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Asymmetric information, self-serving bias and the pretrial negotiation impasse

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Abstract

There is evidence that asymmetric information does exist between litigants: not in a way supporting Bebchuk (1984)'s assumption that defendants' degree of fault is private information, but more likely as a result of parties' predictive capacity about the outcome at trial (Osborne, 1999). In this paper, we investigate the incidence of one component of this asymmetric predictive power, which has been examplified in experimental economics. We assume that litigants assess their priors on the plaintiff's prevailing rate at trial in a way consistent with the self-serving bias, which is the source of the asymmetric information. We compare the predictions of this model regarding the influence of individual priors with those in the literature. Finally, we analyse the influence of another reason for probability distorsion, *i.e.* risk aversion in the sense of Yaari (1987).

JEL classification: D81, K42.

Keywords: litigation, pretrial bargaining, self-serving bias, risk aversion.

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1 Introduction

The fact that informational imperfections introduce biases in litigants' assessment of the outcome of trial, thus entailing efficiency losses in a dispute between two parties, is beyond debate. The issue which is still controversial in the literature is what causes the disagreement between parties leading to the pretrial bargaining impasse?

In the hunt for the most powerful theory of litigations, two prominent theories have been suggested. According to the "optimistic approach" (Priest and Klein (1984), Shavell (1982)), the failure of pretrial negotiations occurs because the plaintiff is more confident than the defendant about his own chances to win at trial - the more confident the plaintiff relative to the defendant, the more likely the trial. As a result, the optimistic model predicts that the subset of cases going to trials is not a representative sample of all tried cases, but it is biased towards those for which the plaintiff has a trial win rate close to 50% (Priest and Klein (1984), Waldfogel (1995,1998)). In the "strategic approach", the existence of information asymmetries between the parties explains why disputes are sometimes inefficiently solved in front of Courts. In a seminal paper, Bebchuk (1984) assumes that the defendant has the private information concerning whether he was negligent, and shows that cases going to trial are those for which the plaintiff has the best chances to prevail[1].

The available empirical evidence is mixed. Priest and Klein (1984) and Waldfogel (1995) find evidence in favour of the prediction of a 50% prevailing rate for plaintiffs, but Hughes and Snyder (1985) and Katz (1987) conclude that it is more likely to be less than 20%. Waldfogel (1998) rejects the assumption that information asymmetries exist for cases going to trial, while Osborne (1999) finds evidence that they do exist, but interestingly not in a way supporting Bebchuk (1984)'s assumption that defendants' degree of fault is a private information. He suggests that this is actually more likely to be connected with differences between parties' predictive power of the outcome at trial. In other words, litigants are neither equally skilled nor have the same ability to assess their chances to prevail at trial. Hence, we come back to the question of what explains that litigants are unequally skilled in predicting the outcome at trial?

Farmer and Pecorino (2002) and Bar-Gill (2002,2005) investigate a promising line of research. They assume that litigants exhibit the self-serving bias, a form of bounded rationality that has been documented in the experimental literature. Akerlof and Dickens (1982) early discussed the influence of cognitive limits and self-manipulation of believes for economic decisions. Farber and Bazerman (1987) long ago argued that neither divergent expectations nor asymmetric informations provide sufficient explanations for the existence of a disagreement in bargaining; in contrast, the existence

[1] Daughety (2000) provides a complete survey of the strategic analysis of litigations.

of cognitive limits, and various forms of bounded rationality, provide the most powerful arguments. More recently, a growing literature in the area of *behavioral law and economics* has also provided empirical and experimental evidence for the presence of cognitive limits such as anchoring effects and optimistic or self-serving bias on behalf of individuals in civil litigations. There exist convincing proofs that cognitive biases are exhibited by both well experienced lawyers and judges (Ichino, Polo and Rettore (2003), Marinescu (2005), Rachlinski, Guthrie and Wistrich (2007), Viscusi (2001)) and more naive individuals (Babcock and Loewenstein (1997)). For example, Babcock and Loewenstein survey experimental studies showing that people display the self-serving bias, that is, a systematic tendency for individuals to interpret facts in civil litigations in a way which is favorable to themselves: given identical facts, an individual given the role of a plaintiff (defendant) will interpret those facts as more favorable for the plaintiff (respectively for the defendant).

In their paper, Farmer and Pecorino (2002) introduce the self-serving bias in a model of litigations *à la* Bebchuk (1984) and analyse its incidence on the trial rate and the well-being of parties (i.e. the amount for which they settle the case). Typically, the authors[2] find that an increase in the optimistic bias of the informed party (the defendant) has an ambiguous effect on the frequency of trial and settlement demand. In contrast, an increase in plaintiff's self-serving bias (uninformed party) increases the incidence of trial but decreases his settlement proposal. Bar-Gill (2002,2005) argues that in an evolutionist context (with symmetric information), the factors allowing a specific kind of optimistic litigants to survive are twofold: on the one hand, optimism works as a commitment device in the bargaining process, allowing them to appear as tougher negotiators settling only for more favorable terms - this pushes litigants towards a high degree of optimism. On the other hand, optimism as a general feature of litigants, makes less likely that all the cases being filed end up in a settlement - hence, this effect pushes litigants towards less optimism. The tension between these two forces leads to an equilibrium where the (homogenous) population of litigants share the same level of "cautious optimism".

