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Litigation Selection as a Signal under Asymmetric Information: A Two-Type Model with Alternating Bargaining Offers

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Abstract

This paper studies the signaling role of the litigation/settlement selection under asymmetric information. As an attempt to improve existing asymmetric information theory, we separate litigation/settlement selection process and the actual settlement bargaining process, and adopt an infinitely repeated settlement bargaining with alternating offers, instead of the extreme 'take-it-or-leave-it' offer which has been frequently assumed in current literature. Upon the explicit derivation of the sequential equilibria, we interpret heuristically the role of asymmetric information in litigation selection, and provide comprehensive comparative static analyses for more concrete empirical testings of asymmetric information theory.

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1. Introduction

Asymmetric information (*hereafter* AI) theory has rapidly been elaborated to enhance our understanding of several essential aspects of litigation, such as the settlement/litigation selection, the adjudication rate, the plaintiff's win rate, and the relationship between these indices, etc. However, there is no doubt that the AI theory needs further improvement in order to be a standard model in litigation/settlement analysis. Among possible candidates for improvement, the following three aspects of the current literature should be given priority.

First, the trend wherein the uninformed party is modeled to move first should be changed. If the uninformed party offers a settlement demand first, we cannot analyze the signaling, or the information transmission, through the action taken by the informed party.[1] Bebchuk(1984), who is a pioneer in AI theory, confesses that the reason he modeled the uninformed party to move first was to avoid the signaling issue. However, ignoring the information transmission aspect is not a natural approach to the AI situation. The better way would be to allow the informed party to move first so that his action can play the signaling role.[2]

Second, most of the current AI literature assume that the settlement follows the 'take-it-or-leave-it' bargaining process.[3] However, it should be noted that, even if the informed party is modeled to move first, the analysis is not robust under such an extreme bargaining method. Reinganum and Wilde(1986) is a good example in this regard. Their main result holds only under the condition when the first mover retains the whole settlement, which requires such an extreme bargaining process. If we allow a more general bargaining method, which gives a non-zero pie to the late-mover, the main result of Reinganum and Wilde, as well as the results of many other current AI studies about litigation selection, will no longer hold. For the robustness of the AI theory, we need a more general settlement bargaining model.

Finally, the litigation/settlement selection process is mixed with the settlement process itself. When the two processes are mixed, the size of the settlement demand naturally becomes the signaling device. Consequently, who offers the settlement demand first not only affects whether to litigate or to settle, but also critically affects the settlement outcome. However, while who moves first should matter in the litigation/settlement selection because of the signaling nature, it should play a more neutral role in determining the settlement outcome. This is because there is no *ex-ante* reason why either the defendant or the plaintiff should offer the settlement demand first in the actual settling process. Separating settlement from litigation/settlement selection, and adopting a more general bargaining method for the settlement, one which is neutral against who moves first, is a better model specification.

In this paper, we attempt to make improvements in these three aspects of the current AI literature. Our model is an extension of the simple two-type model by Hylton(1993), who developed an AI model, along the tradition of Bebchuk and Png, to test win-rate patterns. Hylton correctly argues that the strategic behavior of the defendant, who is the informed party, can explain the litigation puzzle However, she does not actually provide a precise equilibrium analysis of the signaling game. The fundamental reason for the incompleteness of Hylton's analysis is that it is derived from the above mentioned three unsatisfactory model specifications. Therefore, extending Hylton by adopting more satisfactory model specifications will be a general contribution to current AI theories.

The structure of the paper is as follows. In Section 2, a signaling model of legal disputes is introduced. In our model, the informed party moves first so that we can explicitly analyze the signaling game. The settlement itself is separated from the litigation/settlement selection process and follows an infinitely repeated Nash bargaining with alternating offers. Section 3 derives the conditions and the characteristics of both separating and pooling equilibria of the signaling lawsuit game under AI. Section 4 submits heuristic explanations about the role of AI, where the litigation puzzle and welfare implications are examined. In Section 5, upon the explicit derivation of the sequential equilibria, we provide testable hypotheses about adjudication rate, plaintiff's win rate, and the relationship between these two key indices, for future empirical testings of the AI theory. Section 6 concludes the paper with additional remarks.

2. A Signaling Model

Consider a legal dispute where a defendant causes harm to a plaintiff. The defendant is either guilty or innocent depending on whether or not he has violated legal standards. Let x be the probability that the defendant is guilty, and assume that x is either α with probability w, or β with probability $1-w$, where $0 \le \alpha < \beta \le 1$ and $w \in (0, 1)$. We further assume that α and β are selected randomly from a cumulative distribution function F on [0, 1]. We will call a defendant who is guilty with probability α, 'type α,' or simply 'innocent', and a defendant who has probability β, as 'type β,' or 'guilty'.[4)]

<Figure 1> A Signaling Lawsuit Game

The lawsuit game between the two parties under AI is a two-person two-stage game as in <Figure 1>. After the defendant type is determined by nature, in the first stage, the defendant chooses either 'litigate'(l) or 'settle'(s). If the defendant chooses l, the game moves to the second stage litigation subgame. If the defendant chooses s, the plaintiff chooses between s and l without knowing the defendant's type.[5)] If the plaintiff also chooses s, the second stage settlement bargaining begins. If he chooses l, the litigation subgame starts.

