to higher levels of liability.

beliefs about the likelihood that the plaintiff will be found liable, and if this likelihood is uncorrelated with their subjective assessments of damages, then the parties will write a contract that is independent of liability. In other words, the plaintiff and defendant will settle the issue of liability and they will continue to litigate on the issue of the plaintiff's damages.

To illustrate, let's extend our earlier example to reflect this extension. Suppose that both the damages x and liability y are uncertain, and the court's award will be $z = xy$. As before, the litigants have divergent priors about the damage award, x. The litigants' beliefs about x are normally distributed with mean $\mu_p = 200,000$, $\mu_d = 160,000$, $\sigma^2 = 400,000,000$. They have common beliefs about y: they believe that fifty percent of the time the court will find for the defendant ($y = 0$) and fifty percent of the time the court will find for the plaintiff ($y = 1$). In this example, the litigants will agree to a linear award-modification contract with a slope of one half. If the litigants were similarly risk averse ($a_p = a_d = .0001$) with equal bargaining power, the lump sum payment would be zero. In other words, the parties will partially settle with the defendant accepting liability and the plaintiff agreeing to discount any future damage award by fifty percent.

3.2   Endogenous Litigation Spending

We will now extend the basic framework to include endogenous litigation spending. Suppose that after the award-modification contract is signed, but before the trial, the plaintiff and defendant may invest in their claims. Specifically, suppose the investments of the two parties affect the litigants' subjective means of the distributions of trial awards. Specifically, from the plaintiff's subjective perspective, x is normally distributed with mean $\mu_p + \theta\sqrt{c_p} - \theta\sqrt{c_d}$. From the defendant's perspective, the mean of the distribution is $\mu_d + \theta\sqrt{c_p} - \theta\sqrt{c_d}$. As before, the litigants are assumed to have common beliefs about the variance σ^2.[42]

Given a linear contract, $s(x) = \gamma_0 + \gamma_1 x$, it is straightforward to characterize the Nash equilibrium investments of the two parties.[43]   The plaintiff's certainty

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[42]Prescott et al. (2014) provide a partial analysis along these lines for binary outcomes and risk-neutral litigants.

[43]In this section, we will simply assume that the contracts are linear. Although it is possible that the introduction of rent-seeking contests will lead to Pareto-optimal award-modification contracts that are not linear, an analysis of this case is beyond the scope of the current manuscript.

equivalent associated with this contract is:

$$\gamma_1(\mu_p + \theta\sqrt{c_p} - \theta\sqrt{c_d}) - c_p - a_p\gamma_1^2\sigma^2/2.$$

Differentiating this expression with respect to c_p and setting the resulting expression equal to zero shows that the plaintiff will choose to invest $c_p = \theta\gamma_1^2/4$. An analogous calculation verifies that the defendant will spend the same amount, $c_d = \theta\gamma_1^2/4$. In this rent-seeking contest, the plaintiff and the defendant spend resources just to stand still; since $c_p = c_d = \theta\gamma_1^2/4$, their expenditures cancel each other out and do not influence the expected award at trial. These expenditures reflect a deadweight loss, however, and the size of the loss is proportional to the slope of the award-modification contract.[44] The implication is that the parties have a private incentive to lower the value of γ_1 in order to reduce their own incentives to spend money preparing for litigation.

We can now characterize how endogenous litigation spending will influence the form of award-modification contracts. Formally, the plaintiff and the defendant would negotiate a contract that maximizes their joint surplus, which is simply the difference between their certainty equivalents,

$$\gamma_1(\mu_p - \mu_d) - \theta\gamma_1^2/2 - (a_p + a_d)\gamma_1^2\sigma^2/2.$$

The first term reflects their divergent beliefs about the outcome at trial, the second term is the sum of their (endogenous) litigation expenses, and the third term is the sum of the two risk premiums. Taking the derivative and setting it equal to zero, we establish the following result.

