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Adversarial Bias and Court-Appointed Experts in Litigation

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Abstract

Adversarial bias is witness bias that arises because litigants retain experts to advance their causes. We provide a simple framework where the level of adversarial bias is endogenously determined in a litigation process. Using this model, we study the effect of using a court-appointed expert on the level of adversarial bias and the average error rates, and find an interesting trade-off: although the judge can reduce the number of mistakes at trial by consulting a court-appointed expert, litigants choose to hire biased experts more frequently in response, which increases the level of adversarial bias, thereby inducing evidence distortion more often.

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Ⅰ. Introduction

The number of legal disputes involving complex technological issues has been increasing lately as vividly shown by the lawsuit between two IT giants, Apple and Samsung.1) In such cases, judges'

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1) Apple initiated a litigation against Samsung in patent infringement suits in

ability to efficiently handle the matter has been called into question. Although equipping fact-finders with scientific knowledge could help alleviate the problem, many legal scholars and practitioners express concerns about the effectiveness of such education policies. Instead, they propose a system that could assist judges in their decision making, which calls for using a court-appointed expert.2)

An immediate benefit of employing such a public expert at trial, as argued by proponents, is the volume of information. As a judge can obtain one more piece of information through a court-appointed expert, in addition to information provided by litigants' experts, she can make a more informed decision at trial. Moreover, whereas the experts hired by litigants often engage in evidence distortion, suppressing unfavorable information for their clients, a court-appointed expert is usually regarded as impartial, as long as he has no stake in the case, providing truthful information to the judge.

However, there could be an adverse effect of a court-appointed expert, which could outweigh the benefits suggested by proponents. In particular, the presence of such a public expert could influence litigants' behaviors, which has not been addressed in the literature. Thus, in this paper, we aim to study the ways in which litigants respond to the judge's usage of a court-appointed expert. Our focus especially rests on the degree of adversarial bias, which has been criticized by academic scholars as well as lay people.3)

2011, and eventually both parties agreed to settle the matter in 2018.

2) For example, see Runkle (2001), who discusses the structure of the Court Appointed Scientific Experts Program created by the American Association for the Advancement of Science to help judges obtain independent experts. Also see Hillman (2002), Adrogue and Ratliff (2003), and Kaplan (2006), among others. Based on his experience as Judge Richard Posner's court-appointed economic expert, Sidak (2013) argues for court-appointed, neutral economic experts.

3) For a discussion on adversarial bias, see, e.g., Bernstein (2008). See also *Olympia Equip. Leasing Co. v. Western Union Telegraph Co.*, 797 F.2d 370 (7th Cir. 1986) ("It is thus one more illustration of the old problem of expert witnesses

Bernstein (2008) defines adversarial bias as "witness bias that arises because a party to an adversarial proceeding retains experts to advance its cause." Thus, if the degree of adversarial bias in a litigant-expert relationship increases, the expert is more likely to engage in evidence distortion practices, suppressing unfavorable information for his client. What is the effect of a court-appointed expert on adversarial bias in the courtrooms? To investigate this issue, following Kim (2016), we provide a simple framework in which the level of adversarial bias is endogenously determined in equilibrium. Using this framework, we study two situations, one with a court-appointed expert and the other without such a public expert, and find an interesting trade-off: although the judge can reduce the number of decision mistakes by consulting a court-appointed expert, litigants respond by hiring a hired-gun, who is willing to distort evidence for his client, more frequently in equilibrium, thereby generating a larger volume of evidence distortion.

To the best of our knowledge, the relationship between the presence of a court-appointed expert and the degree of adversarial bias has not been addressed in the literature. The law and economics literature on the effect of a court-appointed expert is thin. Kim and Koh (forthcoming) provide a model in which they studied the benefits and costs of utilizing a court-appointed expert in adversarial litigations. The degree of adversarial bias has not been studied in the literature except by Kim (2016), who studied a formal framework in which litigants interact with a judge at trial. These papers study

who are "often the mere paid advocates or partisans of those who employ and pay them, as much so as the attorneys who conduct the suit. There is hardly anything, not palpably absurd on its face that cannot now be proved by some so-called 'experts.'""); *E.I. du Pont de Nemours and Co., Inc. v. Robinson*, 923 S.W.2d 549 (Tex. 1995) ("[T]here are some experts who 'are more than willing to proffer opinions of dubious value for the proper fee.'").

litigation situations within a disclosure-game framework in which the informed agents may choose to hide unfavorable evidence but cannot fabricate favorable evidence for their causes.