Let U_d and U_p be the expected payoffs from settlement, and U_d^o and U_p^o be the respective expected payoffs from litigation for the defendant and the plaintiff. Note that the defendant's payoff is the cost or burden to be minimized, while that of the plaintiff is measured by the usual return to be maximized.

In litigation, we assume that the court decision is subject to some minor random errors. Let Q_1 be the probability that a defendant who has violated the legal standard will be found not guilty (type I error), and Q_2 be the probability that an innocent defendant will be found liable (type II error). Q_1 and Q_2 are the public information, and satisfy $1-Q_1-Q_2>0$.[6)]

The expected payoffs from the litigation are $U_d^o=P_dJ+C_d$ for the defendant, and $U_p^o=P_pJ-C_p$ for the plaintiff, where J is the size of the stake in dispute, P_d and P_p are the subject probabilities of the plaintiff's win, and C_d and C_p are the litigation costs, of the defendant and the plaintiff, respectively. We assume that $U_p^o\geq 0$ against all defendant types so that the plaintiff's litigation choice is credible.[7)] It is also assumed that C_d, C_p, and J are exogenously fixed, while P_d and P_p are endogenously determined by the information of the players as follows:

$$P_d=x(1-Q_1)+(1-x)Q_2,\quad x=\alpha,\ \beta.$$

$$\begin{aligned} P_p &= P_d \text{ if the plaintiff identifies defendant's type,} \\ &= w[\alpha(1-Q_1)+(1-\alpha)Q_2]+(1-w)[\beta(1-Q_1)+(1-\beta)Q_2],\ \text{otherwise.} \end{aligned}$$

On the other hand, if the settlement subgame begins, the two parties play an infinitely repeated Nash bargaining game with alternating offers. The defendant either offers a settlement demand or simply stops bargaining. If the defendant stops bargaining, the case goes to trial. If the defendant offers a settlement demand, the plaintiff either accepts or rejects the offer. If the plaintiff accepts the defendant's offer, the game ends with a settlement. If he rejects it, he either counter-offers another settlement demand or stops bargaining. If the plaintiff chooses to stop, the case again goes to trial. If he counter-offers, it is the defendant's turn again. The game is repeated until either party stops bargaining or one party accepts the other's offer. Note that the payoffs in the litigation are the opportunity costs of the settlement, so that the settlement occurs if and only if $U_d^o > U_p^o$. The payoffs from litigation, which satisfy the condition $U_d^o > U_p^o$, thus become the status quo of the settlement bargaining.

Rubinstein(1982) proves that there is a unique subgame perfect Nash equilibrium in such a bargaining game which depends on the bargaining powers, or the discount factors about the future payoffs of the two parties. Assume that the two parties have the same discount factor, which is denoted by $\delta \in (0,1)$, and further assume that δ converges to 1.[8)]

Lemma 1. Assume that $U_d^o > U_p^o$ and that the two parties have the same discount factor which converges to 1. Then the settlement, which is the subgame perfect Nash equilibrium outcome, is symmetric, such that

$$(U_d, U_p) = \left(\frac{U_d^o + U_P^o}{2}, \frac{U_d^o + U_P^o}{2}\right).$$

Proof. Refer to Rubinstein(1982).

3. Equilibrium

Now, let us find an equilibrium of the signaling game. The equilibrium concept in this paper is the sequential equilibrium following Kreps and Wilson(1982).[9)] The equilibrium, if it exists, is either separating or pooling.[10)] Let us examine the conditions and characteristics of both equilibria.

(1) Separating Equilibrium

Proposition 1. There exists a separating equilibrium if and only if $\beta-\alpha>\dfrac{C_d+C_p}{2(1-Q_1-Q_2)J}$ such that

defendant's strategy : l if type α, s if type β

plaintiff's belief : if the defendant has chosen l, he is type α,

if the defendant has chosen s, he is type β,

plaintiff's strategy : s.

<Proof> First note that the plaintiff's belief is consistent with the defendant's strategy. Let us check if the strategies of the defendant and the plaintiff are optimal against each other, given the plaintiff's belief.

Optimality of Defendant's Strategy.