Our paper departs from both works. We consider a heterogenous population of optimistically biased litigants, and we assume that the source of the asymmetric information is the size of the plaintiff's bias. In this framework, we show that during the pretrial bargaining round, the population of plaintiffs is split according to their type between those (more optimistically biased) going to trial and those (less biased) accepting the defendant's settlement offer. We show that changes in the optimistic bias of the uninformed litigant (defendant) have unambiguous consequences which are similar to the predictions of the "naïve" optimistic approach. We also study various shifts in bias

[2] More precisely, Farmer and Pecorino (2002) study the consequence of both a multiplicative and an additive bias.

distribution for the informed party (plaintiff), showing that additive shifts have predictable consequences consistent with the optimistic approach, while multiplicative ones entail more ambiguous consequences.

Finally, the paper introduces another channel for probability manipulation, which is distinct from the optimistic bias. Experimental economics also provides lots of proofs that naïve, as well as experienced individuals display a typical pattern of probabilities transformation, termed "probabilistic risk aversion". Decidue and Wakker (2001) as Weber and Kirsner (1997) present several arguments allowing to rationalize such a probability transformation process. This kind of deliberate mental accounting is the way in which individuals take into account and minimize the loss, disappointment or pain they will suffer when making an error in the assessment of the outcome associated with their decision. In a sense, probabilistic risk aversion is a behavioral theory explaining the degree of confidence of an individual regarding his priors and his ability to take the best decision; while the self-serving bias is supported by a theory of self-manipulation of beliefs reflecting that, even if they have the true and objective information about the situation, individuals are prone (more or less deliberately) to reinterpret the facts in a way favorable to themselves. For practical purpose, the point is that individuals display simultaneously both attitudes. In this paper, we introduce the characterization provided by Yaari (1987) for the (probabilistic) risk aversion assumption, and show that changes in risk aversion of the informed litigant have an ambiguous effect on negotiations and trials, but typically different from those resulting from the optimistic bias.

The paper is structured as follows. Section 2 presents the main assumptions of our screening model of litigation and its equilibrium. Section 3 discusses the comparative statics results. Section 4 briefly considers the influence of probabilistic risk aversion. Section 5 concludes.

2 The model with the informed Plaintiff

We will modify the screening model of Bebchuk (1984) in the following manner.

2.1 assumptions and timing of the model

We consider a plaintiff which is harmed by an accident that may be the result of negligence or wrongdoing by another party, the defendant. The loss suffered by the plaintiff in case of accident is $D > 0$ and corresponds to the damages awarded by the Court in case the trial is in favour of the victim. The compensation D is public information. We denote p the probability that the judgment at trial be in favour of the plaintiff.

We assume that the (risk-neutral) plaintiff displays a self-serving bias ($\sigma > 1$), and thus has an assessment of the prior corresponding to his chances to win at trial denoted $\sigma.p$, which is larger than his true probability: in other words, the plaintiff interprets the facts of the case as more favorable for himself than they really are from an objective point of view. His assessment of the risky prospect faced at trial $X = (D - C_p, p; -C_p, 1 - p)$, writes:

$$E(X) \equiv \sigma p D - C_p$$

with $C_p > 0$ his legal costs. However, the prior σp is private information for the plaintiff and is not observable by the defendant: the defendant only knows that the plaintiff's bias is a random variable $\sigma \in [a, b]$ (with $a > 1$) distributed according to a probability function characterized by the cumulative function $G(\sigma)$ and the density $g(\sigma)$, which are public information. In what follows, σ is labelled as the type of the plaintiff[3]. In order to rule out secondary difficulties, we introduce the following assumption:

Assumption 1: the hazard rate $\frac{G}{g}$ is increasing.

Finally, we consider that the (risk-neutral) defendant also displays a self-serving bias denoted by $\sigma_d < 1$, such that his assessment of the plaintiff's chances to win at trial is $\sigma_d.p$ which is supposed to be public information; this implies that when facing the risky prospect of trial $Y = (-(D + C_d), p; -C_d, 1 - p)$, the expected loss borne by the defendant at trial is:

$$E(-Y) \equiv \sigma_d p D + C_d$$

with $C_d > 0$ his legal costs.

The pretrial bargaining process has two main stages[4], following Nature's choice of the type of

[3] As discussed in Bar-Gill (2005), there is an unavoidable tension between the structure of information and the assumption that parties are not aware of their own bias. In fact, the distinction between p and the priors $\sigma_i \times p$ is a harsh simplification; but it is very tractable for the purpose of modelization: it means that there exists some public information which is used by both parties to assess their own priors - the very existence of the self-serving bias implies that people select and interpret the same available information in a way favorable to themselves. Akerlof and Dickens (1982) long ago discussed the psychological motivations (rationalization process) for such information selection and self-manipulation of beliefs, which allows only the partial and imperfect learning of his own bias by an individual. Experimental economics confirms that such biases are persistent and that de-biasing people is difficult (Camerer and Talley (2007)).