PROPOSITION 3: *Suppose that the plaintiff's and defendant's subjective prior beliefs $f_p(x)$ and $f_d(x)$ are normally distributed with means $\mu_p + \theta\sqrt{c_p} - \theta\sqrt{c_d}$ and $\mu_d + \theta\sqrt{c_p} - \theta\sqrt{c_d}$, respectively, and variance σ^2. The set of Pareto optimal award-modification contracts satisfies:*

(7) $$s(x) = s_1 + \left(\frac{\mu_p - \mu_d}{\theta + (a_p + a_d)\sigma^2}\right)x,$$

where s_1 is a constant.

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[44]A naked trial would involve higher litigation costs for the two parties than trial governed by an award-modification contract with $\gamma_1 < 1$.

Two important observations are in order here. First, when litigation costs are endogenous, the slope of the award-modification contract will be flatter. This makes sense, since a flatter slope will reduce the litigants' incentives to spend money and the deadweight loss of the rent-seeking contest will be reduced. Second, mitigating the risk of litigation is valuable even if the parties are essentially risk neutral. When θ is positive, then the slope of s(x) is bounded above by $(\mu_p - \mu_d)/\theta$. In contrast, when the costs of litigation were exogenous, the slope of $s(x)$ diverged when the sum of the risk aversion coefficients, $a_p + a_d$, approached zero. Thus, award-modification contracts may be privately valuable even for litigants who are risk neutral.[45]

3.3 Alternative Distributions

Prescott et al. (2014) considered a binary distribution where the outcome at trial was either high or low, and the plaintiff and defendant had potentially different priors about the relative likelihood of these two outcomes. There, as here, the optimal award-modification contract (which took on exactly two values) depended on the divergence in beliefs and the risk aversion parameters of the two parties. The current paper has extended this earlier framework to consider continuous distributions, and more general award-modification contracts.

While the linear form of the award-modification contracts will not be Pareto optimal in general models, it will hold for all distributions for which the logarithm of the likelihood ratio is linear. Exponential distributions have this property, and as illustrated below the set of Pareto-optimal award-modification contracts remains linear in the court's award.

PROPOSITION 4: *Suppose that the plaintiff's and defendant's subjective prior beliefs are exponential, with $f_i(x) = \lambda_i \exp^{-\lambda_i x}$ for $i = p, d$. The set of Pareto optimal award-modification contracts satisfies:*

$$(8) \qquad s(x) = s_2 + \left(\frac{1}{a_p + a_d}\right)(\lambda_p - \lambda_d)x,$$

where s_2 is a constant.

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[45] As described in Prescott et al. (2014), parties can and do sometimes constrain their litigation spending by contract. They can, for example agree in advance to not hire expert witnesses.

PROOF. Using the expression for the exponential distribution,

$$\frac{f_p(x)}{f_d(x)} = (\lambda_p/\lambda_d) \exp^{(-\lambda_p + \lambda_d)x} .$$

Substituting this expression into equation (3) and rearranging terms gives our result. ∎

The model section assumed that the plaintiff and defendant had different subjective beliefs about the mean of the normally distributed random variable, μ_p and μ_d, but had common beliefs about the distribution's variance. Our earlier results can be extended to consider situations where their beliefs about the variance may diverge as well. The next result shows that when the variances diverge, then the Pareto-optimal award-modification contracts are quadratic functions of the court's award.

PROPOSITION 5: *Suppose that the plaintiff's and defendant's subjective prior beliefs are normally distributed with means μ_i and variances σ_i^2 for $i = p, d$. The set of Pareto optimal award-modification contracts satisfies:*

$$(9) \qquad s(x) = s_1 + \left(\frac{1}{a_p + a_d}\right)\left[\left(\frac{\mu_p}{\sigma_p^2} - \frac{\mu_d}{\sigma_d^2}\right)x - \left(\frac{1}{2\sigma_p^2} - \frac{1}{2\sigma_d^2}\right)x^2\right],$$

where s_1 is a constant.