Consider the type β (guilty) defendant first. If the guilty defendant chooses l, the case goes to trial, and the payoff of the defendant will be:

$$U_d^o=[\beta(1-Q_1)+(1-\beta)Q_2]J+C_d. \quad ---(1)$$

On the other hand, if he chooses s, the plaintiff considers the defendant as type β and will choose s following his strategy. Then the game moves to a settlement bargaining subgame. Since both parties have the same expectations about the litigation outcome, such that $U_d^o=[\beta(1-Q_1)+(1-\beta)Q_2]J+C_d$ and $U_p^o=[\beta(1-Q_1)+(1-\beta)Q_2]J-C_p$, and since $U_d^o>U_p^o$, by Lemma 1, the defendant's expected payoff from the settlement will be:

$$U_d=[\beta(1-Q_1)+(1-\beta)Q_2]J+(C_d-C_p)/2. \quad ---\ (2)$$

Since (1)>(2), s is the optimal choice to the type β defendant.

Now, consider the type α defendant. If the innocent defendant chooses l, the case will be resolved at trial, and the payoff will be:

$$U_d^o=[\alpha(1-Q_1)+(1-\alpha)Q_2]J+C_d. \quad ---\ (3)$$

Meanwhile, if he chooses s, the plaintiff's perception will be that the defendant is of type β, and the case will be settled out of the court. Note that, in this case, the plaintiff's belief is not consistent with the true defendant type. The plaintiff considers the payoffs from the litigation as $U_d^o = [\beta(1-Q_1)+(1-\beta)Q_2]J + C_d$ and $U_p^o = [\beta(1-Q_1)+(1-\beta)Q_2]J - C_p$. Even though the defendant correctly knows that the true payoffs from the litigation will be $U_d^o = [\alpha(1-Q_1)+(1-\alpha)Q_2]J + C_d$ and $U_p^o = [\alpha(1-Q_1)+(1-\alpha)Q_2]J - C_p$, the settlement should be based on what the plaintiff believes, not on the truth. This is because, since the defendant has already sent a signal, s, there is no way to make the plaintiff believe that he is of type α.[11] Therefore, the settlement payoff to the type α defendant is the same as that of the type β, who chooses signal s, as in equation (2). The choice of l by the type α defendant is optimal if and only if (2)>(3), that is, if and only if

$$\beta - \alpha > \frac{C_d + C_p}{2(1-Q_1-Q_2)J}.$$

Optimality of Plaintiff's Strategy.

The plaintiff makes a decision only when the defendant has chosen s. If the plaintiff observes the signal s, he believes that the defendant is of type β, and compares between the payoffs from s and l. If he chooses l, the expected payoff from the litigation is:

$$U_p^o = [\beta(1-Q_1)+(1-\beta)Q_2]J - C_p. \quad \text{---(4)}$$

If he chooses s, the expected payoff from the settlement is:

$$U_p = [\beta(1-Q_1)+(1-\beta)Q_2]J + (C_d - C_p)/2. \quad \text{--- (5)}$$

Since (4)<(5), s is optimal, given his belief and the defendant's strategy.

To summarize, under the condition in Proposition 1, the strategies of both types of defendants, and of the plaintiff, are the best responses against each other given the plaintiff's belief. Also, the plaintiff's belief is consistent with the defendant's strategy. **Q.E.D**.

(2) Pooling Equilibrium

First, make a useful observation that, in any pooling equilibrium, litigation cannot involve type β defendants.

Lemma 2. In any pooling equilibrium, 'litigate' cannot be the optimal strategy of the type β defendant. Therefore, the pooling equilibrium, if it exists, must involve s by both types of defendants.

<Proof> Assume that there exists a pooling equilibrium where both types of defendants choose l. The payoff of the type β defendant in such a pooling equilibrium is $U_d^o = [\beta(1-Q_1)+(1-\beta)Q_2]J + C_d$. However, if he chooses s, he should pay as a settlement amount $U_d = [\beta(1-Q_1)+(1-\beta)Q_2]J + (C_d - C_p)/2$. This is because, if only the type β defendant deviates from l and chooses s, it signals that the defendant is type β. The plaintiff will thus also choose settlement to avoid litigation costs. It is clear that the type β defendant can reduce his payment by choosing s instead of sticking to l. As such, a pooling equilibrium where both types choose litigation cannot exist. **Q.E.D.**[12)]

Now, let us prove that the following is the unique pooling equilibrium.

Proposition 2. There exists a pooling equilibrium if and only if $\beta - \alpha < \frac{C_d + C_p}{2(1-w)(1-Q_1-Q_2)J}$ such that

defendant's strategy : s regardless of his type,
plaintiff's belief : if the defendant chooses s, he is type α with probability w and type β with probability $1-w$; if the defendant chooses l, he is type α,
plaintiff's strategy : s.