[4] Daughety et Reinganum (1994) argue that this is the more relevant assumption. First, Courts impose delays on pretrial bargaining. Then, parties chose to self-restrain the negotiations in order to lower the associated costs. We may also consider that parties often reach an agreement on the steps of the tribunal, just some minutes before the trial.

the plaintiff σ in $[a, b]$, and also following the plaintiff having filed his case:

- In a first stage, the defendant makes a "take-it-or-leave-it" offer to the plaintiff, denoted s, in order to reach a settlement of the case.

- In the second stage, depending on his type, the plaintiff accepts the offer (thus, the case is settled) or rejects it, in which case the parties go to trial.

Finally we assume that $pD > C \equiv C_p + C_d$ meaning that the case to be solved is socially valuable. Remark that this implies that: $apD - C_p > 0$, meaning that the weakest plaintiff's type (who believes that the defendant has the best chances to be seen as not liable by the Court) always has an incentive to go to trial.

2.2 the equilibrium

The (Bayesian) equilibrium is described in terms of the amount for which the parties settle, s (the equilibrium offer of the defendant to the plaintiff), and of the probability of a trial corresponding to the marginal plaintiff $\sigma(s)$, the one who is indifferent between accepting the offer or rejecting it and going to trial.

In the second stage, the plaintiff σ chooses between accepting the offer which gives him a sure gain s, and going to risky trial X in which case the expected payoff obtained is $\sigma pD - C_p$. As a result, the plaintiff σ accepts the offer s as soon as: $s \geq \sigma pD - C_p$. Otherwise, he rejects it. The marginal plaintiff $\sigma(s)$ is thus defined by the condition:

$$\sigma(s)pD - C_p = s \tag{1}$$

Any plaintiff having a prior more pessimistic than the marginal plaintiff (any $\sigma \leq \sigma(s)$) will also accept the offer, while any plaintiff having a more optimistic prior ($\sigma > \sigma(s)$) will go to trial.

Going back to the first stage, we can write the loss function according to which the defendant will set his best offer. With probability $G(\sigma(s))$, the defendant knows he will face a plaintiff prone to accept his offer, and thus will incur the cost s to settle the case. But with probability $1 - G(\sigma(s))$, the defendant knows he will face a plaintiff more optimistic than the marginal one, and thus will have to pay the expected cost $\sigma_d pD + C_d$. The defendant will announce the best offer $\hat{s} \geq 0$, which minimize the loss function:

$$L(s) = G(\sigma(s)) \times s + (1 - G(\sigma(s))) \times (\sigma_d pD + C_d) \tag{2}$$

under condition (1).

■ **Proposition 1:** *In an interior equilibrium, the offer $\hat{s}$ and the marginal plaintiff $\hat{\sigma}$ are set according to the following conditions:*

$$\begin{aligned} \hat{s} &= \hat{\sigma}pD - C_p && (3) \\ \left(\frac{G}{g}\right)_{|(\hat{\sigma})} &= \sigma_d - \hat{\sigma} + \frac{C}{pD} && (4) \end{aligned}$$

such that the probability of a trial is $\hat{\pi} = 1 - G(\hat{\sigma})$.

Proof: If $\hat{s} > 0$ and $\hat{\sigma} \in]a, b[$ are an admissible interior solution for the minimization of (2), then the First Order Condition writes as:

$$G(\hat{\sigma}) - g(\hat{\sigma}) \frac{1}{pD} ((\sigma_d p - \hat{\sigma} p)D + C_p + C_d) = 0 \qquad (5)$$

Rearranging the various terms leads to (4). Note that the Right Hand Side in (4) must be positive since the gains of the negotiation must be positive for an interior solution to exist: $\sigma_d - \hat{\sigma} + \frac{C}{pD} > 0 \Leftrightarrow \hat{s} < \sigma_d pD + C_d$. Existence may be proven as in Bebchuk (1984). Moreover, under assumption 1, the Left Hand Side in (4) is increasing with σ; the RHS is decreasing with σ. Thus, the solution for (3)-(4) is unique and satisfies the second order condition (which requires that $L''(\hat{s}) > 0$). ■

The first LHS term in (5) is the marginal cost of the defendant's offer: raising this offer leads to an increase in the loss incurred by the defendant which is equal to the probability of settlement. The second LHS term in (5) is the marginal benefit of the offer which may be split in two components:

- on the one hand, the effect of raising the offer on the probability of trial (which decreases), $\frac{d}{ds}(1 - G(\sigma(s)) = -g(\hat{\sigma}) \frac{1}{pD} < 0$; this term reflects the efficiency of the screening of the various plaintiff's types due to an increase in the settlement offer. As the defendant raises his offer, some (types of) plaintiffs abandon the trial and prefer to settle their case. But remark that the higher the expected judgment, the lower the impact of the offer on the probability of trial, *i.e.* the higher the expected damage obtained by the plaintiff at trial in case of victory, the weaker the efficiency of the screening role played by the settlement offer.