Another strand of literature investigating the interaction between the informed and uninformed agents utilizes cheap-talk games. First developed by Crawford and Sobel (1982), a cheap-talk game provides an environment in which an informed agent (called "sender") can fabricate favorable evidence with zero cost.[4] Crawford and Sobel characterize the equilibrium of a class of cheap-talk games and show that the equilibrium features partial separation: the type space can be partitioned with all types in the same partition sending the same message. Extending their research to an environment with multiple senders, Battaglini (2002) show that full separation is possible if there are more than one informed agent (called, "fully-revealing equilibrium"), and Battaglini (2004) further extends the model to an environment in which the biased agents do not possess perfect information about the true state. Although these papers are similar to ours in that they study the interaction between a decision maker and multiple informants, they do not investigate the effect of a neutral agent on the behavior of biased experts. In addition, the disclosure models we adopt assume commitment power of an agent in sending signals, whereas an agent in cheap-talk models is free to send any signal. While these papers investigate a static setting, Herresthal (2018) and Min (2018) study a dynamic interaction between a decision maker and an agent who is "experimenter."

The rest of the paper is organized as follows. Section Ⅱ provides a theoretical framework in which we study the relationship between the presence of a court-appointed expert and the level of adversarial bias. Section Ⅲ finds an equilibrium of the model and studies its properties, and Section Ⅳ studies the effect of using a

4) For a survey on cheap talk models, see Sobel (2013).

court-appointed expert. Finally, Section Ⅴ concludes.

Ⅱ. Model

Consider a situation in which a defendant is accused of allegedly having inflicted harm on a plaintiff, and a judge is required to adjudicate the matter at trial. We formalize this situation as a dynamic game with incomplete information in which the uninformed judge wants to deliver a correct decision, i.e., holding the defendant liable if the accusation turns out to be true ($t=l$) and dismissing the case otherwise ($t=h$), where t represents the true state of the world. Without loss of generality, we assume the following:

$$\mu = P(t=h) > \frac{1}{2}$$

where μ represents the prior probability about the true state. One can easily derive results for $\mu < 1/2$ because the situation is symmetric. If $\mu = 1/2$, the judge believes that the defendant is equally likely to be liable or not liable. In such a case, the "presumption of innocence" requires the judge to rule in favor of the defendant, in which case the analysis is identical to that for $\mu > 1/2$.[5)]

In contrast to the judge's preference, both litigants want to prevail at trial. To succinctly capture these preferences, we assume that a litigant obtains payoff 1 if he prevails at trial and 0 otherwise, and that the judge obtains payoff 1 if her verdict is correct and 0

5) The presumption of innocence is a legal principle that one is presumed innocent until proven guilty in a court of law. Quintard-Morenas (2010) notes "… today no one would seriously deny the role played by the presumption of innocence in civil law jurisdictions (p.108)."

otherwise. The judge's payoff structure implies that she rules in favor of the defendant if $t = h$ is more likely than $t = l$ and vice versa.

As the judge is uninformed about the true state, a crucial element at trial is the evidence presented by the litigants. To capture this point, we assume that there exists a piece of evidence, $x \in \{H, L\}$, whose realization depends on the true state:

$$P(x = H \mid t = h) = P(x = L \mid t = l) = p > \frac{1}{2}.$$

This piece of evidence provides valuable information about the true state because the "high" signal (i.e., $x = H$) is more likely under the "high" state (i.e., $t = h$), and vice versa. To exclude the cases in which this evidence is not influential, and therefore meaningless, for the judge's decision making, we assume $\mu < p$. Thus, if the judge were to eventually observe $x = H$, she would rule in favor of the defendant because, using Bayes' rule based on $x = H$, the judge believes that $t = h$ is more likely than $t = l$. Similarly, if $x = L$ were eventually presented to the judge, she would rule in favor of the plaintiff.

To collect evidence and present it to the judge at trial, a litigant hires an expert who observes x. As experts are not perfectly informed about the truth in reality, we assume that the defendant's expert observes x with probability $e_D \in (0, 1)$ and the plaintiff's expert $e_P \in (0, 1)$.[6]

To investigate the endogenous adversarial bias exhibited by the litigant-expert relationship, we consider two types of expert: biased and unbiased. Whereas an unbiased expert truthfully reveals his

6) Thus, there are four possibilities: (*i*) both experts do not observe x, (*ii-iii*) only one of the experts observes x, and (*iv*) both experts observe the same piece of evidence x. This is a standard modeling approach in the literature; see, e.g., Shin (1998), Demougin and Fluet (2008), and Kim (2014, 2016).

evidence (if he observed) to the judge at trial, a biased expert engages in evidence distortion. Thus, if a litigant is more likely to hire a biased expert, we say that the degree of adversarial bias increases in the litigant-expert relationship.