<Proof>

Optimality of Defendant's Strategy.

First, assume that the defendant is type α. If he sends signal s, the plaintiff keeps his prior belief about the defendant's type, and chooses s. Then the game becomes a settlement bargaining.

Recall that the settlement is not based on what really is, but on what is believed by the uninformed party who receives a signal. The type α defendant predicts that the uninformed plaintiff would expect
$U_d^o = [w[\alpha(1-Q_1)+(1-\alpha)Q_2]+(1-w)[\beta(1-Q_1)+(1-\beta)Q_2]]J + C_d$ and
$U_p^o = [w[\alpha(1-Q_1)+(1-\alpha)Q_2]+(1-w)[\beta(1-Q_1)+(1-\beta)Q_2]]J - C_p$ from the

litigation.[13] Since the type α defendant already sent signal s, he would accept the payoff from settlement as:

$$U_d = [w[\alpha(1-Q_1)+(1-\alpha)Q_2]+(1-w)[\beta(1-Q_1)+(1-\beta)Q_2]]J+(C_d-C_p)/2. \quad \text{--- (6)}$$

On the contrary, if the type α defendant sends signal l, the dispute will be litigated, with the following payoff to the defendant:

$$U_d^o = [\alpha(1-Q_1)+(1-\alpha)Q_2]J+C_d. \quad \text{---(7)}$$

Choosing s is optimal for the type α defendant if and if only (6)<(7), that is, $\beta-\alpha < \dfrac{C_d+C_p}{2(1-w)(1-Q_1-Q_2)J}$.

Now consider the type β defendant. If he chooses s, the uninformed plaintiff will choose s. Note that the settlement is the same as when the type α defendant chooses signal s. Therefore, the payoff to the defendant is the same as in equation (6). If the type β defendant chooses l, the payoff from the litigation will be:

$$U_d^o = [\beta(1-Q_1)+(1-\beta)Q_2]J+C_d. \quad \text{--- (8)}$$

Since (6)<(8), choosing s is optimal for the type β defendant.

Optimality of Plaintiff's Strategy.

Now, consider the plaintiff's behavior. If the uninformed plaintiff chooses l, the expected payoff from litigation is:

$$U_p^o = [w[\alpha(1-Q_1)+(1-\alpha)Q_2]+(1-w)[\beta(1-Q_1)+(1-\beta)Q_2]]J-C_p. \quad \text{--- (9)}$$

On the other hand, the uninformed plaintiff's payoff from the settlement bargaining will be the same as the defendant's in (6):

$$U_p = [w[\alpha(1-Q_1)+(1-\alpha)Q_2]+(1-w)[\beta(1-Q_1)+(1-\beta)Q_2]]J+(C_d-C_p)/2. \quad \text{--- (10)}$$

Since (9)<(10), s is the optimal strategy for the plaintiff.

Finally, it is evident that the plaintiff's belief is consistent with the defendant's optimal strategy along the equilibrium path. Furthermore, the plaintiff's belief is also consistent along the out-of-equilibrium path, that is, when signal l is observed. This is because, from Lemma 2, since l is a dominated strategy by the β type defendant, it should be from the type α defendant. Therefore, the plaintiff's belief is still consistent with the optimal behavior of the defendant which is not implemented in equilibrium.

To summarize, under the condition in Proposition 2, the strategies of all parties are optimal given other player's strategy and the plaintiff's belief, and the plaintiff's belief is consistent with the defendant's behavior. **Q.E.D**.

4. The Role of Asymmetric Information

(1) The Litigation Puzzle Revisited

Why do people litigate even though the settlement cost is believed to be much lower than the litigation cost? AI is one answer. When information about the defendant's type is incomplete, two-way externalities occur between the type α (innocent type) and type β (guilty type) defendants: the guilty type receives a positive externality from, and gives a negative externality to the innocent type. In this situation, the incentives are such that the innocent type wants to signal that he is different from the guilty type, and the guilty type wants to mimic the innocent type.

How can the innocent type signal himself against the guilty defendant? Choosing litigation is the answer, because the court will verify the defendant's identity. In other words, litigation functions as an effective signal mechanism since going to trial is more costly to the guilty defendant than to the innocent defendant. If the latter chooses litigation, the former will not mimic simply because revealing his identity in court brings no benefit to him, but rather, incurs litigation costs. However, going to trial, a signaling, is also costly to the innocent type. The question for the innocent type thus comes down to whether the benefit from signaling is larger than the litigation cost.

The cost-benefit analysis of signaling depends on litigation costs, size of the stake, and court errors. For high litigation costs, minor stakes, and/or high court errors, the innocent defendant will give up signaling and stay mixed with the guilty type. This explains the pooling equilibrium with no litigation. In contrast, if litigation costs are low, the harm level is high, and/or the court's decision errors are minor, signaling will be the better choice for the innocent defendant, and the guilty defendant will not want to mimic. Thus, a separating equilibrium is obtained when litigation occurs.