- on the other hand, the gains of the negotiation for the marginal plaintiff, $(\sigma_d - \hat{\sigma})pD + C > 0$, since the amicable settlement of the case allows the defendant to save his judiciary costs and extract those of the plaintiff plus the value of the judgment. This second term obviously reflects the gain associated with the screening of the plaintiffs according to their type. Remark that as a result of the assumption on the domain of definition of individual bias, we have: $\sigma_d - \hat{\sigma} < 0$, and thus the larger the self-serving biases (i.e. the larger the disagreement between parties), the smaller the gains of the negotiation.

Remark that this framework shares some features with both the optimistic approach and the strategic one. The condition $\sigma_d - \hat{\sigma} < 0$ implies that the gains of the negotiation (at equilibrium) are *smaller* than the transaction costs at trial. Were the parties both risk neutral and having no self-serving bias, these gains would be reduced to the aggregate transaction costs of a trial: $C_p + C_d$. But given that the parties do not have the same perception of the risk of a trial (they have different priors) the negotiation gains are different from the sum of transaction costs of a trial: $E(Y) - \hat{s} \neq C_p + C_d \Leftrightarrow \sigma_d p - \hat{\sigma} p \neq 0$. The effect highligthed in the "optimistic approach" of litigations (Priest and Klein (1984), Shavell (1982)) is that litigants displaying an exogenous optimistic prior will be biased in favor of a trial since they both overestimate their own chance to prevail in the Court. In our set-up and despite the existence of this optimistic bias, some plaintiffs may prefer to settle their case. The result is in fact consistent with the well known intuition of strategic models, according to which pretrial negotiations may fail even when the gains of the negotiations are positive, due to the existence of an asymmetric information. Here, the population of plaintiffs is split between those going to trial because the gains of the negotiation are smaller than their expected payment in case of judgment, and those accepting the defendant's offer for the opposite reason.

3 Comparative statics

We first investigate the influence of the expected damage and transaction costs. Then, we focus on the role of both individual self-serving biases. We make an extensive use of the fact that the effect of a given shock on the equilibrium may be understood thanks to its specific impact on the marginal benefit of the settlement offer, as previously defined.

3.1 influence of expected damages and fee shifting

This analysis is easy to perform since as remarked in the proof of proposition 1, $\left(\frac{G}{g}\right)_{|\sigma}$ in the LHS term in (4) is an increasing function of σ while $\left(\sigma_d - \sigma + \frac{C}{pD}\right)$ in the RHS term of (4) is decreasing function of σ.

The first issue of interest is the impact on the equilibrium of a increase in pD the expected damage at trial. Remark first that this may be the result of an increase in p or in D, and in fact both have the same influence:

■ **Proposition 2:** *An increase in pD:*

I) *decreases the marginal plaintiff (hence the probability of trial increases).*

II) *has an ambiguous effect on the equilibrium offer.*

Proof. I) It is easy to verify that an increase in pD has a negative impact on the RHS in (4). Hence $\hat{\sigma}$ decreases with pD. II) An increase in pD has two effects on $\hat{s}$ in (3): a direct effect which is positive, and an indirect effect through the impact on the marginal plaintiff, which is negative; hence the ambiguity. ■

The ambiguity associated with the settlement offer reflects the existence of two opposite forces. On the one hand, there is a direct and positive effect: given that the increase in pD improve the plaintiff expected payoff at trial, the defendant must increase his settlement offer (all else held equal) in order to convince more plaintiffs to accept it; but on the other hand, there is an indirect and negative effect, given that the borderline plaintiff type decreases. Specifically, this decrease in the marginal type of plaintiff is explained by the decrease in the marginal benefit of an offer (see the discussion following proposition 1) with pD, through both a contraction of the gains of the negotiation and a reduction of the impact (decrease in the efficiency) of the settlement offer on the frequency of trials. Thus, the increase in the expected damage at trial has a clear-cut and positive effect on the trial rate.

Another issue close to the previous one, is the influence of the stakes at trial, as a result of the choice of a specific fee-shifting rule. We obtain the next result:

■ **Proposition 3.** *The rate of trial is the smallest under the American rule, the largest under the English rule, and intermediate under the Continental rule.*

Proof. Consider a general formulation of the fee-shifting rule, such as the French or Continental rule, where the judge has the discretionary power to transfer to the loosing party a part of the winner's costs (called "depens", such as taxes, expertise expenditures, but excluding attorney's fees): Let $\alpha \in [0, 1]$ be the proportion of the defendant's costs borne by the plaintiff when he looses at trial. Similarly, let $\beta \in [0, 1]$ be the proportion of the plaintiff's costs borne by the defendant when the plaintiff wins at trial. The American rule where each party simply bears its own costs is obtained when $\alpha = \beta = 0$. The British rule, according to which the party loosing at trial has to bear the aggregate costs of the trial, is the case where $\alpha = \beta = 1$. It can be shown that for any α and β (being public information), the equivalent to condition (4) writes:

$$\left(\frac{G}{g}\right)_{|(\hat{\sigma})} = \sigma_d - \hat{\sigma} + \frac{C}{p(D + \beta C_p + \alpha C_d)}$$

where the larger $\frac{C}{\theta+\beta C_p+\alpha C_d}$, the higher $\hat{\sigma}$ and the smaller $1-G(\hat{\sigma})$. All else held equal, we have:

$$\frac{C}{pD} > \frac{C}{p\,(D+\beta C_p+\alpha C_d)} > \frac{C}{p\,(D+C_p+C_d)}$$

Thus, under the American rule the borderline type is larger than under the French rule, which one is larger also than under the British rule. ■

It may also be verified that the impact of fee-shifting on the settlement offer is ambiguous.