Definition 1. *The degree of adversarial bias is said to increase if a litigant is more likely to hire a biased expert.*

More precisely, a biased expert reveals favorable evidence for his client and suppresses unfavorable evidence. This means that the defendant's biased expert reveals (if he observed) $x = H$ but does not reveal $x = L$, pretending that he could not observe evidence. Likewise, the biased expert hired by the plaintiff reveals (if he observed) $x = L$ but suppresses $x = H$. If an expert, either biased or unbiased, could not observe evidence, he presents nothing to the judge. Thus, the information technology assumed in our model features *verifiable information* following, e.g., Milgrom (1981) and Milgrom and Roberts (1986).

How does the equilibrium adversarial bias respond to the existence of a court-appointed expert? To study this issue, we consider two games as follows:

- Game 1: There exists a court-appointed expert who always observes evidence $y \in \{H, L\}$ and truthfully reveals it to the judge, where

$$P(y = H \mid t = h) = P(y = L \mid t = l) = p > \frac{1}{2}$$

  and y and x are *i.i.d.* conditional on t.
- Game 2: There exists no court-appointed expert.

In Game 1, a court-appointed expert assists the judge in her decision making by providing an additional piece of evidence y, which is equally valuable as x in terms of information about the true state. Thus, two pieces of evidence can be available for the judge's decision making in Game 1. In contrast, there is no such public expert in Game 2, and therefore the only available evidence at trial is that provided by litigants' experts, i.e., x. Legal scholars and practitioners who argue for a court-appointed expert usually focus on the total number of available evidence: as more information is presented, the judge can deliver a more accurate verdict in Game 1, which strengthens the argument for utilizing a court-appointed expert for judicial decision making. However, the presence of a court-appointed expert may influence the litigant's incentive to hire an expert, and thereby affecting the equilibrium adversarial bias. In particular, if the equilibrium adversarial bias increases, inducing a litigant to hire a biased expert more often in equilibrium, evidence distortion would occur more frequently, which would weaken the case for a court-appointed expert. Thus, our main focus in this paper is to analyze and compare these two games and investigate the relationship between the equilibrium adversarial bias and the presence of a court-appointed expert.

To summarize, the timeline of the model is as follows:

(1) Litigants simultaneously choose whether to hire a biased or an unbiased expert. The judge cannot observe the type of the expert hired by a litigant.

(2) Both experts simultaneously report their observations to the judge. In Game 1, the court-appointed expert also reports his observation to the judge.

(3) Forming a belief about the types of litigants' experts, the judge makes a decision based on the reports from all experts.

Observe that the judge should form a belief about the types of litigants' experts prior to her decision making because she cannot directly observe a litigant's choice of expert. In our equilibrium analysis, such a belief held by the judge should be consistent with the actual types of litigants' experts in equilibrium. In the next section, we find the equilibrium of our model and study its properties. The equilibrium concept used in this paper is perfect Bayesian equilibrium, which is simply referred to as equilibrium.

Ⅲ. Equilibrium Analysis

We first study Game 1 in which a court-appointed expert assists the judge in her decision making at trial. Using backward induction, we find the judge's strategy at trial and then proceed to investigate litigants' behaviors. Finally, we find the equilibrium and study the effect of a court-appointed expert on the equilibrium adversarial bias.

1. Judge's Strategy

At trial, there are six possible events that the judge may face: HH, HL, LH, LL, ϕH, and ϕL where the first element of each event indicates the evidence presented by litigants' experts and the second element represents the evidence supplied by the court-appointed expert. For instance, the first event HH refers to a situation in which $x = H$ is supplied by litigants' experts and $y = H$ is supplied by the court-appointed expert. Here, $x = H$ might have been revealed by the defendant's unbiased/biased expert or the plaintiff's unbiased expert[7] or both. The second through fourth events can be similarly

7) It must be an unbiased expert because a biased expert suppresses unfavorable evidence for his client.

understood. In the fifth and sixth events, the first element ϕ represents the situation in which no evidence is revealed by any of the litigants' experts. This situation may occur if (*i*) both experts could not observe evidence or (*ii*) one expert could not observe evidence and the other (biased) expert suppressed evidence after observing it. For instance, if the defendant's expert could not observe evidence and the plaintiff's biased expert observed $x = H$, the former expert reports nothing and the latter expert also reports nothing by suppressing unfavorable evidence for his client.

The judge's decision at the first through fourth events are straightforward. In the first event, HH, both pieces of evidence strongly sway the judge's posterior belief toward $t = h$ (i.e., the posterior belief is higher than 1/2), thereby inducing the judge to rule in favor of the defendant. In the second event, HL, both pieces of evidence cancel each other because they are *i.i.d.* signals conditional on the true state. Thus, the judge's posterior belief is equal to her prior belief, $\mu > 1/2$, thereby inducing her to rule in favor of the defendant. Likewise, the defendant wins in LH and the plaintiff wins in LL.