(2) Welfare Implications

Another interesting aspect of AI is its impact on welfare. First of all, AI lowers efficiency of the society as a whole. If information is complete, there will be no costly litigation, and the payoffs of the parties will be $U_d = U_p = [x(1-Q_1)+(1-x)Q_2]J+(C_d-C_p)/2$, for $x=\alpha,\beta$. With incomplete information, some litigations with a positive probability will be initiated by the innocent defendants, and social welfare decreases by litigation costs.

Furthermore, AI is beneficial for the guilty defendant, harmful for the innocent defendant, and both for the plaintiff. Consider a pooling equilibrium first. From equations (6) and (10), the payoffs to the parties are $U_d = U_p = [w[\alpha(1-Q_1)+(1-\alpha)Q_2]+(1-w)[\beta(1-Q_1)+(1-\beta)Q_2]]J+(C_d-C_p)/2$. Compared with complete information, the guilty type defendant is better-off and the innocent type defendant is worse-off. On the other hand, the plaintiff is better-off in a settlement with an innocent defendant, and worse-off with a guilty defendant because of AI.

Next, consider a separating equilibrium. If the defendant is guilty, the dispute is resolved in a settlement as under full information. Therefore, both the plaintiff and the guilty type defendant obtain the same level of welfare as under complete information. On the other hand, when the defendant is innocent, the dispute is resolved at trial, even though the defendant's type is identified through signaling. Hence, both the plaintiff and the innocent defendant are worse-off by the litigation costs, compared to the case of complete information.

This welfare analysis confirms the classic proposition that signaling in litigation is only the second-best solution to the adverse selection problem under AI.[14] Particularly, note that although the innocent type successfully signals himself against the guilty type in a separating equilibrium, he still obtains a lower payoff than under complete information. Accordingly, as the informational asymmetry between the defendant and the plaintiff gets is out, there will be fewer litigations, with less dissipation of resources by both the litigants and the court.

5. Comparative Statics

(1) Conditions of Differing Equilibria

Let us summarize the equilibrium of the signaling lawsuit game. There exists a separating equilibrium if and only if $\beta-\alpha > \frac{C_d+C_p}{2(1-Q_1-Q_2)J}$. In a separating equilibrium, type β defendants choose a settlement which is agreed to by the plaintiff, and type α defendants choose litigation. As such, only the type α defendants are litigated. Furthermore, there exists a pooling equilibrium where both types of defendant choose settlement, which is agreed to by the plaintiff, if and only if $\beta-\alpha < \frac{C_d+C_p}{2(1-w)(1-Q_1-Q_2)J}$. In a pooling equilibrium, no litigation occurs.

<Figure 2> Conditions for an Equilibrium

<Figure 2> describes how the differing equilibria of the lawsuit are determined by the variation in defendant types ($\beta-\alpha$), the litigation costs (C_d and C_p), the size of the stake (J), the court errors (Q_1 and Q_2), and the composition of defendant types (w). A pooling equilibrium, where no litigation occurs, is more probable with a smaller variation among defendant types, higher litigation costs, lower harm level, higher court errors, and more innocent types in defendant population. On the other hand, a separating equilibrium, where the innocent defendants are involved in litigation, is more probable with the opposite conditions, except that it is independent of w.

Based on the equilibrium analysis, we make several testable hypotheses regarding the pattern of litigation selection under AI below.

(2) Adjudication Rate

What can we predict about the probability that a case will go to trial? Since we may have multiple equilibria, depending on the values of the exogenous parameters, and since there is no *ex-ante* probability distribution among those multiple equilibria, we cannot calculate the exact adjudication rate in our model. However, we can make some qualitative predictions.

Litigation occurs only in a separating equilibrium. The probability that a separating equilibrium is observed is $k[1-F(\frac{C_d+C_p}{2(1-Q_1-Q_2)J})]$, where $k\in(0,1]$ represents the probability of separating equilibrium in the event that we have multiple equilibria.[15] Note that $k=1$ if the separating equilibrium is the only equilibrium. Since the portion of the type α defendants who go to trial is w, the adjudication rate T becomes:

$$T=k[1-F(\frac{C_d+C_p}{2(1-Q_1-Q_2)J})]w. \quad --- \quad (11)$$

The adjudication rate T defined in (11) is an *ex-ante* index representing the probability that any randomly selected case is litigated. From (11), it is easy to see that the adjudication rate increases with J and w, and decreases with the litigation costs C_d, C_p, and the court errors Q_1 and Q_2.