It is obvious that the channel through which the value of the stakes at trial influences the equilibrium is the same as for the expected judgment pD: the larger $D+\beta C_p+\alpha C_d$, the smaller the marginal benefit of the settlement offer. As remarked before as the value of the stakes at trial increases, it implies both a contraction of the gains of the negotiation and a reduction of the impact (decrease in the efficiency) of the settlement offer on the frequency of trials. Thus, it has a positive effect on the trial rate.

In this sense, proposition 3 predicts that the American rule is the best promoter of settlements. This is a well known result in the literature whatever the informational context, including the "naïve optimistic" model (with purely exogenous optimistic beliefs: Priest and Klein (1984), Shavell (1982)) and the strategic approach (Bebchuck (1984), Farmer and Pecorino (2002)), but including also alternative analysis of the litigation system such as the rent-seeking (Farmer and Pecorino (199), Katz (1987)) or the auction-theoretic approach (Baye, Kovenock and de Vries (2005)). It has also some connections with the evolutionist-based analysis recently developed. Bar-Gill (2002,2005) shows that the "cautious optimistic" type supporting an Evolutionary Equilibrium, is higher under the American rule as compared to the British one. However[5], we do not verify the prediction of the author who observed that "since a greater level of optimism increases the likelihood of a bargaining impasse, [the usually recognized] advantage of the American rule is reduced [in a context where the degree of optimism is endogenous]". Our result in contrast shows that for a heterogenous population of litigants, this advantage does not vanish: the tendency of the British rule to induce more legal expenditures is enhanced by the optimism of litigants.

3.2 changes in individual biases

The next results focus on the effects attached to the change of individual priors, and thus in the perception of the risk at trial experienced by each litigant, beginning with:

[5] There is a major difference between our approach and the evolutionsit one: our result allows the separation between plaintiffs according to their optimistic types - the less (more) optimistic prefering to settle their case (the trial, respectively); on the other hand, the EE is consistent with the settlement of all cases.

■ **Proposition 4:** *A rise in σ_d:*

I) *increases the marginal plaintiff (hence the probability of trial decreases),*

II) *increases the equilibrium offer.*

Proof. Straightforward: I) the RHS in (4) increases with σ_d; II) σ_d has a positive impact on $\hat{s}$ only through the marginal plaintiff (see (3)). ■

Proposition 4 is consistent with the intuition of Farmer and Pecorino (2002, p 164) that the specific way in which the optimistic bias of a party affects the frequency of trials at equilibrium may depend on the nature of the information asymmetry and/or on the order of play between the parties: the ambiguity concerning the role of σ_d obtained by Farmer and Pecorino (2002) disappears when the plaintiff is supposed to have private information. This is fully explained in our framework as follows: the marginal benefit of the settlement offer (and specifically, the gain of the negotiation, since the impact of the offer on the rate of trial does not depend on σ_d) increases with the defendant's bias, yielding fewer trials, and thus a higher settlement offer.

On the other hand, a rise in σ_d means that the defendant becomes less optimistic (given that $\sigma_d < 1$): as σ_d increases, the bias regarding his perception of the chances that the plaintiff prevails is reduced, and his own assessment of the likelihood of winning becomes closer to the true probability. Hence, the result that fewer trials occur is exactly the one more usually obtained in the "naïve optimistic" model (Priest and Klein (1984), Waldfogel (1998)).

The next two propositions highlight how alternative changes in the relevant domain for the value of plaintiff's self-serving bias affect the equilibrium:

■ **Proposition 5:** *An additive shift to the right in the range of plaintiff's types:*

I) *implies a less than proportional increase in the marginal type;*

II) *increases the probability of trial;*

III) *increases the equilibrium offer.*

Proof. We define (see also Bebchuk (1984)) an additive shift to the right of the range of plaintiff's types as a t-translation of plaintiff's types, such that σ is now distributed on the interval $[a+t, b+t]$ (with $t \geqslant 0$) with the cumulative $\Gamma(\sigma)$ and the density $\gamma(\sigma)$ functions satisfying the following correspondences with the primitives $G(\sigma)$ and $g(\sigma)$:

$$\begin{aligned}\Gamma(\sigma) &= G(\sigma - t)\\ \gamma(\sigma) &= g(\sigma - t)\end{aligned}$$