PROOF. The probability density function for litigant $i = p, d$ is

$$f_i(x) = \frac{1}{\sigma_i\sqrt{2\pi}}\exp\left(\frac{-(x - \mu_i)^2}{2\sigma_i^2}\right),$$

and so we have

$$\frac{f_p(x)}{f_d(x)} = (\sigma_d/\sigma_p)\exp\left(\frac{-(x - \mu_p)^2}{2\sigma_p^2} + \frac{(x - \mu_d)^2}{2\sigma_d^2}\right).$$

Using equation (3) we have

$$s(x) = k_0\left(\frac{1}{a_p + a_d}\right)\left(\frac{-(x - \mu_p)^2}{2\sigma_p^2} + \frac{(x - \mu_d)^2}{2\sigma_d^2}\right).$$

Expanding this out and incorporating the terms that do not involve x or x^2 into the constant, this yields the expression in the proposition. ∎

4 Contracting with Third Parties

The main section of the paper assumed that only the litigants themselves could contract upon the outcome at trial. In practice, litigants may be able to contract with third parties. Indeed, many of institutional practices that we observe in real markets are qualitatively similar to the contracts identified here. This section will assume that the award-modification contracts of the previous sections are impossible, but that competitive markets with third party investors exist. We characterize the contracts that would, in theory, be offered to plaintiffs and defendants when these third party investors are perfectly competitive and risk neutral.

4.1 Litigation Funding for Plaintiffs

We will first explore the possibility that a third party, a "litigation funder," can receive an interest in the outcome of litigation by writing contracts with the plaintiff prior to trial.[46] To begin, we will assume that litigation funders are risk averse with CARA utility $u_0(z) = -\exp(-a_0 z))$ with $a_0 > 0$ and beliefs $f_0(x)$, although we will later relax this assumption to consider risk neutral funders. Using the same methodology developed earlier, one can characterize the set of Pareto optimal contracts where the plaintiff and litigation funder each have a claim on the damage award: the plaintiff receives $t(x)$ and the funder receives $x - t(x)$.

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[46]It is not just financial services companies that provide this type of service to plaintiffs. Through contingent fees, plaintiff's attorneys are creating similar risk sharing benefits. There are also examples where defendants provide funding for plaintiffs. In 1986, Marvin E. Myers was injured while working on board a drilling vessel in the Gulf of Mexico. His employer, Griffin-Alexander Drilling Company, also owned the drilling vessel. Mr. Myers sustained a back injury while performing his job on top of a nitrogen tank, which was owned and operated by Camco.[47] Myers brought suit agaist both Griffin and Camco, but settled with Griffin prior to trial. Under the terms of the settlement, Griffin paid Myers $60,000 for release of all claims against him. In addition, Myers agreed to share any future recovery from Camco (or Camco's insurers) with Griffin, fifty cents on every dollar, up to a total of $60,000. At trial, the jury found that Camco was ninety-nine percent negligent and awarded Myers a total of $579,000 and Griffin was repaid the $60,000. Myers was found one percent negligent, and Griffin was found to be free from negligence. On appeal, Camco argued that the damage award should be offset by the settlement paid by Griffin. The appeals court found that the district court did not err in denying the offset.

The optimal contract must satisfy:

$$(10) \qquad \frac{f_p(x)}{f_0(x)} \frac{u_p'(t(x) - c_p)}{u_0'(x - t(x))} = k$$

where k is a constant. Substituting in the expected utility functions and rearranging terms, we find:

$$(11) \qquad t(x) = t_0 + \left(\frac{1}{a_p + a_0}\right) \ln\left(\frac{f_p(x)}{f_0(x)}\right) + \left(\frac{a_0}{a_p + a_0}\right) x.$$

Note that this expression resembles equation (3), which characterized the Pareto optimal contract between the plaintiff and the defendant. The defendant has been replaced by the litigation funder, however, so the funder's risk parameter a_0 and beliefs $f_0(x)$ are now relevant for the contract. Second, the current expression has an additional term that is linear in x and whose slope is determined by the plaintiff and funder's relative risk preferences. If the plaintiff and the litigation funder had the same beliefs, $f_p(x) = f_0(x)$, then the middle term would drop out of the expression. The contract would be linear in x, however.