The judge's decisions in the fourth and fifth events are less clear. The judge's posterior beliefs in these events can be calculated as follows:

$$\begin{aligned}
\hat{\mu}(\phi H) &= P(t = h \mid \phi H) \\
&= \frac{P(\phi H | t = h) P(t = h)}{P(\phi H | t = h) P(t = h) + P(\phi H | t = l) P(t = l)} \\
&= \frac{\mu p q_h}{\mu p q_h + (1 - \mu)(1 - p) q_l} \\
\hat{\mu}(\phi L) &= P(t = h \mid \phi L) \\
&= \frac{P(\phi L | t = h) P(t = h)}{P(\phi L | t = h) P(t = h) + P(\phi L | t = l) P(t = l)}
\end{aligned}$$

$$= \frac{\mu(1-p)q_h}{\mu(1-p)q_h + (1-\mu)pq_l}$$

$$q_h = (1-e_D)(1-e_P) + e_D(1-e_P)(1-p)\psi_D + (1-e_D)e_P p\psi_P$$

$$q_l = (1-e_D)(1-e_P) + e_D(1-e_P)p\psi_D + (1-e_D)e_P(1-p)\psi_P$$

where $\hat{\mu}(\cdot)$ indicates the judge's posterior under the event and $\psi_P(\psi_D)$ is the probability that the plaintiff (the defendant) chooses a biased expert.

We can show that the judge's optimal decision in ϕH is to rule in favor of the defendant. To see this, observe that there are three possibilities leading to ϕ: (*i*) both litigants' experts could not observe evidence, (*ii*) the defendant's expert could not observe evidence and the plaintiff's biased expert suppressed $x = H$ after observing it, and (*iii*) the defendant's biased expert suppressed $x = L$ after observing it and the plaintiff's expert could not observe evidence. For (*i*), the judge obtains no evidence at all from ϕ, and therefore she makes a decision solely based on $y = H$. Therefore, she rules in favor of the defendant. For (*ii*), despite the fact that no expert presents evidence, the judge can still obtain some evidence from ϕ because $x = H$ had been suppressed if this were the case. Therefore, if (*ii*) were true, the judge would have two pieces of evidence, $x = H$ and $y = H$, thereby ruling in favor of the defendant. For (*iii*), $x = L$ had been suppressed if this were the case. Then, the judge would have two conflicting pieces of evidence, $x = L$ and $y = H$. As these cancel each other, the judge rules in favor of the defendant following her prior belief. Because all three possibilities lead to the defendant's winning, the judge's optimal decision in ϕH is to rule in favor of the defendant.

Finally, the judge's decision in ϕL depends on her belief about the types of litigants' experts. For instance, suppose the judge believes that the defendant's expert is biased (i.e., $\psi_D = 1$) and the plaintiff's expert is unbiased (i.e., $\psi_P = 0$). Then two pieces of evidence exist, one hidden, in $\phi L: y = L$ is presented by the court-appointed expert, and $x = L$ might have been observed but suppressed by the defendant's biased expert. As these two pieces of evidence against the defendant are sufficient to lower the judge's posterior belief below 1/2, the judge rules in favor of the plaintiff. More precisely, in this case, we have

$$q_h = (1 - e_D)(1 - e_P) + e_D(1 - e_P)(1 - p)$$
$$q_l = (1 - e_D)(1 - e_P) + e_D(1 - e_P)p$$

where we have $q_h < q_l$ because $p > 1/2$. Also, observe that $\mu(1-p) < (1-\mu)p$ because $\mu < p$. Therefore, we have

$$\mu(1-p)q_h < (1-\mu)pq_l$$

which leads to $\hat{\mu}(\phi L) < 1/2$, thereby inducing the judge to rule in favor of the plaintiff.

On the other hand, suppose the judge believes that the defendant's expert is unbiased (i.e., $\psi_D = 0$) and the plaintiff's expert is biased (i.e., $\psi_P = 1$). Then, two pieces of evidence exist in $\phi L: y = L$ is presented by the court-appointed expert, and $x = H$ might have been observed but suppressed by the plaintiff's biased expert. If e_P is sufficiently large, the judge believes that the plaintiff's biased expert is highly likely to have observed and suppressed $x = H$, in which case these two pieces of evidence almost cancel each other. Thus, if the judge's prior belief is not very close to 1/2, the judge's posterior belief will be above the threshold 1/2, thereby inducing the judge to rule in favor of the defendant. To see this more clearly, suppose $e_P = 1$. Then, we have

$$q_h = (1 - e_D)p$$
$$q_l = (1 - e_D)(1 - p)$$

Therefore, we have $\hat{\mu}(\phi L) > 1/2$ if

$$\mu(1-p)q_h > (1-\mu)pq_l$$
$$\Leftrightarrow \mu(1-p)(1-e_D)p > (1-\mu)p(1-e_D)(1-p)$$
$$\Leftrightarrow \mu(1-e_D) > (1-\mu)(1-e_D)$$

where the last inequality is true because $\mu > 1/2$. Thus, by continuity, if $e_P \approx 1$, we have

$$\mu(1-p)q_h > (1-\mu)pq_l$$

and therefore we have $\hat{\mu}(\phi L) > 1/2$.