In fact, these two conditions characterize a family of distribution functions which is parametrized by $t \geqslant 0$, where $t = 0$ gives us the primitives, and $t > 0$ leads to a distribution with a higher mean type but having identical higher order moments. In this case, the condition (4) may be substituted with the general formulation:

$$\left(\frac{G}{g}\right)_{|(\hat{\sigma}-t)} = \sigma_d - \hat{\sigma} + \frac{C}{pD} \tag{6}$$

with $\hat{\pi} = 1 - G(\hat{\sigma} - t)$ and $\hat{s}$ given by (3). I) Differentiating (6) gives:

$$\frac{d\hat{\sigma}}{dt} = \frac{1}{\Omega}\left(\frac{G}{g}\right)'_{|(\hat{\sigma}-t)}$$

with: $\Omega \equiv \left(\frac{G}{g}\right)'_{|(\hat{\sigma}-t)} + 1 > 0$ according to the second order condition. Moreover, under assumption 2: $\left(\frac{G}{g}\right)'_{|(\hat{\sigma}-t)} > 0$. Thus, it is obvious that $\frac{d\hat{\sigma}}{dt} > 0$ but $\frac{d\hat{\sigma}}{dt} < 1$. II) As a result, $\hat{\pi} = 1 - G(\hat{\sigma} - t)$ increases with t. III) Given that the marginal type increases with t, it is also straightforward to see that the equilibrium offer $\hat{s} = \hat{\sigma}pD - C_p$ also increases with t. ■

Note that the impact on the settlement offer is related only to the (direct) effect on the borderline type: as the support of the distribution of $\sigma - t$ shifts to the right (with t), the gains of the negotiation are uniformly reduced for all the population of plaintiffs[6], which leads to an increase in the borderline type and a decrease in the likelihood of settlement. Thus, as the plaintiffs appear as (uniformly) tougher negotiators, the defendant must accept an increase in the settlement offer in order to convince some of them to accept it. Proposition 4 gives predictions that are close to the findings by Farmer and Pecorino (2002) in the case of additive biases. This of course reflects the very definition of an additive shift to the right of the range of plaintiff's types since such a shift increases the mean type and leaves unchanged the higher order moments. It is also worth noticing that the results in proposition 4 are consistent with those more usually obtained in the "naïve optimistic" model.

However, changing our definition of the shift in the possible range of plaintiff's optimistic bias will introduce new effects in equilibrium:

■ **Proposition 6.** *A mean-preserving proportional shift in the range of plaintiff's types:*

I) *decreases the marginal type if $\hat{\sigma} < \mu$; otherwise, the effect is ambiguous;*

II) *has an ambiguous effect on the probability of trial;*

III) *decreases (increases) the equilibrium offer if the marginal type decreases (respectively, increases).*

[6] To see this, remark that the RHS in (6) is equivalent to $\sigma_d - (\hat{\sigma} - t) + \left(\frac{C}{pD} - t\right)$.

Proof. We define (see also Bebchuk (1984)) a mean-preserving proportional shift of the distribution of plaintiff's types as the composition of an additive shift to the left (a $\mu(1-t)$-translation, with $t \geqslant 1$ and $\mu = E(\sigma)$) plus a multiplicative shift of plaintiff's types, such that σ is now distributed on the interval $[ta + \mu(1-t), tb + \mu(1-t)]$ with a cumulative $\Gamma(\sigma)$ and a density $\gamma(\sigma)$ satisfying the following correspondences with the primitives $G(\sigma)$ and $g(\sigma)$:

$$\begin{aligned}\Gamma(\sigma) &= G\left(\frac{\sigma-\mu}{t}+\mu\right)\\ \gamma(\sigma) &= \frac{1}{t}g\left(\frac{\sigma-\mu}{t}+\mu\right)\end{aligned}$$

Once more, these two conditions characterize a family of distribution functions which is parametrized by $t \geqslant 1$, where $t = 1$ gives us the primitives, and $t > 1$ gives us a new distribution with the same mean $\mu = E(\sigma)$ but which is more spread than the primitive distribution; thus it has moments of higher orders which are larger than those of the primitive. In this case, condition (4) may be now substituted with the general formulation:

$$\left(\frac{G}{g}\right)_{|\left(\frac{\hat{\sigma}-\mu}{t}+\mu\right)} = \frac{1}{t}\left(\sigma_d - \hat{\sigma} + \frac{C}{pD}\right) \tag{7}$$

with $\hat{\pi} = 1 - G\left(\frac{\hat{\sigma}-\mu}{t}+\mu\right)$. I) Differentiating (7) gives:

$$\frac{d\hat{\sigma}}{dt} = \frac{1}{\Omega} \times \left[\left(\frac{G}{g}\right)'_{|\left(\frac{\hat{\sigma}-\mu}{t}+\mu\right)} \times \left(\frac{\hat{\sigma}-\mu}{t}\right) - \left(\frac{G}{g}\right)_{|\left(\frac{\hat{\sigma}-\mu}{t}+\mu\right)}\right]$$

It is obvious that $\hat{\sigma} < \mu \Rightarrow \frac{d\hat{\sigma}}{dt} < 0$ although if $\hat{\sigma} > \mu$ then $\frac{d\hat{\sigma}}{dt}$ has an ambiguous sign. II) Similarly, $\hat{\pi}$ may decrease or increase with t since:

$$\frac{d\hat{\pi}}{dt} = -g\left(\frac{\hat{\sigma}-\mu}{t}+\mu\right) \times \frac{1}{t} \times \left(\frac{d\hat{\sigma}}{dt} - \frac{\hat{\sigma}-\mu}{t}\right)$$