To explore the implications of this institutional arrangement more concretely, let's assume that the plaintiff and the funder have normally distributed beliefs with different means but the same variance, σ^2, and that the litigation funder comes from a competitive market of diversified and risk neutral investors.

PROPOSITION 6: *Suppose that the plaintiff's litigation funder is risk neutral, has normally distributed beliefs with mean μ_0 and variance σ^2, and comes from a competitive market. The equilibrium litigation funding contract is:*

$$(12) \qquad t(x) = (1 - \rho)\mu_0 + \rho x \quad \text{where} \quad \rho = \frac{\mu_p - \mu_0}{a_p \sigma^2}.$$

PROOF. Plugging the functional forms for $f_p(x)$ and $f_0(x)$ into the formula for $t(x)$ and taking the limit as a_0 approaches zero establishes that $t(x) = k_0 + \rho x$ where ρ is defined in the proposition.[48] To find t_0, we use the assumption that the funders come from a competitive market and must break even, on average, using their subjective beliefs. That is, from the perspective of the litigation funder, the

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[48]Technically, the CARA expected utility functions are not defined for $a_i = 0$. Assuming that $u_0(z)$ is linear gives exactly the same result, however.

expected value of $x - t(x)$ must be equal to zero, so the expected value of $t(x)$ must be μ_0. It follows that $k_0 = (1 - \rho)\mu_0$ and we are done. ∎

At first blush, one might think that the litigation funding contract would provide more insurance for the plaintiff than the award-modification contract in Proposition 1. One's reasoning might be that litigation funders are often more tolerant of risk, since they can diversify their holdings across multiple plaintiffs and claims. Comparing the expression to the analogous expression in Proposition 1 shows that this is not necessarily the case. The slope of the litigation funding contract may be either steeper or flatter than the optimal award-modification contract.

More concretely, suppose that the litigants are mutually optimistic ($\mu_d < \mu_p$) and define

$$(13) \qquad \mu_0^* = \left(\frac{a_d}{a_p + a_d}\right)\mu_p + \left(\frac{a_p}{a_p + a_d}\right)\mu_d.$$

If $\mu_0 = \mu_0^*$ then the litigation funding contract has exactly the same slope as the award-modification contract. If $\mu_0 < \mu_0^*$ then the litigation funding contract is steeper, and if $\mu_0 > \mu_0^*$ then the contract is flatter.

4.2   Insurance for Defendants

Many, if not most, defendants in civil lawsuits are at least partially insured against litigation losses. Virtually all of the insurance policies that we observe in practice were initiated before the events leading to litigation took place. For example, doctors purchase generous insurance policies to protect themselves against future malpractice claims, and car owners are often required to hold liability insurance policies to cover any future accident losses to others. The contractual arrangement we will now explore similar to a less-common form of insurance – after-the-event (ATE) insurance.[49] With ATE insurance, a defendant seeks out an insurance company that will protect the defendant against high judgments.[50]

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[49]For example, in England, where the winner's litigation costs are shifted to the loser, it is not uncommon for litigants to take out litigation insurance policies to cover their opponent's litigation fees. See Molot (2009, 380); Molot (2014, 189). Molot (2014, 189) describes how Burford Capital, a litigation funder, did one defense-side insurance deal in the United States by essentially partnering with an insurance company.

[50]Insurance can also be provided by other litigants. Through so-called verdict sharing settlement agreements, multiple defendants can mitigate their risks at trial by agreeing in advance to the shares

Formally, suppose that the defendant can write contracts with a third party insurance company. As with the litigation funders, we will assume that the insurance company is risk averse with CARA utility $u_0(z) = -\exp(-a_0 z))$ and beliefs $f_0(x)$. Later, we will consider what happens when the distribution is normal and a_0 approaches zero. Suppose that the contracts are such that the damages are allocated with the defendant paying $r(x)$ and the insurance company paying $x - r(x)$. The optimal contract satisfies:

$$(14) \qquad \frac{f_0(x)}{f_d(x)} \frac{u_0'(-x + r(x))}{u_d'(-r(x) - c_d)} = k,$$

where k is a constant. Substituting in the expected utility functions and rearranging terms, we find:

$$(15) \qquad r(x) = r_0 + \left(\frac{1}{a_0 + a_d}\right) \ln\left(\frac{f_0(x)}{f_d(x)}\right) + \left(\frac{a_0}{a_0 + a_d}\right) x.$$