To be more precise, we introduce a few definitions:

Definition 2. *An event is called ambiguous if the judge's decision in the event depends on her belief about the types of expert.*

Definition 3. *If the judge rules in favor of the defendant (the plaintiff) in the ambiguous event, the burden of proof is said to be on the plaintiff (the defendant).*

According to the first definition, the event ϕL is an ambiguous event. Then, according to the second definition, the burden of proof is either on the defendant or the plaintiff, depending on the judge's decision in ϕL. This discussion reveals that there are two types of equilibrium in our model, depending on which litigant bears the burden of proof in equilibrium. In the following analysis, we focus on an equilibrium in which the burden of proof is on the plaintiff, and study its property. The analysis of the other type of equilibrium, in which the defendant bears the burden of proof, follows the exactly same reasoning, so we omit it to present our main argument succinctly. Then, we are ready to determine the judge's strategy as follows:

Proposition 1. *The judge rules in favor of the defendant in HH, HL, LH, ϕH, and ϕL, and in favor of the plaintiff in LL.*

2. Litigants' Strategies

Anticipating the judge's decision at trial, litigants simultaneously choose the type of expert in the first period. First, we can calculate the defendant's expected payoff from hiring a biased expert, denoted by π_D^b, and that from an unbiased expert, denoted by π_D^u, as follows:

$$\begin{aligned}
\pi_D^b &= 1 - e_P P(x=L)P(y=L) \\
&= 1 - e_P((1-p)\mu + p(1-\mu))^2 \\
\pi_D^u &= 1 - (1-(1-e_D)(1-e_P))P(x=L)P(y=L) \\
&= 1 - (e_P + e_D(1-e_P))((1-p)\mu + p(1-\mu))^2
\end{aligned}$$

Since $e_D(1-e_P) > 0$, we have $\pi_D^b > \pi_D^u$. Thus, the defendant strictly prefers a biased expert to an unbiased expert in the first period, and the equilibrium strategy of the defendant should be $\psi_D^* = 1$. This is intuitive because a biased expert leads to the defendant's winning event more often. If the defendant's expert, either biased or unbiased, could not observe evidence, he reports nothing, leading to the same outcome. If he observed $x = H$, it again leads to the same outcome because the defendant's expert, regardless of his type, reveals favorable evidence for his client. However, the observation of $x=L$ leads to different outcomes depending on the expert type: (supposing $y=L$) an unbiased expert reveals $x=L$ leading to LL (lose) but a biased expert reports nothing possibly leading to ϕL (win).

Second, turning to the plaintiff's choice, we find:

$$\pi_P^b = (e_P + (1-e_P)e_D(1-\psi_D))P(x=L)P(y=L)$$
$$\pi_P^u = (e_P + (1-e_P)e_D(1-\psi_D))P(x=L)P(y=L)$$

which show that the plaintiff's expected payoffs are the same regardless of the type of expert. Therefore, the plaintiff is indifferent between a biased expert and an unbiased expert, and the equilibrium strategy of the plaintiff can be any number between 0 and 1, i.e., $\psi_P^* \in [0,1]$. This finding may seem odd; how come a biased hired-gun, who is willing to distort evidence for the client, is not able to increase the client's expected payoff? To understand the logic, observe that the necessary condition for the plaintiff's winning is the presentation of $x=L$ at trial. As this piece of evidence is favorable for his client, the plaintiff's expert, either biased or unbiased, is willing to reveal it at trial as long as he observes it. We emphasize that the only way that an expert reveals $x=L$ at trial is through his observation of $x=L$; in particular, an expert cannot fabricate evidence (e.g., presenting $x=L$ is not possible when observing $x=H$) because information is verifiable. Then, both types of expert have an equal chance to present $x=L$ at trial (i.e., by observing it) and are therefore equally valuable for the plaintiff.

Proposition 2. *The defendant strictly prefers a biased expert to an unbiased expert* $(\psi_D^*=1)$, *and the plaintiff is indifferent between the two types of expert* $(\psi_P^* \in [0,1])$.