Hence the result. III) Given the ambiguity on the marginal type, it is also straightforward to see that the equilibrium offer $\hat{s} = \hat{\sigma}pD - C_p$ may as well increase (if the marginal type increases) as decrease (respectively if the marginal type decreases) with t. ■

In contrast with the uniform perturbation of the distribution, the spread of all possible types appears to have a more complex, thus less easy to predict impact on the pretrial negotiations. Once more, the impact on the settlement offer reflects the (direct) effect of the shift t on the borderline type. But this last effect is now ambiguous: on the one hand, the efficiency of the separation obtained through the settlement offer is inversely related[7] to t, while the relationship between t

[7]The impact of s on the likelihood of a trial is now equal to $-\frac{1}{t}g$.

and the gains of the negotiation appears here as ambiguous. The potential benefit obtained through the negotiation by the marginal plaintiff depends on his specific range among all possible types, and thus in this sense, it depends on some specific features of the concentration of the distribution (such as the concentration around the mean type)[8].

Proposition 6 confirms the ambiguous results of Farmer and Pecorino (2002) in the case of a multiplicative optimistic bias, which contrast with those predicted by the "naïve optimistic model". To see this, let us remind that Priest and Klein (1984) and Waldfogel (1998) showed that when the errors made by the litigants in predicting[9] the outcome at trial increase, then the likelihood of a trial also increases: this is because the chances are higher that plaintiff's optimistic estimate of prevailing at trial are larger than defendant's ones. Now, let us interpret the mean-preserving proportional shift in the range of plaintiff's types as representing, from the defendant's point of view, the expectation of an increasing variability in plaintiff's priors on the outcome at trial. In this sense, proposition 6 means that as the plaintiff's priors are expected to become more spread, the impact of the equilibrium become less clear, depending for example on some additional characteristics of the distribution of types[10].

4 Risk aversion

We briefly sketch now how the results extend to the case where the plaintiff has a self-serving bias and is risk averse in the sense of Yaari.

Assume that the plaintiff has preferences which satisfy the axiomatic of Yaari's model (Yaari (1987)); thus, there exists a probability transformation (or probability weighting) function $\varphi(p)$ which is endowed with the basic properties that $\varphi : [0,1] \to [0,1]$ is unique, continuous and increasing in p, with $\varphi(0) = 0$ and $\varphi(1) = 1$. We will assume that $\varphi(p)$ is (at least twice)

[8] Note that the bracketed term in the RHS of (7) also writes: $\sigma_d - \left(\frac{\hat{\sigma}-\mu}{t} + \mu\right) + \left(\frac{C}{pD} + \left(\frac{1-t}{t}\right)(\hat{\sigma} - \mu) + \mu\right)$; hence as t increases, the RHS in (7) may increase or decrease according to the sign of $\hat{\sigma} - \mu$, yielding accordingly a decrease or an increase in the equilibrium rate of trials

[9] In the interpretation of the optimistic model suggested by Priest and Klein (1984), litigants perform unbiased estimates, or rational expectations, for their chances of prevaling at trial. In contrast and by definition, we consider here the situation where litigants have biased estimates of their chances to win at trial.

[10] Remark that $\frac{d\hat{\sigma}}{dt}$ may equivalently be written as:

$$\frac{d\hat{\sigma}}{dt} = \frac{1}{\Omega} \times \left(\frac{G}{g}\right)_{|\left(\frac{\hat{\sigma}-\mu}{t}+\mu\right)} \times (e-1)$$

where $e = \left(\frac{G}{g}\right)' \frac{\left(\frac{\hat{\sigma}-\mu}{t}\right)}{\left(\frac{G}{g}\right)}$ is the (partial) elasticity of the rate of hazard with respect to $\left(\frac{\hat{\sigma}-\mu}{t}\right)$, evaluated at $\left(\frac{\hat{\sigma}-\mu}{t} + \mu\right)$. Hence, the results may depend on the concentration of the distribution, as captured by e.

differentiable, with $\forall p \in [0,1] : \varphi''(p) > 0$; accordingly, the plaintiff is risk averse (Yaari, 1987).

In this setting, the satisfaction level or "anticipated utility" of the plaintiff σ facing a risky prospect at trial $X = (D - C_p, p; -C_p, 1-p)$, writes:

$$\begin{aligned} E_{\varphi op}(X) &\equiv (1-\varphi(\sigma p))(-C_p) + \varphi(\sigma p)(D - C_p) \\ &= \varphi(\sigma p)D - C_p \end{aligned}$$

In other words, $E_{\varphi op}(X)$ is the subjectively transformed expected outcome of the prospect, since the probability of each outcome is replaced by a subjective weight of likelihood. Specifically, according to the convexity of $\varphi(.)$, the plaintiff places a weight of likelihood to the worst (best) outcome which is larger (smaller) than its prior: *i.e.* $1-\varphi(\sigma p) > 1-\sigma p$ (respectively $\varphi(\sigma p) < \sigma p$).