If we assume that insurance providers come from a competitive market with fully diversified investors and had normally distributed beliefs with mean μ_0 and variance σ^2, we have the following result.[52]

PROPOSITION 7: *Suppose that the defendant's insurance company is risk neutral, has normally distributed beliefs with mean μ_0 and variance σ^2, and comes from a competitive market. The equilibrium insurance contract is:*

$$(16) \qquad r(x) = (1 - \Delta)\mu_0 + \Delta x \quad \text{where} \quad \Delta = \frac{\mu_0 - \mu_d}{a_d \sigma^2}.$$

So, with the optimal insurance contract, the defendant effectively pays a premium, $r_0 = (1 - \Delta)\mu_0$ to the insurance company and bears a fraction Δ of the trial

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of the damage award to be paid by each defendant. This happened in a tort lawsuit involving William Crawford, was seriously injured by a vertical mounted door that was manufactured by ASI Technologies and sold and installed by Johnson Equipment. During the trial, ASI and Johnson executed an agreement that specified that the proportion of damages that would be paid by each.[51] The jury found that the door was defectively marketed and designed, assigned full liability to ASI and none to Johnson. The private verdict-sharing agreement, where twenty percent of the damages were paid by Johnson, was upheld on appeal. "Under Texas law, though, as well as by Texas usage and custom, a deal is a deal. The seller enjoyed the security of limited exposure beforw the verdict. Now it must live by the deal it made." ASI v. Johnson, 75 S.W. 3rd 545 (2002).

[52]The proof is the same as that of the previous result, and is not reproduced here.

award, $1 - \Delta$. The proof is analogous to the proof for the last result, and will not be reproduced here.

Finally, we observe that the insurance contract may be steeper or flatter than the optimal award modification contract. As for the case of the litigation funder, if $\mu_0 = \mu_0^*$ – which is the same value that was defined in the context of the plaintiff – then the slopes will be exactly equal to each other. If $\mu_0 < \mu_0^*$ then the slope is flatter, and if $\mu_0 > \mu_0^*$ the slope is steeper. Note that when $\mu_0 = \mu_0^*$ then the defendant's insurance contract and the plaintiff's litigation funding contract have the same slope as each other. This is a knife-edged case, however – for other values of μ_0, the slopes of the two contracts will differ from each other.

4.3 Welfare Comparison

Finally, we compare the value created by third-party financial investors to the value that the parties can create on their own through a Pareto optimal award-modification contract. To do this, we will first construct the plaintiff's and the defendant's certainty equivalents associated with the litigation funding and insurance contracts, respectively. As shown earlier, given a contract $s(x) = \gamma_0 + \gamma_1 x$, where γ_0 and γ_1 are constants, an agent with CARA risk aversion parameter a_i will be indifferent between receiving the random payoff and the certainty equivalent $\gamma_0 + \gamma_1 \mu - a_i \gamma_1^2 \sigma^2 / 2$.

Applying this formula, we find that the plaintiff's certainty equivalent of the competitive-supplied litigation funding agreement, evaluated using the plaintiff's subjective belief μ_p, is $(1 - \rho)\mu_0 + \rho\mu_p - a_p \rho^2 \sigma^2 / 2$ where $\rho = (\mu_p - \mu_0)/(a_p \sigma^2)$. Combining these two expressions and rearranging terms establishes that the plaintiff's certainty equivalent of going to trial with the litigation funding contract is:

$$\mu_0 + \frac{(\mu_p - \mu_0)^2}{2a_p \sigma^2}.$$

Similarly, the defendant's certainty equivalent is $(1 - \Delta)\mu_0 + \Delta\mu_d + a_d \Delta^2 \sigma^2 / 2$ where $\Delta = (\mu_0 - \mu_d)/(a_d \sigma^2)$. Combining expressions gives us the defendant's certainty equivalent of going to trial with the insurance policy:

$$\mu_0 - \frac{(\mu_0 - \mu_d)^2}{2a_d \sigma^2}.$$

We now construct the plaintiff and defendant's joint surplus of going to trial with their respective third-party contracts. Their joint surplus is simply the plaintiff's

certainty equivalent minus the defendant's certainty equivalent, or

$$(17) \qquad \psi^0(\mu_0, \mu_p, \mu_d, a_p, a_d, \sigma^2) = \frac{(\mu_p - \mu_0)^2}{2a_p\sigma^2} + \frac{(\mu_0 - \mu_d)^2}{2a_d\sigma^2}.$$

Comparing the expressions for $\psi^0(\textbf{.})$ and $\psi^*(\textbf{.})$ gives the following result.

PROPOSITION 8: *Suppose that the plaintiff's litigation funder and the defendant's insurance company are risk neutral and come from competitive markets with beliefs μ_0 and that the litigants are mutually optimistic $\mu_d < \mu_p$. The litigants' joint surplus with third-party contracts is equal to their joint surplus with the award-modification contract when when $\mu_0 = \mu_0^*$ and is larger when $\mu_0 \neq \mu_0^*$.*

PROOF. Differentiating the expression for $\psi^0(\textbf{.})$ with respect to μ_0 verifies that it is convex and minimized at $\mu_0 = \mu_0^*$. We will now show that when evaluated at $\mu_0 = \mu_0^*$, the function $\psi^0(\textbf{.})$ takes the same value as $\psi^*(\textbf{.})$,

$$\psi^0(\mu_0^*, \mu_p, \mu_d, a_p, a_d, \sigma^2) = \frac{(\mu_p - \mu_0^*)^2}{2a_p\sigma^2} + \frac{(\mu_0^* - \mu_d)^2}{2a_d\sigma^2}.$$

First, we will construct $\mu_p - \mu_0^*$ and $\mu_0^* - \mu_d$ using the expression for μ_0^* above.

$$\mu_p - \mu_0^* = \mu_p - \left(\frac{a_d}{a_p + a_d}\right)\mu_p - \left(\frac{a_p}{a_p + a_d}\right)\mu_d = \left(\frac{a_p}{a_p + a_d}\right)(\mu_p - \mu_d).$$

Similarly,

$$\mu_0^* - \mu_d = \left(\frac{a_d}{a_p + a_d}\right)\mu_p + \left(\frac{a_p}{a_p + a_d}\right)\mu_d - \mu_d = \left(\frac{a_d}{a_p + a_d}\right)(\mu_p - \mu_d).$$

Substituting,

$$\psi^0(\textbf{.}) = \frac{a_p(\mu_p - \mu_d)^2}{2(a_p + a_d)^2\sigma^2} + \frac{a_d(\mu_p - \mu_d)^2}{2(a_p + a_d)^2\sigma^2} = \frac{(\mu_p - \mu_d)^2}{2(a_p + a_d)\sigma^2}.$$

This expression is equal to $\psi^*(\textbf{.})$ and we are done. ∎

5 Conclusion

This paper characterized the set of Pareto optimal contracts that risk-averse litigants with CARA expected utility and potentially divergent prior beliefs would choose to write before trial. In contrast to traditional settlement agreements, we allow the

parties to condition future payments on the trial outcome itself. We show that the optimal contracts are monotonic in the trial outcome and are flatter when the litigants are more risk averse, when the trial is riskier, and when litigation costs are endogenous. Since the use of these contracts makes the trial more attractive for the litigants, these contracts will tend to reduce the probability of settlement and increase the probability of litigation. We also compare these contracts to a related set of contracts between litigants and third parties, including litigation funders and insurance companies, and show that social welfare is weakly higher with third party investors.