3. Equilibrium

In finding the judge's and litigants' strategies, we supposed that the burden of proof rests on the plaintiff. Then, to find an equilibrium, these strategies must be consistent with the burden of proof. In other words, the judge's belief about the types of expert must be correct in equilibrium. More precisely, using the litigants' strategies we found in Proposition 2, the existence of equilibrium requires the following inequality:

$$
\begin{aligned}
&\hat{\mu}(\phi L) = P(t=h \mid \phi L) \\
&= \frac{P(\phi L \mid t=h)P(t=h)}{P(\phi L \mid t=h)P(t=h) + P(\phi L \mid t=l)P(t=l)} \\
&= \frac{\mu(1-p)q_h^*}{\mu(1-p)q_h^* + (1-\mu)pq_l^*} \\
&\geq \frac{1}{2} \\
&q_h^* = (1-e_D)(1-e_P) + e_D(1-e_P)(1-p) + (1-e_D)e_P p \psi_P^* \\
&q_l^* = (1-e_D)(1-e_P) + e_D(1-e_P)p + (1-e_D)e_P(1-p)\psi_P^*
\end{aligned}
$$

Rearranging the inequality above, we obtain the following equilibrium condition:

$$
\psi_P^* \geq \frac{p-\mu+((1-\mu)p^2-\mu(1-p)^2)\dfrac{e_D}{1-e_D}}{p(1-p)(2\mu-1)\dfrac{e_P}{1-e_P}} \equiv A > 0 \qquad (1)
$$

which says that to support the equilibrium, the plaintiff must hire a biased expert sufficiently often in equilibrium. The intuition behind this condition is the following. If the plaintiff hires a biased expert "infrequently" in equilibrium, the judge believes (whose equilibrium belief must be correct) that the evidence distortion (if any) in the ambiguous event (i.e., ϕL) is coming from the defendant's side. This reasoning induces the judge to believe that the possibly hidden evidence is highly likely to be $x = L$. Because this lowers the judge's posterior probability, increasing the chance of the plaintiff's winning in ϕL, it becomes harder to satisfy the equilibrium condition above. This intuition explains the reason why ψ_P^* must be sufficiently large to guarantee the existence of equilibrium.

Theorem 1. If $A \leq 1$, there exists an equilibrium in which the defendant hires a biased expert with probability $\psi_D^* = 1$, the plaintiff hires a biased expert with probability $\psi_P^* \geq A$, and the judge rules in favor of the plaintiff only when $x = L$ and $y = L$ are presented at trial.

As can be seen from the expression above, the threshold A depends on many parameters of our model. To obtain more information about this threshold, consider a situation in which μ gets closer to p. Then, in the limit, the equilibrium condition in (1) becomes:

$$\psi_P^* \geq \frac{\dfrac{e_D}{1 - e_D}}{\dfrac{e_p}{1 - e_P}}$$

which shows that the relative expertise matters for our equilibrium condition. If we further assume symmetry between the two experts, condition (1) becomes:

$$\psi_P^* \geq 1$$

which shows that the plaintiff also hires a biased expert for sure in equilibrium.

Also, consider a situation in which the relative expertise between the two parties is quite large. In particular, if e_D gets closer to 1 or e_P gets closer to 0, it turns out that the threshold A increases to infinity. Thus, because ψ_P^* cannot exceed 1, there exists no equilibrium in which the burden of proof rests on the plaintiff. The intuition is the following. If the defendant's expert is more likely to have observed evidence, the judge believes that evidence distortion in the ambiguous event ϕL is more likely coming from the defendant's side. This belief formation reduces the judge's posterior belief in ϕL and makes it harder to place the burden of proof on the plaintiff in equilibrium. In contrast, as the plaintiff's expert becomes better informed than the defendant's expert, the threshold A decreases toward 0. Therefore, it is possible that the plaintiff almost always hires an unbiased expert in equilibrium. The same intuition as above applies here as well.

Ⅳ. The Effect of a Court-Appointed Expert

We compare Game 1 and Game 2 in this section and investigate the effect of a court-appointed expert in our model. We found the equilibrium of Game 1 in Theorem 1. In Game 2, in which there is no court-appointed expert, there are three events at trial: (*i*) $x=H$ is presented, (*ii*) $x=L$ is presented, and (*iii*) no evidence is presented, denoted by ϕ. It is straightforward to verify that the judge rules in favor of the defendant in the first event, and in favor of the plaintiff in the second event. The third event, ϕ, is an ambiguous event since the judge's belief about the type of expert is crucial for her decision making.

