Litigation Procedure under Asymmetric Information : A Grounding Analysis for Future Empirical Research*

Iljoong Kim** · Jaehong Kim***

This paper aims to provide a comprehensive model of litigation procedure as a grounding work for empirical research. Firstly, it extensively examines the signaling nature of litigation selection under asymmetric information. For the robustness of the analysis, we first separate the litigation selection process, where the signaling from the informed party plays the key role, from the actual settlement where, to avoid ad-hoc first-mover advantage, a more neutral bargaining method than the usual 'take-it-or-leave-it' is adopted. With full characterization of an equilibrium of the signaling game both under the defendant's and the plaintiff's private information, our model is believed to provide richer testable hypotheses for the future comparative static analyses. To be sure, these include the fairly famous hypotheses in law and economics such as the litigation puzzle and the 50% win rate hypothesis.

** Department of Economics, Soongsil University, 1-1 Sangdo 5-dong, Dongjak-gu, Seoul 156-743, Korea, E-mail: ijk@ssu.ac.kr

***School of Management and Economics, Handong Global University, Pohang City, Kyungbuk 791-708, Korea, E-mail: jhong@handong.edu

Ⅰ. Introduction

Asymmetric information is an inherent problem of daily life. Legal dispute is not an exception. In a lawsuit game where a defendant, a plaintiff, and the court are the major players, asymmetric information plays a key role in determining the final outcome. This is why the asymmetric information (hereafter AI) theory has emerged as a convincing answer to the litigation puzzle and also has provided testable hypotheses about the adjudication rate, the plaintiff's win rate, and the relationship between these two indices, and etc. This paper in this regard aims to provide a comprehensive model of litigation procedure under asymmetric information, as a comprehensive grounding work for empirical research.

Consider a situation such that a defendant incurs harm to the plaintiff, and a suit is filed. The litigants have two options ; litigation or settle-ment. However, if there exists asymmetric information about the type of the defendant, that is, about whether he actually violates a legal standard or not, strategic behavior of the informed party and also the belief of the uninformed party about the truth should affect not only the litigation-vs-settlement selection but also the settlement outcome if it occurs.

If we analyze such an asymmetric informational legal dispute, signaling becomes an important element of the analysis. This is because the action chosen by the informed party, the defendant for example, might provide additional information to the uninformed party, the plaintiff for example. To incorporate signaling nature in the analysis, we need to model such that the informed party moves first, that is, he chooses between litigation and settlement before the uninformed party's decision.

Even though there are some studies, such as Png (1987) and Reinganum and Wilde (1986), that appropriately allow the informed party to move first for the signaling analysis, it is also true that many studies on AI avoid the signaling analysis by modeling the uninformed party to move first. Shavell (1996) refers to such a trend by saying that it is now the standard model of

'settlement versus trial' that the side without information makes a single settlement offer. However, Bebchuk (1984), which is Shavell's reference model, admits that adopting such a sequence of moves was to avoid a complicated signaling nature.

In addition to signaling, there is another equally important element in modeling a litigation/settlement game. That is, we need to give equal bargaining power to the defendant and to the plaintiff in modeling the settlement bargaining. This is because there is no ex-ante reason why some party, either the defendant or the plaintiff, should have a bigger bargaining power than the other. In this regard, it is somewhat strange that the 'take-it-or-leave-it' settlement offer has become a standard way to describe the settlement bargaining process in most current AI literature. Nonetheless, such an extreme type of bargaining process, which gives the absolute advantage to the first mover, affects the result not only quantitatively but also qualitatively, and therefore is not robust.[1]

To avoid an ad-hoc assignment of asymmetric bargaining powers among the two litigants in settlement, and obtain a more robust result, we need to adopt a more neutral bargaining model than the usual 'take-it-or-leave-it', or ultimatum bargaining method. Among the several possibilities, in this paper, we adopt the Nash bargaining with equal bargaining powers and with the status-quo of the court decision. This can be consistent with the reality that the court, when the case is filed and if the two litigants want some settlement before going for a trial, usually allows pretrial negotiation under the condition that the case is resolved via litigation in case of no settlement agreement.

If we incorporate signaling into the analysis and avoid ad-hoc first-mover advantage in modeling the settlement bargaining, it is also needed to separate the litigation/settlement selection process and the actual settlement

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1) In this regard, Reinganum and Wilde (1986) is a good example. Their main proposition holds only under the assumption that the first mover retains the whole pie. This implies that the analysis based on the ultimatum settlement bargaining is not robust compared to more general bargaining models where the first mover does not have the absolute advantage.

process. In most current AI literature, the litigation/settlement selection process is mixed with the settlement process. When the two processes are mixed, the size of the settlement offer naturally becomes the signaling device. Consequently, who offers the settlement demand first affects not only the decision to litigate or to settle, but also the settlement outcome itself. However, although who moves first should matter in the litigation/ settlement selection because of its signaling nature, it should play a more neutral role in determining the settlement outcome. Separating settlement from the litigation/settlement selection, and adopting a bargaining method for the settlement, which is more neutral against who moves first, can be a way to highlight the signaling nature and to avoid ad-hoc first-mover advantage problem simultaneously.

This paper is an attempt to improve the AI theory in these three respects ; highlighting signaling nature of the legal dispute under asymmetric in- formation, avoiding ad-hoc assignment of the absolute first-mover advantage in settlement bargaining, and to separate litigation/settlement decision and the settlement itself to make the first two attempts not inconsistent. By doing so, we expect the AI theory can be enriched to become a more appropriate framework in analyzing litigation and settlement, and provide more comprehensive testable hypotheses regarding such as the litigation puzzle, the 50% win rate hypothesis, and its welfare implications, and etc.

The order of the paper is as follows. In Section Ⅱ, we will describe the lawsuit as a signaling game under AI. Section Ⅲ characterizes the perfect Bayesian equilibrium of the signaling lawsuit game. For empirical studies, several interesting comparative static analyses will be provided in Section Ⅳ, with discussions regarding the classic propositions in the field. Section Ⅴ equivalently analyzes the situation under which the plaintiff (not the defendant) is the party who has private information, which is of great importance in utilizing our comparative statics for future empirical studies. Section Ⅵ concludes the paper with additional implications to the divergent expectations theory of litigation.