In practice, however, the litigants themselves may have a competitive advantage over third-party investors in providing these financial services to each other. Although many defendants do have pre-existing insurance policies, many defendants enter litigation either uninsured or underinsured. Defendants in pending litigation have few viable options to mitigate their residual risks since, in practice, after-the-event insurance from third parties is largely unavailable.[53] This "missing market" is perhaps unsurprising, given the informational advantage of the defendant over third parties. However, the plaintiff, armed with more accurate and detailed information about the pending litigation than a third-party insurer, can simultaneously offer valuable after-the-event insurance to the defendant while securing a guaranteed minimum recovery. More generally, as parties to the lawsuit, the plaintiff and the defendant may have better collective information about claim value and characteristics than litigation funders or insurance companies.[54] Thus, the transactions costs may be lower without third party involvement. A careful treatment of these transactions costs is left for future research.

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[53]See Molot (2009) for a very illuminating discussion.

[54]Bypassing the third-party investors, and bundling litigation funding with insurance, can reduce additional transactions costs as well.

6 Appendix

CLAIM: *Suppose that a litigant has CARA expected utility with a coefficient of absolute risk aversion a, and that random variable x is normally distributed with mean μ and variance σ^2. The litigant's certainty equivalent of $\gamma_1 x + \gamma_0$ (where γ_1 and γ_0 are constants) is $\gamma_1 \mu + \gamma_0 - a\gamma_1^2\sigma^2/2$.*

PROOF OF CLAIM. The litigant's expected utility from the gamble is

$$(18) \quad \int u(\gamma_1 x + \gamma_0)f(x)dx = \frac{-1}{\sigma\sqrt{2\pi}} \int \exp(-a(\gamma_1 x + \gamma_0))\exp\left(\frac{-(x-\mu)^2}{2\sigma^2}\right)dx.$$

Using the property of exponential functions that $\exp(y)\exp(z) = \exp(y+z)$, the right-hand side becomes:

$$(19) \quad \frac{-1}{\sigma\sqrt{2\pi}} \int \exp\left(\frac{-2\sigma^2 a(\gamma_1 x + \gamma_0) - (x-\mu)^2}{2\sigma^2}\right)dx,$$

expanding and combining terms, we have,

$$(20) \quad \frac{-1}{\sigma\sqrt{2\pi}} \int \exp\left(\frac{-x^2 + 2x(\mu - \sigma^2 a\gamma_1) - \mu^2 - 2\sigma^2 a\gamma_0}{2\sigma^2}\right)dx.$$

Subtracting and adding $(\mu - \sigma^2 a\gamma_1)^2$ to the numerator, we "complete the square" and rewrite the expression as:

$$(21) \quad \frac{-1}{\sigma\sqrt{2\pi}} \int \exp\left(\frac{-[x - (\mu - \sigma^2 a\gamma_1)]^2 - \mu^2 - 2\sigma^2 a\gamma_0 + (\mu - \sigma^2 a\gamma_1)^2}{2\sigma^2}\right)dx.$$

Combining terms, we have

$$(22) \quad \frac{-1}{\sigma\sqrt{2\pi}} \int \exp\left(\frac{-[x - (\mu - \sigma^2 a\gamma_1)]^2 - [2\sigma^2 a\gamma_1\mu + 2\sigma^2 a\gamma_0 - \sigma^4 a^2\gamma_1^2]}{2\sigma^2}\right)dx.$$

$$(23) \quad \frac{-1}{\sigma\sqrt{2\pi}} \int \exp\left(\frac{-[x - (\mu - \sigma^2 a\gamma_1)]^2}{2\sigma^2}\right)\exp\left(-a(\gamma_1\mu + \gamma_0 - a\gamma_1^2\sigma^2/2)\right)dx.$$

The first part of this expression is the integral of a normal density with mean $\mu - \sigma^2 a\gamma_1$ and variance σ^2, which is of course simply 1. So this expression reduces to:

$$(24) \quad -\exp\left(-a(\gamma_1\mu + \gamma_0 - a\gamma_1^2\sigma^2/2)\right).$$

So, the certainty equivalent is as displayed in the lemma. ∎

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