Proposition 3. The *ex-ante* adjudication rate is positively correlated with the size of the stake and the portion of the innocent type defendants, and negatively correlated with the litigation costs and the court errors.[16]

Also, given that the existence of a separating equilibrium is already guaranteed (but the defendant's type is not yet identified), the *ex-post* measure for the adjudication rate will be simply w, the ratio of the innocent type to the defendant population.

(3) Plaintiff's Win Rate

Going beyond the usual discussion of the existing literature, we demonstrate three different measures for the plaintiff's win rate. The potential win rate P_1 is the one in which all disputes were litigated. The *ex-ante* win rate P_2 is the probability that a randomly selected case will be resolved in court in the plaintiff's favor. Finally, the *ex-post* win rate P_3 is the portion of the litigated cases that actually go in the plaintiff's favor.

$$P_1=w[\alpha(1-Q_1)+(1-\alpha)Q_2]+(1-w)[\beta(1-Q_1)+(1-\beta)Q_2]. \quad --- \quad (12)$$

$$P_2 = k[1 - F(\frac{C_d + C_p}{2(1-Q_1-Q_2)J})] \cdot w \cdot [\alpha(1-Q_1) + (1-\alpha)Q_2]. \quad --- \ (13)$$

$$P_3 = \alpha(1-Q_1) + (1-\alpha)Q_2. \quad --- \ (14)$$

P_3 might be a usual index in the current literature for the plaintiff's win rate. Intriguingly enough, however, to the extent that the adjudication rate has the *ex-ante* connotation as in (11), we might sometimes require an *ex-ante* prediction about the plaintiff's win rate P_2 as well.[17)]

Proposition 4. $P_1 > P_3 > P_2$.

Proposition 4 reflects the famous proposition that the cases in litigation are not a random sample from the whole population, and biased to the defendant's innocence.[18)] It further proposes that the *ex-post* win rate is higher than the *ex-ante* win rate, since the former is conditional on the litigated cases. Moreover, some interesting comparative statics regarding the plaintiff's *ex-ante* and *ex-post* win rates are summarized in Proposition 5.

Proposition 5. P_2 is positively correlated with J and w, and negatively correlated with C_d, C_p, and Q_1. However, it has no systematic correlation with Q_2.[19)] P_3 increases in α and Q_2, and decreases in Q_1.

<Proof> Omitted.

The intuition and the interpretation of Proposition 5 is self-evident, except for the effect of the type II error on P_2. The increase in Q_2 has two opposite effects on P_2. First, it lowers the probability of a separating equilibrium, or simply the adjudication rate, which lowers the *ex-ante* plaintiff's win rate. Second, it raises the win rate among cases that are actually litigated, which positively affects the *ex-ante* win rate. The final effect of the type II error then depends on the relative strength of these two conflicting effects.

Whether the adjudication rate and the plaintiff's win rate have any systematic relationship is another interesting issue in the study of litigation selection. However, we argue that the presumption that the two indices have a certain causal relationship is incorrect. More specifically, even though it is true that when the adjudication rate changes the plaintiff win rate also changes, the relationship between the two indices is not one of cause-and-effect. The point is that the adjudication rate is not the independent variable which changes autonomously in the model. It is a dependent variable, just like the plaintiff win rate, which is affected by the exogenous parameters. As a consequence, a certain change in these independent parameters can generate changes in these two indices either in the same direction or in the opposite direction. Proposition 6 summarizes such a non-causal relationship between the two indices.

Proposition 6.

(a) If the shock comes from J, w, C_d, C_p, and/or Q_1, T and P_2 move in the same direction. However, if it comes from Q_2, there is no specific correlation between T and P_2.

(b) If the shock comes from J, w, C_d and/or C_p, P_3 does not change while T does. If it comes from Q_1, T and P_3 move in the same direction. However, if it comes from Q_2, T and P_3 move in the opposite directions.

<Proof> Omitted.

With regard to the relationship between T and P_3, which is one of the main issue in current literature, we emphasize that there is no systematic correlation contrary to the existing predictions. This is because the same exogenous cause can generate the same or the opposite effects on them, depending on what force has triggered the initial change. As such, even though some sample data show that the two indices move in the same or opposite directions, it cannot be formalized as a theoretic ground without figuring out the original source of the change.

(4) Further Implications

Before we finish the comparative static analysis, three more comments might be interesting. First, Priest and Klein(1984) argue that there will be more settlements as the degree of uncertainty (about the party who has private information) becomes smaller. One way to interpret this argument, in the context of our model, is that as $\beta-\alpha$ converges to zero, there will be more settlements. If $\beta-\alpha$ converges to zero, the possibility of a separating equilibrium also approaches nil. This implies a lower chance of litigation. In this regard, our model supports Priest and Klein's hypothesis.