Ⅱ. The Model

1. A Recap of the Relevant Literature

Before moving to the formal analysis, we will provide some more descriptions of the existing literature regarding the three points highlighted in the Introduction. Bebchuk (1984) is the pioneering study on the role of AI in litigation and settlement. Even though Bebchuk provides the basic intuition about the AI nature of the legal disputes, he does not examine the signaling role of settlement offers. He confesses in his concluding remarks that the reason why the uninformed party is modeled to move first is to avoid the issue of signaling, and adds that, to analyze the signaling aspect, we need a complete model of settlement decisions under imperfect information.

Reinganum and Wilde (1986) analyze a signaling model where the plaintiff has private information about the size of the stake in dispute, and show that AI explains the existence of costly litigation. Their main result is that the equilibrium, more specifically, the trial rate, is affected only by the total litigation cost, and not by its allocation. Yet, such a result is not robust because it holds only when the following two conditions are satisfied ; both parties share common beliefs about the likelihood of a judgement in favor of the plaintiff, and the plaintiff retains the entire settlement. The first condition is not satisfied if the source of AI is the plaintiff's win rate *per se*, as in many models including ours. Furthermore, the second condition is satisfied only under the 'take-it-or-leave-it' type of bargaining. If the settlement process is not such an extreme ultimatum bargaining, their proposition cannot hold.[2]

Png (1987) studies the hidden action problem and derives a sequential equilibrium in a signaling game setting. Png allows the informed party, the defendant, to offer the settlement demand first, so that the uninformed plaintiff can update his belief about the defendant's type. Even though Png deals with the moral hazard problem in the care level by the defendant, the

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2) Reinganum and Wilde also provide no further comparative static analyses other than the proposition on the aggregated litigation cost.

prior probability that the defendant is guilty is assumed to be fixed. It is clear that, in a model of moral hazard, the probability of being guilty should depend on the defendant's choice in care. If the probability of being guilty is determined by the care level, his equilibrium might be totally changed.[3]

Hylton (1993) also emphasizes the signaling role of the settlement demand to explain the litigation puzzle. Even though Hylton correctly points out that the strategic behavior of the parties is the key to litigation selection, she is somewhat inaccurate in explaining information transmission, because, we submit, she has not actually provided a full description of an equilibrium of the signaling game.

2. A Signaling Model

Consider a situation such that the defendant (D) incurs harm to the plaintiff (P), and a suit is filed. The defendant is identified by v, the probability that he is guilty, which is selected by Nature (N) according to the uniform distribution on the [0, 1] interval.[4] We assume that the defendant knows his own type, while the plaintiff knows only the distribution of v.[5]

We model the lawsuit process as a two-person two-stage game with incomplete information as in <Figure 1>.[6] The first stage determines whether the case goes to the litigation or to the settlement. The defendant,

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3) The separating equilibrium, which is Png's main focus, might not even exist. Actually, in his paper, Png repeatedly hints that the care level and the probability of being guilty are correlated. Furthermore, Png derives a mixed strategy equilibrium, rather than the standard pure strategy equilibrium. Png's model is a two-type one, where the defendant is either guilty (negligent) or innocent (careful). When there are only two defendant types, without mixed strategy, there is no hybrid equilibrium where some portion of the guilty defendants go to trial and the remainders settle out of the court. Nevertheless, it would be more desirable to analyze a pure strategy equilibrium, if it exists, than a somewhat unrealistic mixed strategy equilibrium.

4) The uniform distribution is only for convenience, and is not crucial to our analysis.

5) Our model analyzes a hidden information (adverse selection) problem since we assume that v is exogenously given. However, a defendant can affect v through his effort or care. See Png (1987) for such a hidden action (moral hazard) problem.

6) The game model in <Figure 1> is a reduced form where the subgames for the settlement bargaining and for the litigation are not explicitly represented. Each subgame will be explained in detail separately.

who is the informed party, first chooses either 'litigate' (l) or 'settle' (s). If the defendant chooses l, the game moves to the litigation stage. If the defendant chooses s, the plaintiff chooses between s and l without knowing the defendant's type.[7] If the plaintiff chooses s, the settlement bargaining begins, and if he chooses l, the litigation subgame starts.
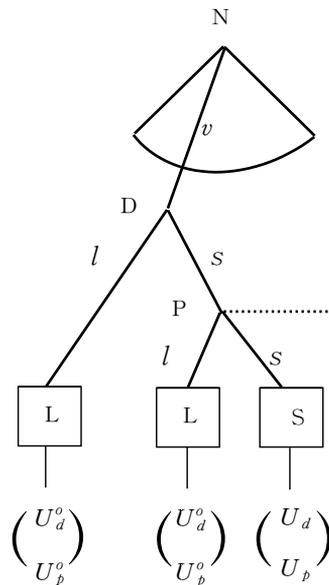
N : Nature, D : defendant, P : plaintiff, l : 'litigate', s : 'settle',
L : litigation subgame, S : settlement subgame

<Figure 1> A Signaling Game of Lawsuit

The second stage is either a litigation subgame or a settlement bargaining subgame depending on the moves of the two parties at the first stage. Let U_d and U_p be the expected payoffs in the settlement subgame, and U_d^o and U_p^o be the expected payoffs from litigation, for the defendant and for the plaintiff, respectively. 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.

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7) This is represented by the dotted line, the information set, in <Figure 1>.