As before, we restrict our attention to the situation in which the burden of proof rests on the plaintiff. That is, we focus on the equilibrium in which the judge rules in favor of the defendant in the ambiguous event ϕ in equilibrium. Following the logic from the previous analysis, it is easy to show that defendant strictly prefers a biased expert to an unbiased expert ($\Psi_D^* = 1$) and the plaintiff is indifferent between the two types of expert ($\Psi_P^* \in [0,1]$) where $\Psi_D^*(\Psi_P^*)$ is the equilibrium probability that the defendant (the plaintiff) hires a biased expert in Game 2. Thus, with the burden of proof on the plaintiff, the equilibrium requires the following inequality:

$$\hat{\mu}(\phi) = \frac{\mu r_h^*}{\mu r_h^* + (1-\mu) r_l^*} \geq \frac{1}{2}$$

$$r_h^* = (1-e_D)(1-e_P) + e_D(1-e_P)(1-p) + (1-e_D)e_P p \Psi_P^*$$

$$r_l^* = (1-e_D)(1-e_P) + e_D(1-e_P)p + (1-e_D)e_P(1-p)\Psi_P^*$$

Rearranging the inequality above, we obtain the following equilibrium condition:

$$\Psi_P^* \geq \frac{(1-2\mu) + (p-\mu)\dfrac{e_D}{1-e_D}}{(\mu-(1-p))\dfrac{e_P}{1-e_P}} \equiv B \tag{2}$$

which leads us to the next theorem.

Theorem 2. If $B \leq 1$, there exists an equilibrium in which the defendant hires a biased expert with probability $\Psi_D^* = 1$, the plaintiff hires a biased expert with probability $\Psi_P^* \geq B$, and the judge rules in favor of the plaintiff only when $x = L$ is presented at trial.

As before, in the game with no court-appointed expert, the plaintiff must hire a biased expert sufficiently often to sustain the equilibrium with the burden of proof on the plaintiff. Comparing the equilibrium conditions (1) and (2), we obtain the following result:

Proposition 3. *In the game where the judge appoints a court-appointed expert, there can exist an equilibrium in which the plaintiff is more likely to hire a biased expert than he/she would otherwise: that is,* $A > B$.

Proof. Since $p - \mu > 1 - 2\mu$ and $(1-\mu)p^2 - \mu(1-p)^2 > p - \mu$, the numerator of A is greater than that of B. Moreover, since $p(1-p)(2\mu - 1) < \mu - (1-p)$, the denominator of B is greater than that of A. Therefore, we have $A > B$. □

As these thresholds indicate the lower bound for the equilibrium probability of the plaintiff's hiring a biased expert, Proposition 3 tells us that there is a more restrictive equilibrium condition on the plaintiff's behavior in Game 1 than in Game 2. In other words, the plaintiff employs a hired-gun more frequently in equilibrium in response to the court's usage of a court-appointed expert. Thus, our result suggests that despite many benefits possibly provided by a court-appointed expert, such a public expert system could lead to more serious adversarial bias, generating the instances of evidence distortion more frequently.

Next, we study whether society can indeed reduce the number of judicial decision making mistakes by using a court-appointed expert, as claimed by proponents for such a public expert system. For this purpose, we define two types of judicial mistakes as follows:

$$\alpha = P(\text{P wins} \mid t = h)$$
$$\beta = P(\text{D wins} \mid t = l)$$

where α represents type I errors and β type II errors. More precisely, α is the probability that the plaintiff wins at trial despite $t = h$, and β is the probability that the defendant wins at trial despite $t = l$. Using these two types of errors, we define the average error as follows:

$$E = P(t = h)P(\text{P wins} \mid t = h) + P(t = l)P(\text{D wins} \mid t = l)$$
$$= \mu\alpha + (1 - \mu)\beta$$

Using these expressions, we can calculate the average error in Game 1 in which a court-appointed expert is present as follows:

$$\alpha^1 = P(\text{P wins} \mid t = h)$$
$$= P(LL \mid t = h)$$
$$= (1 - p)e_P(1 - p)$$
$$= (1 - p)^2 e_P$$
$$\beta^1 = P(\text{D wins} \mid t = l)$$
$$= 1 - P(\text{P wins} \mid t = l)$$
$$= 1 - p^2 e_P$$
$$E^1 = \mu(1 - p)^2 e_P + (1 - \mu)(1 - p^2 e_P)$$

Similarly, the average error in Game 2 in which no court-appointed expert is present can be calculated as follows:

$$\alpha^2 = P(\text{P wins} \mid t = h)$$
$$= P(L \mid t = h)$$
$$= (1 - p)e_P$$

$$\beta^2 = P(\text{D wins} \mid t = l)$$
$$= 1 - P(\text{P wins} \mid t = l)$$
$$= 1 - pe_P$$
$$E^2 = \mu(1-p)e_P + (1-\mu)(1-pe_P)$$

A simple algebra provides us with the following ranking among these average errors:

Proposition 4. *We have* $E^1 < E^2$.

This proposition shows the benefit of a court-appointed expert as claimed by proponents: it reduces the average error rate. Thus, although adversarial bias increases in response to the introduction of a court-appointed expert, generating evidence distortion more frequently, one more piece of information provided by the court-appointed expert outweighs the negative information effect, thereby helping the judge make fewer mistakes in decision making. These findings provide a policymaker with a trade-off. On the one hand, the judge can make a more informed decision at trial by consulting a court-appointed expert. On the other hand, litigants may change their behaviors in response to such a policy by resorting to a biased expert more frequently, thereby increasing the level of adversarial bias.