Second, Hylton(1993) argues that court errors will decrease over time due to some error-reducing technology. The stock of legal doctrines may be an example. Accepting Hylton's argument, we can predict that the separating equilibrium becomes more probable over time. This implies that there will be more litigations mainly by the type a defendants, who can now be more reliant on the court decision.[20)]

Finally, what if the plaintiff, not the defendant, is the party who has private information? It is not difficult to confirm that we obtain the same results as in the case of defendant's private information regarding Propositions 1, 2, and 3. In contrast, we obtain opposite results regarding Proposition 4, 5, and 6.[21)] Therefore, particularly if we assume that the informational asymmetries between the defendant and the plaintiff are equally distributed among all different types of legal disputes, then, as we aggregate data, we are likely to obtain the famous '50% win rate' result as predicted by Priest and Klein.

6. Concluding Remarks

In this paper, by extending Hylton's simple two-type model, we attempted to provide a more rigorous and comprehensive analysis of the signaling nature of a legal dispute under asymmetric information. Firstly, we highlighted the signaling aspect inherent in the litigation selection process, and explicitly solved a signaling game between the informed and the uninformed, obtaining some fundamental characteristics of the sequential equilibrium. Specifically, we introduced a more general settlement bargaining, instead of the extreme 'take-it-or-leave-it' type, in order to make our conclusions more robust. Secondly, we derived extensive comparative static analyses, based on the detailed equilibrium analysis, about the essential indices frequently discussed in the literature, These, we believe, have not only offered some alternative explanations concerning the nature of AI from a new angle, but have provided sound ground work for further empirical testing in the future.

We conclude the paper with some suggestions for the refinement of our model. First, we need to extend our analysis to a continuum types model. Note that the two-type model does not fully abstract from the reality in which both the guilty and innocent defendants go to trial. In other words, the two-type model does not allow the existence of a hybrid equilibrium, unless we allow mixed strategies, where part of the guilty type defendants also choose litigation. A continuum types model, with the desirable AI specifications suggested in this paper, is necessary to attain such a hybrid equilibrium. The continuum types model will apparently level up our understanding of the litigation/settlement selection.

Second, the strategic behavior of the court needs to be incorporated into the model for a better understanding of the litigation process. With respect to the court's role, we have used only the assumption of the 'minor judgement errors.' This assumption in fact reflects the passiveness of the court in the selection process. We believe, however, that, for any social program (litigation), there exists selection bias unless the players are randomly selected, and that the non-randomness surely results either from participants (litigants) or from the program administrators (courts). In this regard, exploring the court's screening role will add greatly to the stock of research in this field. Our tentative thoughts indicate that the selection will be dictated by the asymmetric information of the court, for instance, on the types of litigants, etc., and/or by other self-interested objectives of the court than the naive social welfare.

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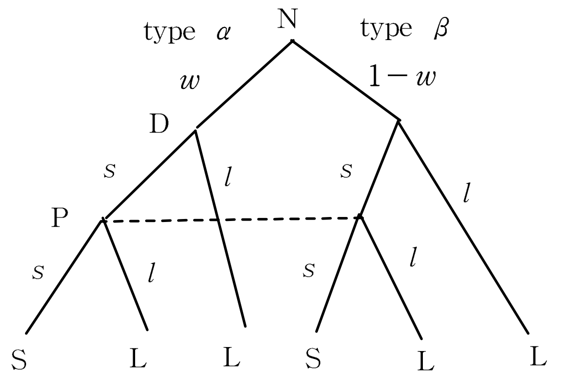
Figures

<Figure 1> A Signaling Lawsuit Game

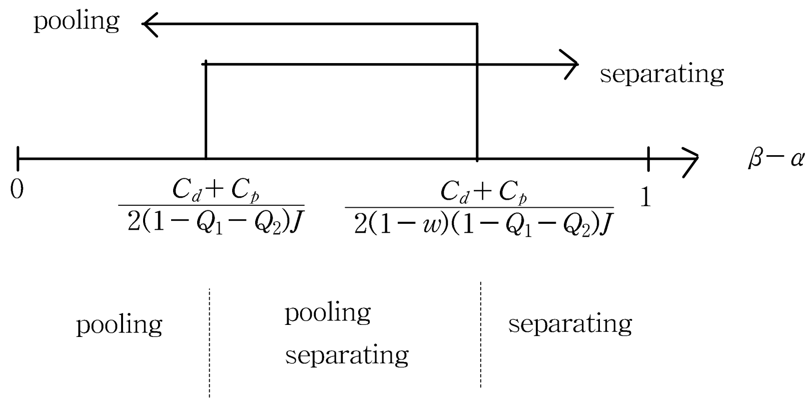


N : nature D : defendant P : plaintiff

s : 'settle' l : 'litigate'

S : settlement subgame L : litigation subgame

<Figure 2> Conditions for an Equilibrium



Pooling equilibrium is more probable as $\beta-\alpha\downarrow$, $(C_{d,}\ C_p)\uparrow$, $J\downarrow$, $(Q_1,\ Q_2)\uparrow$, $w\uparrow$

Separating equilibrium is more probable as $\beta-\alpha\uparrow$, $(C_{d,}\ C_p)\downarrow$, $J\uparrow$, $(Q_1,\ Q_2)\downarrow$

Footnotes

1) Shavell(1996) admits such a trend by noting that it is now the standard model in bargaining for settlement versus trial for the side without information to make a single settlement offer or demand.