(1) Litigation Subgame

If litigation starts, then there is no strategic behavior by the two parties, and the payoffs are determined by the court. We assume that the court identifies the true type of the defendant 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 public information and satisfy $1 - Q_1 - Q_2 > 0$.[8]

Let P_d and P_p be the subjective beliefs on the plaintiff's winning probability of the defendant and of the plaintiff, respectively. Then, since the defendant's type is private information, $P_d = v(1 - Q_1) + (1 - v)Q_2$ and $P_p = \int_V [v(1 - Q_1) + (1 - v)Q_2]\, dF(v)$, where V is a subset of $[0, 1]$ to which the plaintiff, after observing defendant's move, believes the defendant's type belongs, and $F(v)$ is the cumulative distribution function for this interval V.[9] Note that P_p is common knowledge, but P_d is private information of the defendant.

The expected payoffs from litigation are $U_d^o = P_d J + C_d$ for the defendant and $U_p^o = P_p J - C_p$ for the plaintiff, where J is the size of the stake in dispute, and C_d and C_p are the litigation costs, of the defendant and the plaintiff, respectively. We assume $U_p^o \geq 0$ against all defendant types so that the litigation choice is not a non-credible threat.[10] It is assumed that C_d, C_p, and J are public information.

(2) Settlement Bargaining Subgame

Any settlement, if it exists, must make both parties better-off than under litigation, because the payoff from litigation is the opportunity cost of the bargaining. Lemma 1 refers to such a condition for the existence of a settlement.


8) See Hylton (1993) for the implications of this assumption.
9) Note that if $V = [0, 1]$, then $dF(v) = dv$.
10) If the plaintiff's payoff is negative against some defendants' 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.

Lemma 1 : Assume that settlement is at no cost. Then, settlement occurs
if and only if $U_d^o > U_p^o$. Otherwise, litigation occurs.[11]

<Proof> See Hylton (1993).
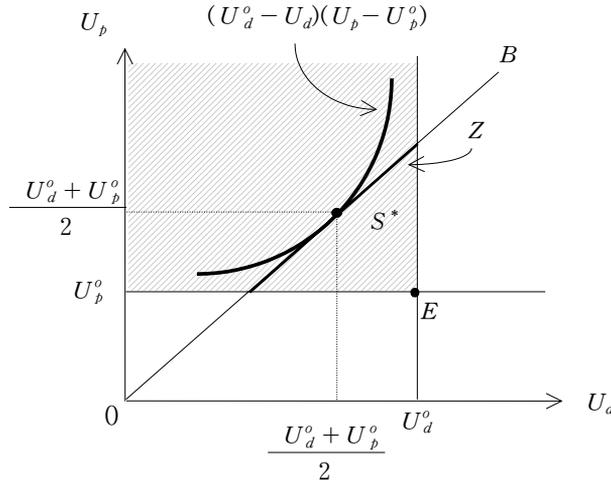
<Figure 2> Bargaining as a Settlement Process

We model the settlement process as a Nash bargaining. <Figure 2> des-
cribes a settlement bargaining assuming that $U_d^o > U_p^o$ and if there is no agree-
ment in the settlement bargaining, the case goes to trial. Since $E = (U_d^o, U_p^o)$
is the status-quo of the Nash bargaining, the settlement, if it exists, should
be in the preferred set, which is to the west and north of the status quo.
Furthermore, since the bargaining itself is a zero-sum game, the bargaining
outcome should be on the bargain-feasible set $B = \{(U_d, U_p) \mid U_d = U_p\}$, which
is the 45° line from the origin. Let Z be the contract zone, which is the
intersect of the preferred set and the feasible set. Then a settlement, if it
exists, should be in Z.

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11) When calculating litigation payoffs, both defendant and plaintiff should have
some (subjective) beliefs on plaintiff's winning probability. Considering asym-
metric information between the two litigants, we need some understandings about
what beliefs of the litigants are relevant. We will provide some explanations
about such issue later. This remark is also applied to Lemma 2.

Assuming equal bargaining powers between the two litigants in the settlement stage, the Nash bargaining solution is as follows.[12]

Lemma 2 : The Nash bargaining solution of the settlement with status quo

$(U_d^o, \ U_p^o)$, which maximizes $(U_d^o - U_d)(U_p - U_p^o)$ subject to (U_d, U_p)

$\in Z$, is $S^* = (\dfrac{U_d^o + U_P^o}{2}, \dfrac{U_d^o + U_P^o}{2})$.

\<Proof\> Omitted.

Ⅲ. Equilibrium

Now, let us find an equilibrium, a perfect Bayesian equilibrium, of the lawsuit signaling game.

Definition : A perfect Bayesian equilibrium of the lawsuit signaling game is the defendant's strategy, 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 plaintiff's belief, and that the plaintiff's belief is consistent with the defendant's strategy.

The equilibrium, if it exists, is either separating, pooling, or hybrid. In a (pure) separating equilibrium, each defendant sends a different signal so that the true type can be predicted by observing the defendant's behavior. In a (pure) pooling equilibrium, all the defendants 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. Finally, in a hybrid equilibrium, defendants are divided into

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12) 'Equal bargaining power' means equal weights in the joint objective function, as is shown in the following Lemma 2 ; the litigants maximize $(U_d^o - U_d)(U_p - U_p^o)$ subject to $(U_d, U_p) \in Z$.

two groups, and each group sends a different signal so that observing a signal gives information regarding to which group the defendant belongs. In a hybrid equilibrium, however, the true type of a defendant cannot be identified within the same group.[13]

The situation on which we will particularly focus is the hybrid equilibrium where those defendants with low v choose litigation, while those with high v choose settlement. Before moving to a formal analysis, some justifications for restricting our attention to such a hybrid equilibrium may be necessary.

First, consider a pooling equilibrium. If all defendant types choose settlement, the plaintiff cannot distinguish their types. The plaintiff will then choose settlement as an optimal strategy to avoid unnecessary litigation costs. A pooling equilibrium where all types of defendants choose settlement, although it might exist, is not in our interest because it has nothing to say about litigation.

On the other hand, a pooling equilibrium where all types of defendants choose litigation cannot exist. This is because the defendant with $v=1$, who is without doubt guilty, will always deviate from litigation to settlement. By continuity, the defendants who are almost surely guilty will act identically.[14]

Furthermore, it is clear that a pure separating equilibrium where every defendant type is identified cannot exist. This is because there are only two signals while there are infinitely many types of defendants. It follows that the most meaningful equilibrium is the hybrid as described above.