The method in paragraph 2.2 can be performed to solve for the equilibrium of the pretrial negotiation game, and it can be shown that in an interior equilibrium, the offer $\hat{s}$ and the marginal plaintiff $\hat{\sigma}$ are now set according to the following conditions:

$$\hat{s} = \varphi(\hat{\sigma}p)D - C_p \tag{8}$$

$$\left(\frac{G}{g}\right)_{|(\hat{\sigma})} = \frac{1}{\varphi'(\hat{\sigma}p)}\left(\sigma_d - \frac{\varphi(\hat{\sigma}p)}{p} + \frac{C}{pD}\right) \tag{9}$$

The way plaintiff's risk aversion affects the negotiation and the equilibrium rate of trial depends on its impact on the RHS in (9); thus, it is linked to the marginal benefit of the settlement offer which is defined as:

$$-g(\hat{\sigma})\frac{1}{\varphi'(\hat{\sigma}p)pD}.((\sigma_d p - \varphi(\hat{\sigma}p))D + C)$$

Note first that the impact of risk aversion on the gains of the negotiation is ambiguous since we may have: $\sigma_d p - \varphi(\hat{\sigma}p) \gtreqless 0$. On the one hand, as previously found for risk-neutral litigants, the existence of the self-serving bias reduces the gains of the negotiation and induces litigants to go more frequently to trial. On the other hand, the risk aversion alone would imply that $\sigma p > \varphi(\sigma p)$ - this means that if both litigants had had the same prior (σp), then the risk neutral defendant's posterior belief would have been *less* pessimistic than the risk averse plaintiff's one. Hence, the plaintiff's risk aversion *per se* tends to increase the negotiation gains, thereby inducing an increase in the borderline type and yielding finally less trials. Thus, as a result of the existence of both the self-serving bias and risk aversion, there is some ambiguity in the relationship between the parties' beliefs (regarding the chances that the plaintiff prevails at trial) and the trial rate: the sign of

$\sigma_d p - \varphi(\hat{\sigma}p)$ is ambiguous. The plaintiff's risk aversion may dampen the influence of those biases and improve the gains of the negotiation. But the opposite result may also obtain.

Second, risk aversion also affects the equilibrium through the impact (efficiency) of the settlement offer on the probability of trial, as reflected by the term $-g(\hat{\sigma})\frac{1}{\varphi'(\hat{\sigma}p)pD}$. On the one hand, if $\varphi'(\hat{\sigma}p) < 1$, meaning that the plaintiff's risk aversion increases with his prior (the difference $\sigma p - \varphi(\sigma p)$ increases with σp), then the separation between plaintiffs is easier for the defendant: this leads, all else held equal, to less trials. The opposite results is obtained when $\varphi'(\hat{\sigma}p) > 1$, meaning that the plaintiff's risk aversion decreases with his prior. Thus, the variation of the plaintiff's risk aversion with its prior introduces another source of ambiguity in the analysis.

The complete comparative static may be developed and it confirms the ambiguous influence of the plaintiff's risk aversion; in contrast, it can also be shown that the results of propositions 2 to 6 still hold[11] under risk aversion. Given that most of the time, the self-serving bias is seen in the literature as an "irrational bias", while the probabilistic risk aversion is described as a "rational" one, our results are quite paradoxical: although the previous analysis suggests that the influence of the former is intuitive and not too troublesome for pretrial negotiations, the impact of the latter seems to be more puzzling.

5 Conclusion

There is a longlasting debate in experimental economics concerning the relevant interpretation for the growing evidence that people proceed to probabilities transformation or manipulation in a way not consistent with rational inference and Bayesian updating rules. On the one hand, for psychologists this reflects a kind of bounded rationality due to the presence of cognitive dissonance or inconsistency, revealing that people use heuristics rather than sophisticated processes for the assessment of their priors. This paper focuses on the self-serving bias and analyses its consequences on litigations when this is a source of asymmetric information. On the other hand, other researches in social sciences argue that the systematic departure from Bayesian inference exhibited in experimental situations does not necessarily rule out any explanation consistent with the theory of procedural rationality, such as the (probabilistic) risk aversion assumption. These two explanations are more complementary than rival, and they may be reconciled; this paper is a proposal in this sense. Two main conclusions may be drawn. The first one is that, roughly speaking, our results are consistent with those of models including a more naïve assessment of individual

[11] See our working paper (Langlais, 2008b). For an analysis of asymmetric information on plaintiff's risk aversion, see also Farmer and Pecorino (1994) and Langlais (2008a).

beliefs, excepted when we consider non trivial changes in the population of litigants' types. The second one is that the risk aversion assumption seems to have more dramatic consequences than the optimistic bias, to the extent that changes in the former are less predictable than shifts in the latter, which are now documented in the literature.

Finally, to the extent that the self-serving bias may be socially, institutionally or culturally determined, the issue for *Law & Economics* is not only how the existence of self-serving bias may affect the judicial process, but also how innovations emerging from the legal process (regarding procedural rules as well as substantive law) may modify the optimism of litigants. Focusing on the pretrial impasse, our paper like some few other existing in the literature, gives insights on the first question, but has not paid enough attention to the second one. Future research, both at the theoretical and empirical levels, should examine the kind of changes promoting uniform (additive) rather than erratic (multiplicative) shifts in the optimism of litigants. In our framework, we have seen that these shifts have far different effects; but a limitation of the analysis is that they are supposed to be purely exogenous.

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