2) There are several studies, such as Png(1987) and Reinganum and Wilde(1986), that allow the informed party to move first so that the signaling aspect can be appropriately analysed.

3) See, for example, Bebchuck(1984, 1988), Png(1987), Hylton(1993), Shavell(1996), etc.

4) The terminologies of 'guilty' and 'innocent' are in the relative sense and for the easy comparison of the two different defendant types.

5) The incomplete information of the plaintiff is represented by the dotted line, the information set, in <Figure 1>.

6) See Hylton(1993) for the implications of such an assumption.

7) If the plaintiff's payoff is negative against some defendant's types, then the credibility of the litigation choice by the plaintiff becomes an important issue. See Nalebuff(1987) and Spier(1992) for credibility in the pretrial negotiation.

8) This is to make the settlement outcome symmetric between the two parties. If the discount factor is significantly less than 1, the first mover has some advantage in the settlement bargaining. Even though such asymmetry does not alter our main results, because we separate the settlement/litigation selection process and the settlement bargaining process itself, it is better to avoid the controversial debate about who should move first in settlement process.

9) A sequential equilibrium of the signaling game is the defendant's strategy for each type, the plaintiff's strategy, and the plaintiff's belief about the defendant's type, such that the strategies are the best responses to each other given the plaintiff's belief is consistent with the defendant's strategy.

10) In a separating equilibrium, each defendant type sends a different signal so that the true type can be predicted by observing defendant's behavior. In a pooling equilibrium, both types of the defendant act in the same way, that is, they send the same signal, so that observing a signal does not provide any additional information about the defendant's type to the uninformed plaintiff. Note that a two-type model such as ours, unlike the assertion in Hylton(1993), does not produce a hybrid equilibrium where a portion of guilty defendants goes to trial. See, however, Png(1987) for the existence of a hybrid equilibrium by assuming a mixed strategy of the player.

11) If the innocent defendant had wanted to reveal his true type to the plaintiff, he should have chosen signal l. However, there would be no settlement. This implies that the plaintiff's belief does not change during the settlement bargaining. In principle, we can introduce further Bayesian updates during the bargaining process. Nonetheless, it is beyond the current analysis.

12) Lemma 2 is the same as the Proposition 2 of Hylton(1993). Therefore, the proof can be replaced by the one in Hylton.

13) Of course, the type α defendant knows that the payoffs from the litigation will be $U_d^o = [\alpha(1-Q_1)+(1-\alpha)Q_2]J + C_d$ and $U_p^o = [\alpha(1-Q_1)+(1-\alpha)Q_2]J - C_p$.

14) See Spence(1973) for his seminal work on the suboptimality of the signaling equilibrium under AI.

15) We focus on the interior solution such that $F \in (0, 1)$.

16) The comparative static results on the adjudication rate are consistent with most of the existing literature, such as Bebchuk(1984, 1988), Eisenberg and Farber(1997), and Waldfogel(1998), even though Png(1987) argues that the effects of the stake size and of the litigation costs on the trial frequency are ambiguous. Particularly, the result that the litigation selection depends only on the aggregated litigation cost, but does not depend on its allocation between the two parties is consistent with the main proposition of Reinganum and Wilde(1986). However, such a result is obtained in our analysis without assuming the two critical conditions needed in Reinganum and Wilde: first, both parties share common beliefs about the likelihood of a judgement in favor of the plaintiff, and second, the plaintiff retains the entire settlement.

17) For example, to a driver who does not want to be involved in a costly legal dispute with other wild drivers, the *ex-ante* estimate about the win rate will clearly be more useful in deciding his optimal care level while driving.

18) This is one of the most agreed upon results in litigation selection studies, both by the AI theory and by the divergent expectations theory.

19) Waldfogel(1998), for example, also argues that the plaintiff's win rate increases with J and decreases with C, even though he does not provide any predictions about the effect of court errors.

20) The long term prediction about the plaintiff win rate is also feasible. Take, for instance, P_3. As both types of court errors converge to zero, P_3 will converge to α, the probability of being guilty of the 'more innocent' type defendants.

21) Details can be obtained from the authors upon request.