In a hybrid equilibrium, there must be a marginal type of defendant who is indifferent between sending signal s and sending l. By extension, all defendants who are located between this marginal type and $v=1$ will

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13) The terminology of a hybrid equilibrium might be somewhat confusing. It is because we sometimes call an equilibrium 'hybrid' when the same types send different signals so that an equilibrium is characterized by both separating and pooling nature at the same time. However, in our model, since there are no identical defendants, and there are only two available signals, the description of a hybrid equilibrium is natural.

14) This is the same as Proposition 2 in Hylton (1993).

choose s, while the others will choose l. Note that those with some positive probability of guilt, not just the purely innocent type, also choose l.

To summarize, a hybrid equilibrium, if it exists, must be such that (relatively) innocent defendants reveal true types, meaning that they signal that they are of low $v's$, by choosing litigation, which will not be followed by the (relatively) guilty defendants.

Proposition 1 : There exists an equilibrium in the lawsuit signaling game where the defendant has private information such that :

- defendant's strategy : l for $v \leq v^*$, and s for $v \geq v^*$,
- plaintiff's belief : if l, then $v \leq v^*$, and if s, then $v \geq v^*$,
- plaintiff's strategy : s,

where $v^* = 1 - \dfrac{C_d + C_p}{J[1 - Q_1 - Q_2]}$ is the marginal defendant type who is indifferent between signals l and s.

<Proof> First, it is clear that the plaintiff's belief is consistent with the defendant's strategy. Let us prove the optimality of the two parties' strategies.

1. Optimality of the Defendant's Strategy

Consider first a defendant whose type belongs to $v \leq v^*$. If he chooses l, his expected payoff from l will be :

$$U_d^o(v) = P_d J + C_d = [v(1 - Q_1) + (1 - v)Q_2]J + C_d \tag{1}$$

On the other hand, if he chooses s, the case is settled out of court since the plaintiff's strategy is also s. The defendant's payoff from the settlement depends on the status quo of the bargaining, which are the expected payoffs when the dispute were resolved through litigation.

One important comment on the assessment of the status-quo in the settlement bargaining is necessary. That is, the defendant should use P_p, not P_d, in assessing the status-quo in the settlement bargaining. The

reason is as follows : The case is under settlement because the defendant has sent signal s. Furthermore, it is because of this signal chosen by the defendant that the plaintiff becomes to have a subjective belief P_p. It is common knowledge that the plaintiff's belief on the winning probability, if the case would have been in the court, is P_p. Specifically, the defendant, after sending a signal s and making the plaintiff believe that the defendant's type belongs to V, cannot credibly argue that the plaintiff's winning chance is P_d, not P_p.[15] Therefore, both the defendant and the plaintiff would use the common P_p in assessing U_d^o and U_p^o in the settlement bargaining, and so we can apply Nash bargaining solution, which is based on the common knowledge assumption on the surplus of bargaining or on the status-quo, to our analysis.[16]

Since the status-quo of the settlement Nash bargaining subgame is $(U_d^o, U_p^o) = (P_p J + C_d, P_p J - C_p)$, from Lemma 2, the defendant's payoff from settlement will be :

$$U_d(v^*) = P_p(v^*)J + (C_d - C_p)/2 \tag{2}$$

where the plaintiff's estimate of his winning probability $P_p(v^*)$ is

$$P_p(v^*) = \int_{v^*}^{1} [v(1-Q_1) + (1-v)Q_2] \frac{1}{1-v^*} \, dv$$
$$= [(1+v^*)(1-Q_1) + (1-v^*)Q_2]/2 \tag{3}$$

The defendant with $v \leq v^*$ will choose l if and only if $(1) \leq (2)$; that is, $U_d^o(v) \leq U_d(v^*)$ (the equality holds when $v = v^*$, since the marginal defendant with v^* is indifferent between the two signals).[17] Since $U_d^o(v)$ in equation (1) is strictly increasing in v, this condition will be satisfied if and only if $U_d^o(v^*) = U_d(v^*)$. Rewriting $U_d^o(v^*) = U_d(v^*)$, using equation (3), we obtain

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15) Actually there is no way to reveal defendant's true type, that is, to inform the plaintiff of the true winning probability.
16) We assume that there is no further Bayesian updating of the plaintiff's belief during the settlement bargaining process.
17) Recall that the defendant's payoff is the cost, and thus needs to be minimized.

$$(1-v^*)(1-Q_1-Q_2)J = C_d + C_p \qquad\qquad (4)$$

From equation (4), we find a marginal defendant type v^* as

$$v^* = 1 - \frac{C_d + C_p}{J[1-Q_1-Q_2]} \qquad\qquad (5)^{18)}$$

If v^* is given as in equation (5), the defendants with $v \le v^*$ will choose l as the optimal strategy.

Now, consider a defendant whose type belongs to $v \ge v^*$. If he chooses l, his payoff from litigation $U_d^o(v)$ is the same as in equation (1). If he chooses s, he again receives the same payoff $U_d(v^*)$ from the settlement bargaining, as in equation (2). Since $U_d^o(v)$ is strictly increasing in v, $U_d^o(v^*) = U_d(v^*)$ is equivalent to $U_d^o(v) \ge U_d(v^*)$ for all $v \ge v^*$ (again the equality holds for $v = v^*$), which is already proven to hold at v^* in equation (5). It follows that a defendant with $v \ge v^*$ will choose settlement as his optimal strategy.

In sum, the defendant's strategy is optimal against the plaintiff's belief and strategy, and the marginal defendant type v^* is defined as in equation (5).