Ⅴ. Concluding Remarks and Discussion

We provided a simple framework in which the level of adversarial bias is endogenously determined in a litigation process. Using this model, we studied the effect of using a court-appointed expert on the level of adversarial bias and the average error rates, and found a trade-off: although the judge can reduce the number of mistakes at trial by consulting a court-appointed expert, litigants choose to hire a biased expert more frequently in response, which increases the level of adversarial bias, thereby inducing evidence distortion more often.

In the main model, we assumed that the court-appointed expert is so competent that he always observes the evidence. What if we relax this assumption by introducing $e_J \in (0,1)$, which is the probability that a court-appointed expert observes the evidence y? Because now it is possible that the court-appointed expert reports nothing, the possible events are as follows: HH, HL, $H\phi$, LH, LL, $L\phi$, ϕH, ϕL, $\phi\phi$.

It is sufficient to discuss about $H\phi$, $L\phi$, and $\phi\phi$ because other cases were covered in the previous analysis. Following the previous logic, it is easy to see that $\hat{\mu}(H\phi) > 1/2$ and $\hat{\mu}(L\phi) < 1/2$. The remaining case, $\phi\phi$, is an ambiguous events: ϕL and $\phi\phi$. This implies that the equilibrium requires the following two inequalities:

$$\begin{aligned}
&\hat{\mu}(\phi L) = P(t=h \mid \phi L) \\
&= \frac{P(\phi L \mid t=h)P(t=h)}{P(\phi L \mid t=h)P(t=h) + P(\phi L \mid t=l)P(t=l)} \\
&= \frac{\mu(1-p)q_h^*}{\mu(1-p)q_h^* + (1-\mu)pq_l^*} \\
&\geq \frac{1}{2}
\end{aligned}$$

$$\begin{aligned}
&\hat{\mu}(\phi\phi) = P(t=h \mid \phi\phi) \\
&= \frac{P(\phi\phi \mid t=h)P(t=h)}{P(\phi\phi \mid t=h)P(t=h) + P(\phi\phi \mid t=l)P(t=l)} \\
&= \frac{\mu(1-e_J)q_h^*}{\mu(1-e_J)q_h^* + (1-\mu)(1-e_J)q_l^*} \\
&\geq \frac{1}{2}
\end{aligned}$$

$$q_h^* = (1-e_D)(1-e_P) + e_D(1-e_P)(1-p) + (1-e_D)e_P p\psi_P^*$$
$$q_l^* = (1-e_D)(1-e_P) + e_D(1-e_P)p + (1-e_D)e_P(1-p)\psi_P^*$$

Rearranging these two inequalities, we obtain the following:

$$\psi_P^* \geq \frac{p-\mu+((1-\mu)p^2-\mu(1-p)^2)\frac{e_D}{1-e_D}}{p(1-p)(2\mu-1)\frac{e_P}{1-e_P}} \equiv A$$

$$\psi_P^* \geq \frac{1-2\mu+(p-\mu)\frac{e_D}{1-e_D}}{(\mu+p-1)\frac{e_P}{1-e_P}} \equiv A'$$

where the first inequality is the equilibrium condition (1) in Game 1. It is easy to verify that $A > A'$. Since these two conditions must be satisfied simultaneously for the existence of equilibrium in Game 1, the only binding condition is (1). Thus, the equilibrium structure remains the same regardless of the level of informativeness of court-appointed experts.

In this paper, we abstracted from many aspects of litigation. For instance, we did not include the possibility of settlement in our model. We also do not study how litigation costs may respond to the introduction of a court-appointed expert. We hope that our simple framework can provide an avenue for these interesting and important future research topics.

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소송에서의 적대 편향과 국선 전문가

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논문초록

적대 편향이란 소송 당사자들이 자신의 소송을 진행시키기 위한 전문가를 보유함으로써 발생하는 증언에서의 편향을 말한다. 우리는 그러한 적대 편향의 정도가 소송 과정에서 내생적으로 결정되는 간단한 분석틀을 제공한다. 본 모형을 통해, 우리는 국선 전문가를 사용하는 것이 적대 편향의 정도 및 평균적인 오류율에 미치는 영향을 분석하고, 흥미로운 트레이드오프 관계를 발견한다: 국선 전문가에게 자문을 구함으로써 판사는 재판에서의 실수의 수를 줄일 수는 있지만, 소송 당사자들은 그에 대한 반응으로서 편향된 전문가를 더욱 빈번하게 고용하기를 선택하며, 이것은 적대 편향의 정도를 증가시키고, 따라서 증거 왜곡을 더욱 빈번히 발생시킨다.

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