2. Optimality of Plaintiff's Strategy

The plaintiff moves only when the defendant has chosen settlement. When the signal s is observed, the plaintiff believes that the defendant is type $v \ge v^*$. If the plaintiff chooses s, his payoff will be :

$$U_p(v^*) = P_p(v^*)J + (C_d - C_p)/2 \qquad\qquad (6)$$

If he chooses l, his payoff from litigation will be :

$$U_p^o(v^*) = P_p(v^*)J - C_p \qquad\qquad (7)$$

where $P_p(v^*)$ is the plaintiff's winning probability defined in equation (3). The plaintiff's strategy of s is optimal, since it always holds that (6)>(7), that is, $U_p(v^*) > U_p^o(v^*)$. **Q.E.D**.

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18) We assume that v^* is not a boundary point in [0, 1] without loss of generality.

IV. Comparative Static Analysis

We present several results of comparative static analyses below for extensive empirical research. Recent studies on litigation selection show special interests in the adjudication rate, the plaintiff's win rate (among adjudicated cases), and the relationship between these two indices. Our analysis with continuum types of defendants who have private information provides rich implications regarding such issues.[19]

1. Adjudication Rate

Let T be the adjudication rate, the fraction of cases for trial, which is equal to v^* in our analysis. Now let us undertake some comparative static analysis. Since the impacts of C_d and C_p, and also those of Q_1 and Q_2, on T are symmetric, let $C = C_d + C_p$ and $Q = Q_1 + Q_2$. As such, the marginal defendant type, or the adjudication rate, v^* can be rewritten as :

$$v^* = 1 - \frac{C}{J(1-Q)} \tag{8}$$

From equation (8) the following comparative statics can be obtained.

$$\frac{\partial v^*}{\partial J} > 0 \tag{9}$$

$$\frac{\partial v^*}{\partial C} < 0 \tag{10}$$

$$\frac{\partial v^*}{\partial Q} < 0 \tag{11}$$

Proposition 2 : The adjudication rate increases with the size of the stake

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19) Bebchuk (1984) also attempts comparative static analyses regarding the settlement amount. He predicts that the settlement amount increases with the size of the stake, and decreases with the plaintiff's litigation cost, but that it can increase, decrease, or do neither when the defendant's litigation cost increases. Our analysis mostly supports Bebchuk's prediction. The settlement amount is given in equation (2), where $P_p(v^*)$ is as in equation (3) and v^* is as in equation (5). We can easily see that the settlement amount in our analysis increases in J, decreases in C_p, and does not change with C_d.

(J), but decreases with the litigation costs (C) and court errors (Q).

(1) Effect of the Stake Size

Equation (9) says that the adjudication rate is positively correlated to the size of the stake.[20] First, consider how the marginal type defendant, who was indifferent to litigation or settlement, will change his behavior when the stake becomes more important. From equation (1) and equation (2), we can determine the impact of the change in the stake size on the payoffs of the marginal defendant type v^* from both litigation and settlement. From equation (1), the change in the payoff from litigation is $\partial U_d^o/\partial J = v^*(1-Q_1)+(1-v^*)Q_2$, which is the plaintiff's win rate when the defendant type is v^*.

On the other hand, from equation (2), the change in the payoff from settlement is $\partial U_d/\partial J = P_p(v^*)$, which is the plaintiff's average win rate for $v \geq v^*$. Therefore, it is clear that $P_p(v^*) > v^*(1-Q_1)+(1-v^*)Q_2$, that is, $\partial U_d/\partial J > \partial U_d^o/\partial J$. As the stake increases, the expected payment by the marginal defendant also increase both in litigation and in settlement. However, the payment increase is less significant in litigation than in settlement, so the marginal defendant will now choose litigation, which means a higher frequency of litigation.

Now check plaintiff's incentive. From equation (6) and equation (7), $\partial U_p/\partial J = \partial U_p^o/\partial J$. This means that the change in the stake size does not affect the plaintiff's incentive to litigate. This is because, as we can see from equation (6) and equation (7), to the plaintiff, the only difference between litigation and settlement is whether he pays the whole litigation cost, or gets some reimbursement in the settlement bargaining.

In conclusion, there will be more litigation as the stake becomes higher. Furthermore, such a change is initiated by the defendant, while there is no

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20) This is consistent with the prediction by Bebchuk (1984, 1988) and Waldfogel (1998). However, Png (1987) argues that the effect of stake size on the trial fre-quency is ambiguous.

change in plaintiff's incentive.

(2) Effect of Litigation Costs

Equation (10) implies that there will be less trials under a higher litigation cost.[21] Consider first the change in the defendant's litigation cost. We will again focus on the incentive of the marginal defendant type. From equation (1) and equation (2), $\partial U_d^o / \partial C_d = 1$, and $\partial U_d / \partial C_d = 1/2$. When his litigation cost increases, the marginal defendant v^* is no longer indifferent to choosing between litigation and settlement. He now prefers settlement.

We can also confirm that the plaintiff also desires settlement, since $\partial U_p / \partial C_d = 1/2 > \partial U_p^o / \partial C_d = 0$ from equation (6) and equation (7). The increase in the defendant's litigation cost is more advantageous to the plaintiff in settlement, though it does not change the payoff resulting from litigation. Thus, the plaintiff will prefer settlement more. To summarize, the increase in C_d makes both the defendant and the plaintiff choose settlement more.

Now consider the change in the plaintiff's litigation cost. From equation (1) and equation (2), $\partial U_d^o / \partial U_p = 0$ and $\partial U_d / \partial C_p = -1/2$. The increase in the plaintiff's litigation cost has no effect on the defendant's payoff from litigation. Nonetheless, it lowers the defendant's payment in settlement. The defendant will thus be more inclined to opt for settlement. Furthermore, from equation (6) and equation (7), $|\partial U_p / \partial C_p| = |-1/2| < |\partial U_p^o / \partial C_p| = |-1|$. The plaintiff's loss from the increased litigation cost is then less significant in settlement. He will thus more often choose settlement. Again, an increase in the plaintiff's litigation cost consistently changes the defendant's and plaintiff's incentives toward settlement.[22]

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21) Our result that the litigation selection depends only on the aggregated litigation cost, and 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, as mentioned in the Introduction.

22) This result is consistent with Bebchuk (1984, 1988), Eisenberg and Farber (1997), and Waldfogell (1998). However, Png (1987) argues that while the defendant's litigation cost has a negative effect on the litigation rate, the effect of

(3) Effect of Court Errors

Let us investigate the impact of the change in court errors, which is summarized in equation (11). Consider the type I error first. From equation (1), the reduction in the marginal defendant's payoff from litigation due to the increased type I error is $|\partial U_d^o/\partial Q_1| = |-v^*J|$. Also, from equation (2), the payoff change from settlement is $|\partial U_d/\partial Q_1| = |-(1+v^*)J/2|$. Since $v^* \leq (1+v^*)/2$, $|\partial U_d^o/\partial Q_1| \leq |\partial U_d/\partial Q_1|$. The marginal defendant now changes his behavior and chooses settlement, since he pays less in settlement. This implies less litigations.[23] Moreover, we can easily confirm that the plaintiff's incentive does not change with the increase in Q_1. Accordingly, when the court makes more type I errors, it is the defendant's incentive which induces more settlements.

Now consider the change in Q_2. The marginal type defendant will more often opt for settlement, since the increased burden from litigation is larger than that from settlement ; $\partial U_d^o/\partial Q_2 = (1-v^*)J > \partial U_d/\partial Q_2 = (1-v^*)J/2$. Nor does the plaintiff's behavior change with a higher type II error, since $\partial U_p/\partial Q_2 = \partial U_p^o/\partial Q_2$. For that reason, there will be more settlements, initiated by the

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the plaintiff's litigation cost can be either positive or negative. Furthermore, our results equation (9) and equation (10) are also consistent with many studies following the divergent expectations model originally claimed by Priest and Klein (1984). In fact, our overall comparative statics results are, in spirit, consistent with their so called 'selective litigation hypothesis,' that the set of cases that go to trial is not a random sample of all cases filed. See Priest and Klein (1984), Wittman (1985), Eisenberg (1990), Waldfogel (1995), Siegelman and Waldfogel (1999), etc.

23) One might think that defendants would prefer litigation as the type I error increases. Yet, such a conjecture is incorrect, since it only considers the litigation side, and ignores the settlement side. When type I error increases, both the plaintiff's and the defendant's estimates about plaintiff's win rate change. The plaintiff, who does not know the true type of the defendant in trial, will have a lower winning estimate against all defendant types in $[v^*, 1]$. This implies that the plaintiff's position in settlement becomes much weaker, or equivalently, that the defendant can retain a much larger portion from the settlement. The decrease in the plaintiff's subjective win rate is in absolute terms larger than that estimated by the marginal type defendant. The marginal defendant benefits more from settlement, since the plaintiff's subjective win rate affects the settlement outcome, while the litigation outcome is based only on the defendant's objective estimate.

defendant, when the court makes more type Ⅱ errors.

Hylton (1993) provides an interesting interpretation of court errors. She postulates that court errors will decline over time, for example, due to some error-reducing technology such as the stock of refined legal doctrines. Accepting Hylton's postulation, we expect that the adjudication rate will increase over time, ceteris paribus.

2. Plaintiff's Win Rate

Now define P_1 to be the potential win rate of plaintiffs, which is the fraction of the plaintiff's winning cases among all disputes including both those settled and litigated. In other words, P_1 is the plaintiff's win rate from litigation when all types of defendants would actually go to trial.

$$P_1 = \int_0^1 [v(1-Q_1)+(1-v)Q_2]dv = \frac{(1-Q_1)+Q_2}{2} \tag{12}$$

Next, define P_2 to be the actual win rate of plaintiffs among the litigated cases.

$$P_2 = \int_0^{v^*} [v(1-Q_1)+(1-v)Q_2]\frac{1}{v^*}\,dv = \frac{1}{2}(1-Q_1-Q_2)v^* + Q_2$$

$$= \frac{(1-Q_1)+Q_2}{2} - \frac{C_d+C_p}{2J} \tag{13}$$

From equation (12) and equation (13), we can make two important predictions regarding the plaintiff's win rate. The first prediction is that $P_2 < P_1$, which implies that the litigated cases are more skewed toward 'defendant's innocence' than would be the case for the whole population. This is intuitively plausible and also consistent with the predictions of the existing literature regarding AI.

Proposition 3 : Litigated cases are more skewed toward 'defendant's innocence' than would be the case for the whole population of the disputes, that is, $P_2 < P_1$.

The second prediction is about the effects of the exogenous variables on

the win rate. Based on equation (13), Proposition 4 summarizes them.

Proposition 4 : The plaintiff's win rate P_2 increases with the size of the stake J, and with the court's type II error Q_2. However, it decreases with the litigation costs C, and with the court's type I error Q_1.

The effects of the litigation costs and of the stake size on the win rate are straightforward, since they affect P_2 only through v^* in equation (13).[24] In contrast, the effects of the court errors are not so simple to understand, since they affect not only the adjudication rate, but also the ex-post win rate directly. Consider the type Ⅰ error first. If Q_1 increases, the adjudication rate will decrease, and the defendants in trial become more 'innocent' such that the plaintiff's win rate decreases. Furthermore, a higher Q_1 implies that the court will identify a guilty defendant as innocent more often than before. This clearly reinforces the fall in the plaintiff's win rate.

Next, consider the type Ⅱ error. If Q_2 increases, there will again be fewer litigations, and defendants in trial become more innocent. This will lower the plaintiff's win rate. However, there is a counter-effect. Since the chance that an innocent defendant will be identified as guilty increases, the plaintiff's win rate will increase. Even though we have two opposite effects, it is not difficult to see that the positive effect is more pronounced than the negative effect. The negative effect is marginal in the sense that it affects only those defendants in the neighborhood of the marginal type v^*. Meanwhile, the positive effect is global in the sense that it affects all defendants $v \leq v^*$. Surely, the global effect would dominate the marginal effect.

Finally, if we accept Hylton's (1993) assumption that court errors converge to zero over time, equation (13) predicts that the plaintiff's win rate will converge to some number which is significantly less than 50%.

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24) Waldfogel (1998) 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.

3. Relationship between Adjudication Rate and Win Rate

Whether there is any systematic relationship between the adjudication rate and the win rate is also a main issue in the literature. Even though the current literature tries to deduce some specific correlation between these two indices (whether it is positive, negative, or even independent), we argue that such an attempt is incorrect. Specifically, the underlying assumption that the adjudication rate is the cause and the win rate is the effect is amiss.

The relationship between the two indices cannot be defined in a simple way. It is true that the win rate changes as the adjudication rate changes. However, the adjudication rate cannot be changed by itself. If there has been any change in the adjudication rate, it must be due to changes in the more fundamental exogenous factors such as J, C_d, C_p, Q_1, and Q_2. To put it differently, the adjudication rate is not an independent variable in the causal relationship, but rather a dependant variable *per se*, which is, just like the plaintiff's win rate, affected by exogenous factors. It is not surprising that the same factor can affect the adjudication rate and the plaintiff's win rate either in the same, or in opposite directions. Combining Propositions 2 and 4, we get the relationship between the two indices, as in Proposition 5.

Proposition 5 : If the change is caused by type II error Q_2, the plaintiff's win rate P_2 is negatively correlated with the adjudication rate T. To the contrary, if the change is caused by J, C, or Q_1, the plaintiff's win rate is positively correlated with the adjudication rate.

4. The 50% Win Rate Hypothesis Revisited

Our analysis of the plaintiff's win rate enables us to make some predictions about the famous '50% win rate' hypothesis of Priest and Klein (1984), which is considered as the major tenet of divergent expectations theory. If we can, from the AI model, derive some implications regarding this 50% win rate hypothesis, it should be another important step toward a

reconciliation (Waldfogel, 1998) between the two competing theories.

From equation (13), it is clear that the win rate can be lower than, higher than, or equal to 50%, depending on the litigation costs, stake size, and court errors.[25] If we make some reasonable assumptions about the court errors, more specific predictions are feasible.

First, if the court errors are small, the win rate will be lower than 50%, even though how much below 50% will depend again on the litigation costs and the size of the stake.[26] With high litigation costs, more defendants will opt for settlement. Since the switch to settlement starts with 'more guilty' defendants, the plaintiff's win rate will be much lower than 50%. As litigation costs converge to zero, the plaintiff's win rate also converges to 50% (under the assumption of negligible court errors). To the extent that the stake becomes higher, there will be more litigations with 'less innocent' defendants, driving the win rate up towards 50%.

Second, if the court makes type I and type II errors with an equal chance, the plaintiff's win rate will be lower than 50%. If the court adopts a stricter rule to detect illegal cases so that type I errors decrease and type II errors (relatively) increase, the win rate will go up. Under this circumstance, a win rate higher than 50% is even possible. By the same token, if the court's standards become more relaxed, the win rate will be much lower than 50%.

One final comment on the win rate in association with the 50% win rate hypothesis is inevitable. As Shavell (1996) correctly emphasizes, the actual win rate critically depends on the underlying distribution function for the defendant's type. If we assume any distribution functions other than the uniform one, we might have different implications about the 50% win rate hypothesis. Accordingly, the most important message regarding the win rate should be that any win rate is possible as the title of Shavell's paper suggests.

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25) Shavell (1996) also points out that the win rate can be any number, depending on the underlying probability distribution about the type of the party with private information. In our model, even under a given distribution function, the win rate can be any value, depending on the exogenous parameters.

26) Following Hylton (1993), such predictions can be realized in the long run.

V. When the Plaintiff Has Private Information

What if the plaintiff has private information? Hylton (1993) makes an opposite prediction regarding the plaintiff's win rate in such a case. She argues that, if the plaintiff has the informational advantage, a high win rate may be observed.[27] Even though such a prediction seems quite intuitive, it is worth confirming its accuracy in our signaling game model.

To avoid unnecessary duplication of the calculations, we provide only intuitive predictions about the results.[28] Except for two things the model is basically the same as the case in which the defendant has private information. First, since it is the plaintiff who has private information, the plaintiff moves first and the defendant moves later, after observing a signal from the plaintiff. Second, we assume a continuum types model of plaintiffs, not of defendants. A plaintiff's type is identified by the probability that he does not prevail, which is again denoted by v. Of course, v is the private information of the plaintiff when the defendant only knows that v is uniformly distributed in the range of [0, 1].

We also keep the notations about court errors. Q_1 is the type Ⅰ error such that the plaintiff prevails when he should not, and Q_2 is the type Ⅱ error such that the plaintiff does not prevail when he should.

As in the case of continuum defendants, we will focus on the hybrid equilibrium where those with low v choose litigation and those with high v choose settlement. A hybrid equilibrium, if it exists, must be such that the plaintiffs with low v reveal that they are low v types by choosing litigation. This course is not imitated by the high v plaintiffs.

Proposition 6 : In a signaling lawsuit model where the plaintiff has private information about his own type, there exists an equilibrium such that :

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27) A similar prediction is made in Shavell (1996).
28) The details about the equilibrium and comparative statics can be provided from the authors upon request.

- plaintiff's strategy : l for $v \leq v^*$, and s for $v \geq v^*$,
- defendant's belief : if l, then $v \leq v^*$, and if s, then $v \geq v^*$,
- defendant's strategy : s,

where $v^* = 1 - \dfrac{C_d + C_p}{J[1 - Q_1 - Q_2]}$ is the marginal plaintiff type who is indifferent between s and l.

Proposition 7 : When the plaintiff has private information, the adjudication rate T, the potential win rate P_1, and the actual win rate P_2 are as follows :

$$T = v^*. \qquad P_1 = \int_0^1 [vQ_1 + (1-v)(1-Q_2)]dv = \frac{Q_1 + (1-Q_2)}{2} \qquad (14)$$

$$P_2 = \int_0^{v^*} [vQ_1 + (1-v)(1-Q_2)]\frac{1}{v^*}\,dv = (1-Q_2) - (1-Q_1-Q_2)v^*/2$$

$$= \frac{Q_1 + (1-Q_2)}{2} + \frac{C_d + C_p}{2J} \qquad (15)$$

What predictions can we make about the adjudication rate and the plaintiff's win rate? Since we already have some understanding about the selection mechanism for litigation, we can easily derive the following observations for the case in which the plaintiff has private information.

Proposition 8 : When the plaintiff has private information,
(i) T increases with the size of the stake, J, and decreases with the litigation cost, C, and the court error, Q,
(ii) $P_2 > P_1$,
(iii) P_2 is positively related to C_d, C_p, and Q_1, and negatively related to J and Q_2,
(iv) P_2 and T move in the same direction when the change is initiated by Q_2, but move in the opposite direction when the change is initiated by C_d, C_p, J, and/or Q_1.

The case in which the plaintiff has private information renders the same predictions about the adjudication rate, but the exact opposite predictions about the plaintiff's win rate and about the relationship between the two indices.

<Table 1> Defendant's vs. Plaintiff's Private Information

Defendant's Private Information	Plaintiff's Private Information
ⅰ) $T\uparrow$ as $J\uparrow$, $C\downarrow$, $Q\downarrow$	$T\uparrow$ as $J\uparrow$, $C\downarrow$, $Q\downarrow$
ⅱ) $P_1 > P_2$	$P_1 < P_2$
ⅲ) $P_2\uparrow$ as $J\uparrow$, $C\downarrow$, $Q_1\downarrow$, $Q_2\uparrow$	$P_2\uparrow$ as $J\downarrow$, $C\uparrow$, $Q_1\uparrow$, $Q_2\downarrow$
ⅳ) $P_2\uparrow$ as $T\downarrow$ if Q_2 changes ;	$P_2\uparrow$ as $T\downarrow$ if J, C, Q_1 change ;
$P_2\uparrow$ as $T\uparrow$ if J, C, Q_1 change	$P_2\uparrow$ as $T\uparrow$ if Q_2 changes

<Table 1> summarizes them. The final observation is that the plaintiff's win rate might well be over 50%, if we assume either low court errors, or the equal chance of the two types of court errors.

Ⅵ. Concluding Remarks

In this paper we have attempted to provide a more comprehensive analysis regarding the AI nature of a legal dispute in order to initiate active empirical studies in full force.

Firstly, we explicitly solved a signaling game between the informed and the uninformed, both for the defendant and the plaintiff, and found out the critical characteristics of the sequential equilibrium. We hope this will help in understanding the signaling nature of the lawsuit game under AI. Secondly, after separating settlement process from the litigation/settlement selection process, we introduced a more general bargaining process rather than the extreme 'take-it-or-leave-it' method, which, we posit, has made the analysis more robust against any arbitrary assumption about who moves first in a settlement/litigation selection game. Finally, based on the detailed equilibrium analysis, we were able to provide extensive comparative

static predictions about the trial rate, plaintiff's win rate, and the relationship between these two key indices. This will hopefully invoke many interesting empirical works for the AI theory.

We conclude the paper with two additional comments on the implications of our work on the divergent expectations theory, which are also believed to be relevant in undertaking empirical tasks in the future.

First, AI theory can be reconciled with the divergent expectations theory. Two major propositions of the divergent expectations theory might be the non-random selection of the litigated cases, and the famous 50% win rate hypothesis. Our analysis, just like all other AI models, is in accord with the non-random selection proposition. The underlying reasons for, or the characteristics of, the non-randomly selected samples in litigation might be significantly different between the divergent expectations theory and ours. Nonetheless, such differences are by no means impasses, but rather more viable motivations for further studies.

Second, the 50% win rate hypothesis of the divergent expectations theory has relevance to our model in two ways. In terms of the theoretic arena, AI theory justifies the hypothesis under certain conditions as discussed in Section VI. Furthermore, in terms of empirical observation, AI studies can also be pertinent to the 50% win rate with data aggregation increasingly pursued. To put it differently, if we assume that informational asymmetries between defendants and plaintiffs are randomly (symmetrically) distributed among all different types of legal cases, the plaintiff's win rate can be predicted to converge to 50% as the aggregation level increases. The empirical validation of this last claim itself will be very intriguing, or obligatory at the least.

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[Abstract]

비대칭정보 하에서의 소송절차 : 향후 실증분석의 토대를 마련하기 위한 연구

김일중 · 김재홍

이 논문의 목적은 향후 본격적인 실증분석의 토대를 마련하기 위한 민사소송절차 전반을 포함하는 모형을 다음과 같이 제시하는데 있다. 첫째, 비대칭정보 하에서 '소송 대 화해' 선택과정에 함축되어 있는 신호의 속성에 관하여 종합적으로 검토한다. 구체적으로, 분석의 공고성을 위해 소송절차를 실제 화해과정과 분리시킨다. 그리고 화해과정에서는 기존이론에서 자주 사용되던 소위 'take-it-or-leave-it' 가정보다 더욱 중립적인 방식을 적용한다. 둘째, 정보우위를 가진 쪽에서 신호기능이 시작되고, 다양한 실정법에 따라 정보비대칭의 형태는 상이할 수 있으므로, 피고 및 원고의 사적 정보우위 경우를 별도로 분석하여 비교한다. 셋째, 이상 신호게임의 균형을 분석한 후, 향후 실증분석을 위해 소송절차와 관련된 주요 변수들에 대한 비교정태분석 결과를 도출한다. 이 과정에서 화해율, 원고승소율 등의 변수들 자체에 대한 분석은 물론, 그간 법경제학에서 오랜 기간 논의 및 논쟁되어 왔던 '소송의 퍼즐'이나 '50% 승소율 가설' 등에 관한 나름대로의 설명 및 평가를 시도한다.

핵심용어 : 비대칭정보, 신호, 소송, 화해, 원고승소율